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Measuring the effect of Smart home Systems on the decision for property purchase in Cyprus

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School of Architecture, Engineering, Land and Environmental Sciences

Msc-Real Estate Management

“Measuring the effect of Smart home Systems on the decision for property purchase in Cyprus”

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Master of Science Thesis, submitted to the School of Architecture, Engineering, Land and Environment of Neapolis University as part of the requirements for obtaining a master’s degree in real estate management

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Dedication:

The present study is dedicated to my family who stand by my side all the way and support me throughout all my accomplishments and failures.

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“Measuring the effect of Smart home Systems on the decision for property purchase in Cyprus”

Abstract

The development of Technology and the advancement of Internet of things (Iot) over the last decade, has influenced almost everything that we do in our lives. Along with technology advancement, the Real Estate Sector has been inevitably affected in many aspects. The rising interest and demand for technology-oriented products has increased Smart Home Systems usage in properties, which provide many benefits for the users. Smart Home Systems create a pleasant environment and comfort within homes, safety, but also savings in some cases through energy efficiency and can be found in different types of properties. However, along with the benefits, some researchers point out some disadvantages such as safety concerns and user friendliness of these systems which in effect can affect the comfort of the user and diverge from the purpose which is to make lives of people easier and more efficient. The purpose of this research is to study and extract data from Cypriot Property buyers that have already purchased a property with these systems, regarding their perception for Smart Homes and the role it has played on their decision to buy a property. The results indicate that although the participants are in favor of these systems and enjoy their benefits, they consider it as a supplementary product which makes their lives easier, but it didn’t affect their decision to choose a property and do not consider it as a primary factor when deciding to buy a real estate. On the other hand, from the results it is shown that there is still a huge area for improvement that can be utilized from property developers and Smart Home System manufacturing companies. The results can be utilized to help property developers better understand the demands of the market, future property buyers that wish to know the advantages and disadvantages of these systems, but also smart home system manufacturing companies that wish to to extract necessary conclusions to improve their products.

Keywords: Smart Home, Smart Home Systems, Internet of Things, Smart home Benefits, Smart Home Services, Real Estate Technology

1.Introduction

The last decade, technology has entered our life in a way which has become a necessity. Many daily operations that were previously done manually, are now automated, and can be done with a touch of a button. Many professions have altered their way of doing business in order to be harmonized with the new technology trends and already, many consumers avoid Businesses that do not follow the Internet of Things (Iot) revolution.

The Real Estate sector has inevitably been affected and over the last years has seen the introduction of new technologies and processes which have made the sector a lot more challenging and at the same time a lot more demanding. Smart Home Technology is one of the new trends that have entered the field and started to conquer every type of property. Many types of Businesses are now integrating this technology to their products in order to match with the trend that has seen a phenomenal rise. Already, electronic devices and appliances that have been traditionally installed in properties are now "smart enabled" which allows them to be controlled by Smart Home Systems which are now rapidly adopted.

Smart Home Technology enables users to automate where possible basic functions of the property and control through their mobile devices their operation. According to Almusaylim and Zaman (2019) these systems offer numerous benefits to the users such as comfort, safety, energy efficiency in way which users perceive it as an added benefit.

However, many believe that there is still a big way ahead in terms of advancement of these systems and the way properties using these systems will interact with their users in the future. According to Petersen, Williams, Mills , (2001), a Smart home is defined as a home which is equipped with the technological equipment to support and control the operation of several home functions such as indoor climate, security and in extend control the comfort and energy efficiency of the house . Therefore, as new technologies emerge and enable smart home integration and compatibility, it is accepted that the potential of these systems is big, and it will become part of people's lives. On the other hand, although the benefits of using these systems are numerous, there are also disadvantages that need to be taken into consideration.

Already amongst the younger generations, technology has had a great impact and it has become a necessity. Following this advancement, numerous properties have now entered the market with Smart Home Technology Systems enabled to comply with the new trend.

This fact makes the field interesting for further research as there are many questions that need to be answered since technology has influenced people's lives in a major degree. Is this technology a necessity in nowadays? Is it the dominant factor in terms of the decision to buy? How it is perceived by property buyers? What are the benefits and disadvantages?

This research intents to study the effect of Smart Home Systems on the decision to buy a property in Cyprus and gain an insight into how Cypriot property buyers perceive the benefits and disadvantages of these systems.

2.Literature Review

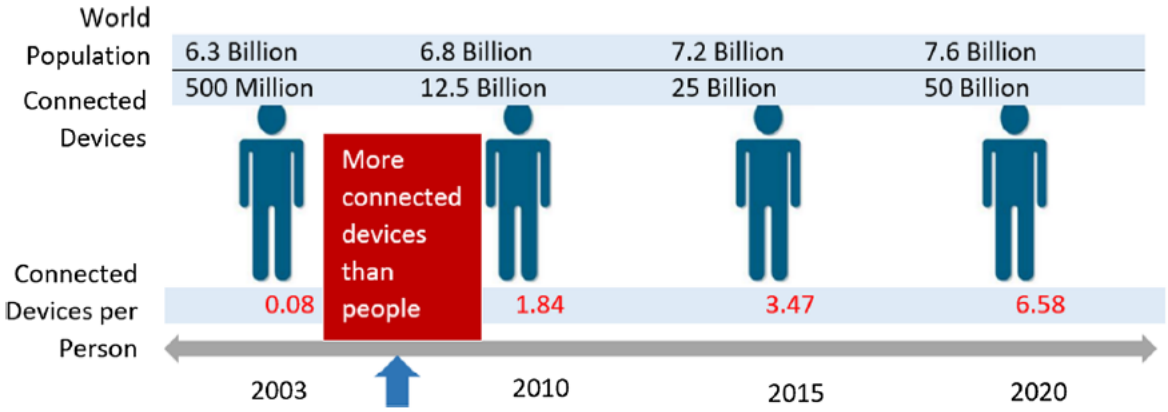
Internet of Things and Challenges:

The recent rise of smartphone usage in conjunction with the addictive Internet usage within the last two decades, had as a result the introduction of smarter solutions on operations and procedures in various sectors on different Industries. The introduction of the Internet of things (IoT) has had a major impact in people's lives over the last years, as it allows the transfer of data without direct interaction by the human factor, therefore enabling the interaction of different devices (mechanical and digital) with the purpose of executing specific functions or generating data based on their installation environment and purpose (Wadhwa and Puri,2016).

The Iot has enabled the connection between devices and systems accessible from anywhere anytime (Zaldan, et al, (2018). This evolution has transformed the everyday lives of people, as now mobile phones and electronic devices are becoming a necessity and being used for a variety of functions, other than the ones that have been bought. Mobile phones are now being used as calendars, photo cameras, communication devices for social media, measuring devices and many more and therefore, with new applications being introduced every day it can be safely predicted that this advancement will lead to a complete diversification of many Industries. Therefore, in order to keep up with the competition businesses are now adapting into the new era, with upgrading their systems and more importantly recruiting people that are familiar with using such devices.

Recent studies have highlighted the increase in device usage and device ownership by people over the last decades, indicating the rapid change in terms of smart devices owned by people. This is justified by a study made by CISCO (Evans,2011), one of the worldwide leaders in IT, which indicates the number of devices connected by people in the timeframe of 2003-2010 and additionally the predictions up to 2020. More specifically the study highlights that in the above timeframe the devices exceeded the number of people almost by double by 2010 and the predictions for 2020 indicate that the number of connected devices will be seven times more than the population of the world.

Therefore, it is almost certain that the following years the world will enter a new era in terms of technology solutions that will have a direct effect on the traditional way things used to be done.



Source: Cisco, IBSG,2011

This reality has been reinforced with the outbreak of the pandemia which has inevitably caused a necessity for online execution of daily tasks and has amazingly surged online buying. Additionally, it forced thousands of people working from home and many sectors looking for solution in order to be able to make their business available online.

The various restrictions that took place in different forms in various countries and the introduction of precaution measures such as travel bans, has had many negative effects in various businesses such as hotels, retail businesses and office demand. This fact has caused many consequences such as delaying of rents, loss of investment value and increase of operating costs (Tanrivermis,2020).

With these rapid changes being introduced, it can be said that the Real Estate sector has been inevitably affected and that this transformation has introduced new business models especially in terms of marketing but also in construction (Aytekin , Demirli , 2017).

Technology advancement has pushed property developers and Real Estate professionals into integrating systems and procedures along their daily operations and philosophy that fit with the technology advancement and the Internet of Things.

Traditional property design and construction have been replaced with modern procedures, approaches and applications that comply with the usage of smart devices and Technology.

It is now accepted that most of the procedures that were previously manually done, are now being automated and electronically executed not only through the construction phase but also for many years after the construction has been completed.

However, with the advancement of technology progressing in rigorous rhythms , it is almost guaranteed that we are only at the beginning of this new evolution and that new technologies entering the field will disrupt many Industries and change the way we traditionally used to do things.

This is also highlighted by Allameh, Vries and Heidari (2018) which support that these technological developments in conjunction with the increased public interest indicate that promising intelligence can become reality soon in the Real Estate sector.

Iot and Smart Homes:

Let alone the various new applications and systems that have been introduced in the Construction processes of real estate projects, one of the recent trends in the Real Estate Sector is the introduction of Smart Home Systems which make the interaction of mobile phones and homes easier. This connection has significant advantages to the users and can offer significant benefits.
According to Almusaylim and Zaman (2019), within the Internet of Things sphere, Smart Home is one of the most essential elements which enables the automation of homes by the interaction of various devices and commands via the internet at any place and anytime. Traditionally, home device control and generally the functions of a home were controlled manually by people and required physical presence in order to be able to use them. With the introduction of Smart home integration, these commands can now be given automatically and online, from any part of the world without requiring presence of the users at their homes.

Smart technology involves the integration of home systems including lighting, climate control, security and other functionalities, to enhance the comfort, convenience and economy of the home for its users. (Petersen, Williams, Mills, (2001).

Application Areas of Smart Home/ Categories

The services provided by Smart Home devices can be achieved through communication and with the interaction by the user and can be divided into different categories related with the services offered such as safety, energy, comfort, health, and leisure. However, these services cannot be achieved without receiving information from sources.

Therefore, the flow of information is needed by various components such as sensors, controllers, network, smart appliances and so on and the services provided by these devices depends on the interaction with the user.

In order to clarify which devices, require the active interaction of the user, these interactions were divided by Cho and Choi (2020) into two types depending on the input needed from the user. The first category includes services that do not need the contribution of the user and the information can be collected automatically through sensors. Therefore, the services offered are based on the information and data collected from the users and their surroundings and there is no need for direct input by the user. This category can be found in various applications such as hotels or offices which use the sensors to minimize energy consumption or measure indoor air quality.

The second category includes services that require the direct input by the user, using commands entered into the smart home control system. This is common in dwellings whereby the user uses the ipad or the smartphone in order to enter commands into the system and receive output result such as turning the music on or the HVAC units. Other than smart phones and tablets these commands can be entered by the user using wall control units also.

The usefulness of smart functions in various industries is unquestionable, however it is not yet clear what are the benefits of these systems in Real Estate in terms of buying a home and most importantly if these benefits would be the deciding factor on purchasing a home.

The decision to buy a property is one of the most important decisions in peoples lifes and along with other important decisions in life, it ranks as one of the most difficult and at the same time more emotional decision. Depending on the circumstances, people will not just select a house without first feeling comfortable and emotionally connected with it.

Along with other deciding crucial factors such as price, location, size, quality and type of house, the facilities and specifications of the property could play an important role to the decision scale. The smart home integration is considered to be amongst the extra specifications provided in nowadays however it is not yet clear if it is considered by prospective homebuyers as an extra advantage to consider when deciding to buy a home.

Mihalache (2017) suggests that this a challenging field and notes that the benefits of these systems are not promoted in a sufficient degree in order to talk about a mass usage of these systems.

On the contrary, numerous property listings that are now available on the market, include the "smart home system" as an extra feature and it is being used as an advantage in terms of property promotion. With the prices of these systems being now reduced over the years, property developers are now installing these systems into their property portfolio and using it as a selling point.

Looking at the technology advancement throughout these years, the future of smart systems looks promising as it can be safely predicted that it will offer enhanced comfort and leisure at the same reduce energy usage. However, the question is, how are these systems are now accepted by homeowners or perspective property buyers? Is there a perception that these systems add value to the property? Can these systems affect a buyer's decision? Are the buyers willing to pay a premium for these systems?

To be able to answer the questions, the advantages and disadvantages of these systems today need to be addressed.

Advantages/Disadvantages

One of the most marketed advantages of smart home systems is energy efficiency. Smart home integration provides the user the ability to control devices that require energy, through their smart device without their physical presence. Therefore, it gives the ability to minimize the energy consumption by turning off devices that are not needed or when the desired comfort is achieved.

It is now a fact that may studies have been connecting zero energy buildings with smart home technologies. Sovacool and Rio (2020) mention a number of studies that indicate the necessity of shifting building portfolios and upgrading them with intelligent systems.

It is well known that excessive energy is being consumed by the usage of buildings by people. Therefore, especially the last decade, there has been an excessive discussion on the ways to reduce this energy consumption and a lot of incentives have been given in order for people to install smart systems that can control basic functions within homes, with the aim to automize their usage as much as possible but at the same time enhance user comfort . This is the reason, Smart homes are amongst European Union's strategic areas for investment in energy (European Union, 2015).

Comfort /Leisure

Another great feature of smart homes is that it gives the ability to the user to control basic functions of the home climate in order to reach a suitable home comfort based on the users preferences and if fully automated, based on their habits . Furthermore, it can provide access to several devices that support smart function and can be controlled with the touch of a button through a single device such as the phone. Numerous products have now entered the market labeled as "smart" products such as smart paintings, smart electrical appliances, smart Tvs and so on, which can be synced with the smart home system. However not all of them can be connected to the main system, as many of them require their own application in the phone or tablet. The end result is that the user can enjoy comfort and leisure at their homes with the touch of a button and can modify the home climate based on their preferences or even based on who is present at the house.

Safety/Security

One of the most beneficial characteristics of the Smart Home is the element of safety that it can provide. Let alone the security alarm which has been around for many years now, the smart home system has developed the security aspect into a new level. Through sensors, users can now detect movement, watch live footage of the areas they desire even if they are not present at their homes and even better users can notify the police once they receive notifications that the security of their house has been breached. Furthermore, they can disable their security alarm and open their entrance door, even if they are not present, in order to give access to members of the family or friends that need to enter the house. This feature can also be accompanied and synced with the bell of the main door which can accommodate a screen.

These characteristics have shifted the security element of a house to extreme levels, however although safety is achieved through increased security, on the other hand there are many safety and privacy constraints that need to be considered.

According to Zaldan et al (2018), HVAC appliances and private date can be easily stolen or breached by hackers. This information can then be used to gain sensitive information about the users of the devices and in extend the occupants of the house. This concern is also supported by Batalla and Gonciarz (2018) which support that due to lack of knowledge of the users on how to properly use the smart devices, there are a lot of times where data are lost and sometimes exposed, causing hacker attacks.

Breach of data has been in nowadays a new way of causing attacks to Companies and Governments by hackers. Adiono, Tandiawan and Fuada (2018), argue that security issue is one of the major challenges that must be tackled in the Smart Home sphere. Since many devices are connected through the internet, the data gathered are exposed in a severe way and can be exploited by hackers.

Having followed the concerns of data breach and security Xue, Xu and Zhang (2018) agree that privacy concerns can inevitably occur and propose a private block-chain access control. Their research proposes the development of a system that can control access from users and can protect against various attacks. In the same line of argument Batalla , Vasilakos and Gajewski (2017), propose good practices on developing secure smart systems. More specifically, they propose the involvement of network operators into the management of these systems in order to efficiently manage the distribution of data and ensure privacy. They conclude that indeed smart home systems are vulnerable and have gaps that enable data breach in several points. A possible way of tackling data breach and hacker attacks is proposed by Olawumi, Vaanamen, Haataja and Toivanen (2017). The authors suggest that from the initial stages of the development of these systems, a detection and prevention feature should be added in order to offer an extra layer of security. In other words, its up to the companies that designs these systems, to understand the necessity and importance of security aspects and start incorporating safety into their future plans. Therefore, smart home systems should be able to have self-protection and prevent intrusion and breach of data (Jager, Phan, Nadschlager, 2016).

Elderly/Ageing/Home Care

Let alone security constraints which are considered to be one of the major advantage-disadvantage of smart Homes, on the other hand their technology nature can facilitate significant tasks in many aspects of human life that require human interaction.

A great example of this is the possibility of monitoring elderly people within a home. In normal life, elderly people require daily caring and monitoring of their health. With the help of smart home systems these daily routine tasks can be facilitated by the smart home system with the help of sensors. The system can collect data through sensing the movement within an environment, therefore it can anytime report the status of the occupant.
Additionally it can collect various and important medical information such as blood pressure, heart condition, sugar levels, appliance usage and notify the medical supervisor in case of health warnings (Zhang, Wang,Wang and Tian, 2018).

The systems can be upgraded to offer additional services such as activities in order keep the occupants proactive within the home and additionally detect emergency situations such as critical falls (Kelly, McLoone, Dishong, 2009).Although the benefits for such systems are numerous, most of the smart home systems are not designed in the initial stage to offer these services into their product line. Most of the services offered and the features of these systems are minimized to the level of offering basic home automation functions. In this context, in order to contribute into the design and implementation of a system that will be designed to assist residents to live independently, without the help of a nurse, Demiris, Oliver, Dickey, Skubic and Rantz (2008), used the contribution of residents of a retirement facility center in order to test whether sensor technology will impact their daily routine.

The results showed that the sensor technology did not affect the participants daily routine and the authors work suggest a localization infrastructure that can be incorporated into existing homes but also into new developed systems. Although these sensor systems could be beneficial for the users, it is not yet clear how these systems will be accepted by the market and how much added value will bε effectuated.
In this perspective Petersen T., Williams P., Mills A., (2001) suggest that it could be argued that smart systems add some value through their functions and benefits especially for some groups such as women or elderly groups. However, they continue arguing that it is currently unknown if homebuyers believe that these systems add value to the home. Therefore, this could create hesitations to property developers who are willing to take an extra step ahead and alternate from the original property design.

Adding to this perception Allameh , Vries and Heidari (2018),support that despite from the fact that the smart home concept has been around for almost three decades, it has not been supported commercially on a wider basis so far although it was an optimistic scenario for many throughout these years.

User friendly issues

They suggest that Smart Home field is a field which seems to be interesting and might be able to address many challenges in society, however an additional aspect that could be argued by many, is that the majority of smart home systems lack of user friendliness

They continue by arguing that these systems are not often accepted by the people even though they can benefit from it. Because these systems are often installed after the design stage, the demands of the buyers are not taken into consideration and hence the possibilities of these systems are not properly matched with the market demands. They support that these systems should take into consideration the lifestyles and the orientation of individuals along with the trends available in society in order to be accepted and used efficiently. They also support that smart home property developments still haven't matched with the needs and preferences of the market in real life.

This is also highlighted by Cho and Choi (2020), which agree with this perception and they support that currently there is a gap between the smart home system and the user and they suggest that the systems should be designed to be user centered.. The systems introduced to the market are designed in a complicated way which makes the interface sometimes difficult to operate, especially for people that are new to technology. The authors propose that smart home systems should be designed in a way that will enable interface affordability and support that the aim of using smart homes should be for the users to be able to use them easily and conveniently. They conclude by suggesting a group of user-friendly guidelines in terms of physical, graphical, voice and user gesture elements.

Smart Home System design

The field of smart homes has a huge prospective in terms of the systems that could be designed to offer a variety of solutions to households and to the users.

Therefore, many attempts have been made to design different systems with different functions using various techniques. Davies and Anireh (2019), designed a system using the Internet of Things with its own cloud system, achieving cost effectiveness. Supporting the fact that there is a huge potential in smart home systems, Palanca, Van, Fornes, Billhardt, Corchado and Julian (2018), designed a system that interacts with the users based on their goals and it proposes certain daily activities.

On another perspective, Dewsbury, Clarke, Rouncefield, Sommerville, Taylor and Edge (2003), specify the needs that need to be taken into consideration in order to allow the design flexibility in these systems for disabled people. In order to increase functionality, Popescu and Culea (2018), propose an IT solution through a combination of hardware and software, allowing users to control various functions.

On another field of expertise, Tastan (2018) proposes a system that can monitor energy consumption in real time and allow users to record their data and study their most costly operation times and at the same time provide information on the energy used by each device. On the same line of research, in order to control the heating comfort and therefore the energy used, based on the habits and preferences of the users, Roessler, Teich and Franke (2012), propose a neural network that will enable future development of expansion of these systems.

Proposing an alternative way of comfort, Chen, Yang, Zhu, Wang, Liu and Song (2017),propose the development of a smart home system that will not only control the interaction between the user but also the interaction with the greenery of the home-therefore the indoor environment. Using specialized equipment, they additionally propose a greenery cultivating system that enables cultivating within the home.

Using sensor technology, the indoor environment and the movement of the occupants is utilized by Ghayvat, Mukhopadhyay, Gui and Suryadevara (2015), which consider the wellness of the users based on their movement throughout the house. They propose that with the appropriate expansion, these systems could become transform buildings into intelligent buildings which will change the way we see buildings.

All this research suggests that there is a great way ahead in terms of the development of various systems that will transform the everyday lives of people.

However, it is not certain in which degree these systems will be accepted from the users and if these systems will be accepted into their lives. It is also a question whether these systems will be demanded by future buyers of new homes and whether this will affect pricing, marketability and even resale of new homes.

Since it is not classified as a marketing priority by property developing companies, many could argue the existing smart home systems have not yet gained the desired popularity and therefore that future homebuyers do not include these systems into their wish list, in terms of specification that their future home should have and.

On the contrary Hoffman and Novak (2018) suggest that, strategic and properly marketed smart home systems, can have a broad market acceptance to people that are interested to buy a new home. They argue that there is a great potential for firms who can recognize this opportunity and install these systems into their property portfolio.

Architecture and designing Smart Homes

Although smart homes have not yet been adopted in full from the market and property developers, a big challenge that will be raised is how to design these homes and how will this affect the traditional design procedure. It is yet unknown how will this evolution affect the Architecture field since up to now smart home systems are installed into existing homes or installed into new homes as an extra added specification. It is therefore a big question in terms of the future challenges and tasks that Architects and many other Built Environment related professions will be faced with. Bitterman and Pinsly (2015) raise this questions in their research and argue that the abilities of the smart homes and the level of future development, raise some concerns on how future developments should be designed in terms of the structure, interior design, orientation and even material selection. More specifically they support that traditionally up to now home design used to take into account the needs of the occupants, the devices and equipment that will be used and the furniture layout. It is therefore uncertain what the future reserves in terms of the needs of the homeowners and in what level home automations will be developed.

They conclude that eventually designing smart homes will be de-attached from the traditional design procedure and therefore there is a need for research in developing architecture models of dynamic residences that will be adjusted based on human needs and.

Factors influencing the adoption of Smart Homes

Although smart homes have not yet been adopted in a large scale, it is unknown whether the demand will be shifted into a new level in the future.

At the time being, the systems installed into new projects and existing homes even though they accommodate basic functions and automations which makes life easier of the occupants, there are some constraints influencing the adoption of these systems. As discussed above in previous sections privacy is a major concern for the users, as the existing systems have not yet established a safety net in terms of data breach. Additionally, complexity is also one major chapter which makes it difficult for users to abandon the traditional way of using their space. Let alone the tangible aspects, Umbrello (2020), raises some ethical aspects in terms of giving up human freedom to devices which are considered to be taking over the last decade, however he argues that there are solutions that can be proposed.

Research Gap:

With these said, there are many important unanswered questions and raising concerns regarding how this "smartness" will affect the Built Environment and Real Estate Sector in general. Although there are many areas which can be researched in this field, this research is focused on the effect that the "smart home" possibility has on a buyer' property purchase decision in Cyprus and if this technology is the determinant factor to buy a property.

Research Questions:

-How do Cypriot Property buyers perceive benefits of smart Home specifications?

- Can these systems affect a prospective buyer's decision?

-What is their perception in terms of the impact of smart Homes on cost and property price?

-What are the main disadvantages of smart Home Systems?

3.Data and Methodology

3.1 Type of Research:

The specific research constitutes of a survey research using primary data. Using the survey-opinions of the participants the research aims to collect information from a specific population in a specific timing in order to collect information regarding the trends and the opinions of this population. Additionally, the research aims to collect information and compare different circumstances or identify if any relationships exist between different facts.

The survey method constitutes one of the most widespread methods of quantitative research (Cohen, Manion & Morrison, 2008).

3.2 Sample-Population:

The population of the research constitutes of property buyers within the Government Controlled area in Cyprus between the age of 20-45 years old, which according to the Cyprus Statistical Service latest updated data they reached 875,000 at the end of 2018 (Cystat,2018). The sample of the research consists of a total of 40 persons that fall within this age group and have purchased a property the last three years. Data collection has been achieved through a questionnaire in electronic form using emails and social media platforms through purposeful selection using buyers list from a Cyprus based property Developer, with participants that have agreed to participate in the research. The questionnaire gave the opportunity to the participants to answer anonymously and helped the researcher to collect information around the basic research questions quickly and with minimized costs.

3.3 Data Collection-Research Tools:

For the purposes of the research, the questionnaire formulated by the researcher was enriched with variables that attempted to measure opinions of property buyers in regards with smart home systems and their perceptions in terms of the value added. Along with the questions that attempted to measure the opinions of the sample, the questionnaire followed the basic principles of an efficient questionnaire with most of the questions formulated with Likert scale.

More specifically the size, the clarity and the completion time have been taken into consideration. Following the questionnaire composition, a pilot distribution took place in order to identify possible areas of improvement in the questionnaires format and additionally the questionnaire has been shared with a specialized person in the research field for suggestions. The final questionnaire was sent online to the sample and was accompanied by a letter which included the research aim and details that were necessary regarding the research. The status of anonymity was held along with data and personal detail protection.

3.4 Data Analysis:

Following the collection of the pilot distributed questionnaires, a factor analysis was conducted to describe the degree of variability amongst variables, in conjunction with a reliability test using Cronbach's alpha. The analysis of data of the final questionnaire was conducted using the statistical software SPSS comparing the results obtained from property buyers.

4.Research Results

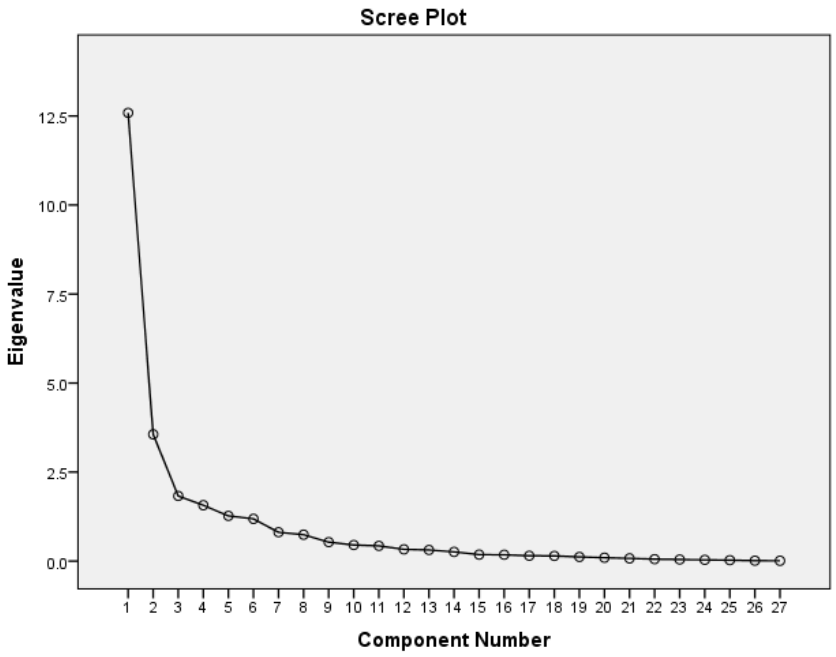
In this chapter, the research results are presented, based on the research targets and research questions of the research. Using simple descriptive statistics, a description of the sample characteristics is presented, and a consistency check is conducted. The results of the questionnaire are presented using inferential statistics by analyzing the results obtained from the sample using spss.

4.1 Consistency check - Cronbach's a

The internal consistency and therefore the reliability test were tested using Cronbach´s alpha coefficient which included all the items of the questionnaire. The questionnaire was found to be of a high internal consistency with Cronbach´s alpha (a=0.895, N_{items}=27). Within the research field, it is considered acceptable if internal consistency is higher than .70, the questionnaire is considered of a high consistency.

4.2 Factor Analysis

To test whether the questionnaire fulfills the purpose of which it was constructed and measures the research problem, a factor analysis was conducted in order to identify how many factors are generated through the questionnaire answers. The results showed that two main factors carry the weight of the variance with a percentage of 46% of the first factor and 13% on the second factor, meaning one factor carries most of the weight. The other factors carry out an insignificant variance weight. This is justified by the below plot which shows the bend of the curve after the second factor.

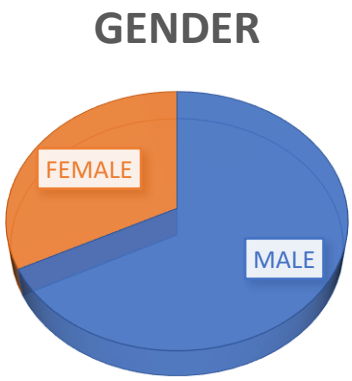


Graph 1: Factor Analysis Scree plot from SPSS

4.3 Descriptive Statistics

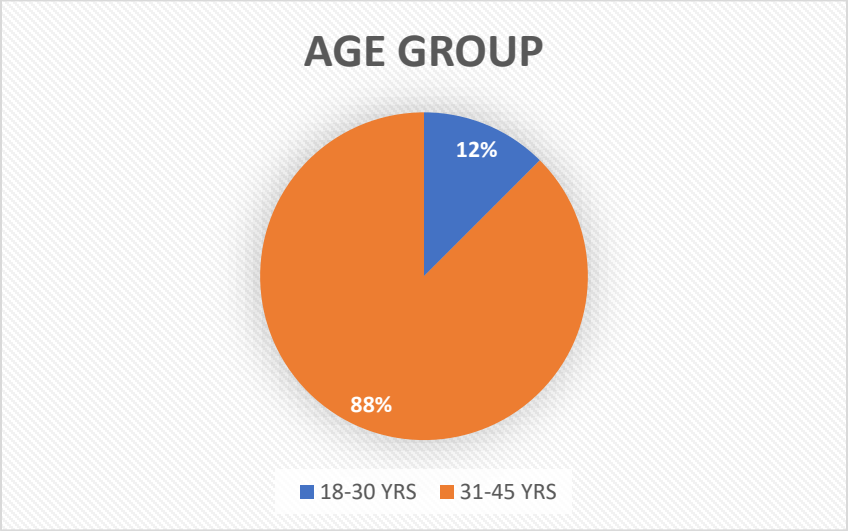
During the course of the research, 45 questionnaires were totally distributed and 40 were answered and returned with a success rate of 88,8%. 5 of the recipients did not wish to participate in the research

All the participants that took place in the research were adults that fall within the age group of 18-45 and have purchased a property the last three years (N=40). The sample consisted of a total of 27 males (67.5%) and 13 females (32.5%) (graph 2).



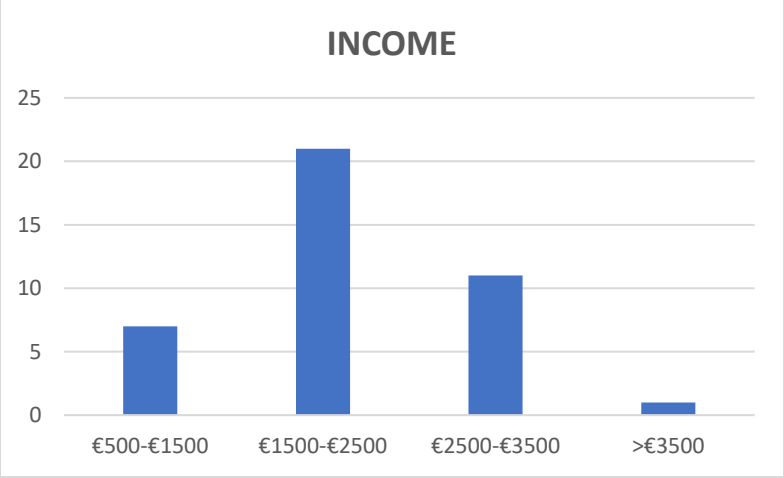
Graph 2: Participants-gender

From the total participants, most of them belonged to the age group of 31-45. More specifically 5 participants were categorized within the group of 18-30 years old and 35 participants within the group of 31-45 years old (graph 3).



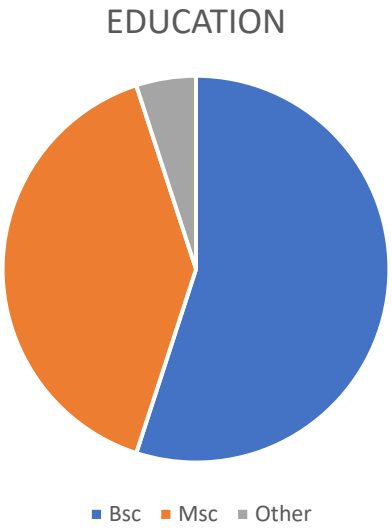
Graph 3: Participants-Age group

The income information of the sample showed that most of participants belonged to the category of "medium" earning income population. More specifically 21 persons (52.5%), belonged to the category of €1500-€2500 monthly income and only 7 of them (17.5%) were considered to be on the lower level of €500-€1500. The rest of them (27.5%), were in the category of "high" earning income persons with a salary of €2500-€3500. Only one participant showed that was earning more than €3500.



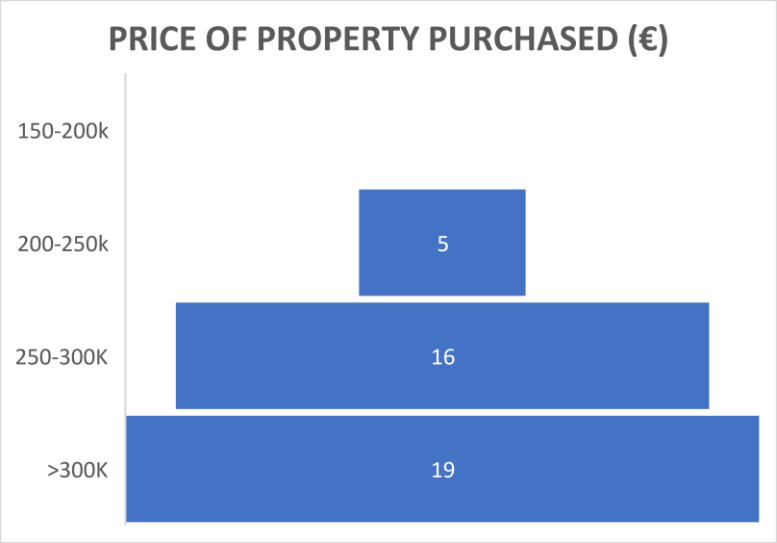
Graph 4: Participants-Income

As for their education, twenty-two participants (55%) declared to have a bachelor's degree and sixteen (40%) participants to have a masters degree. Two of them only declared that have other education (graph 5).



Graph 5: Participants-Education

The results also showed that most of the properties purchased by the participants fall within the category of more than three hundred thousand euros. More specifically 19 participants (47.5%) bought a property which was worth more than 300K and 16 participants (40%) bought a property worth from 250-300K. The rest of the sample chose properties with 200-250K.



Graph 6: Participants-Price of property purchased

4.4 Research Questions-Results

4.2.1 Research Question 1- How do Cypriot buyers perceive benefits of smart home specifications?

In order to test which benefits of Smart home systems are considered to be of essence and how do Cypriot buyers perceive them, all the items of Question B4 were taken into account in which the participants had to state their answer using a scale based on their level of agreement .

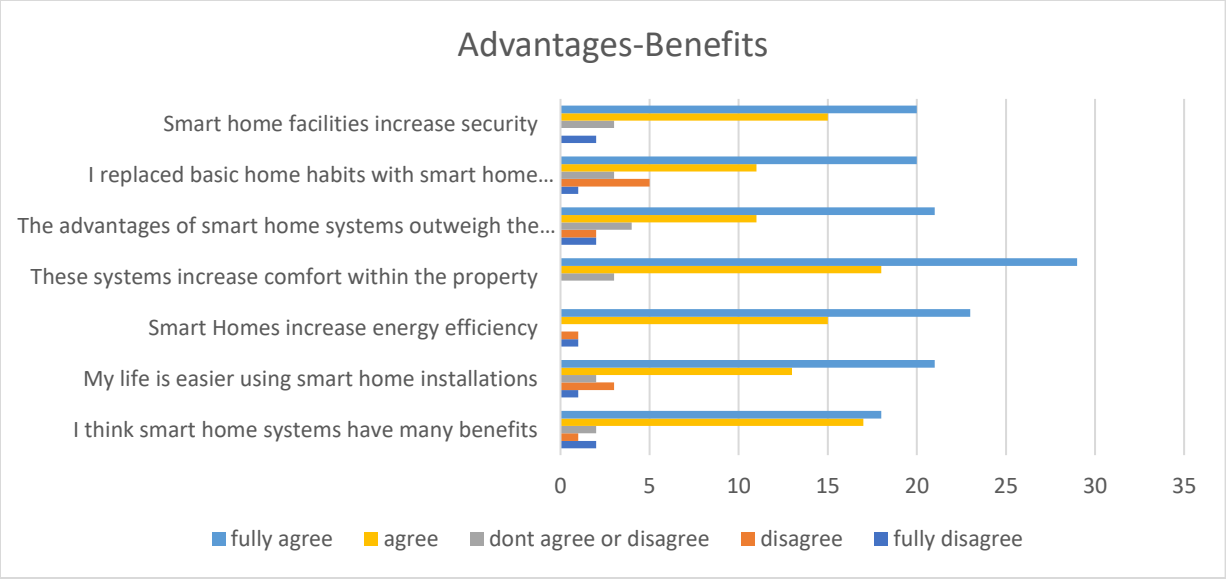


Table 1: Participants-Benefits of Smart Homes

The results indicate that there are three pillars in which consumers base their preference to these systems. The most important element that emerges through the results is comfort, in which people believe that by installing these systems their comfort within the property will increase. However, although comfort is within their preferences it is not clear if they are willing to pay an extra premium for this comfort. The second most important aspect is that consumers believe that one of the main benefits of these systems is that it will help them save energy and by the responses, it is shown that already some of the basic "home habits" have been replaced with automations.

Furthermore, an additional factor that is considered to be one of the most important pillars is security. More specifically the consumers believe that their security is increased with smart homes and one of the most sought-after elements, is the control of their security through sensors, cameras (if possible) and alarm notifications.

In general, the perception that the advantages of smart home outweigh the disadvantages, prevails and by the results it is clear that the majority of the participants support that their life is easier using smart home installations.

Although it is clear that the participants are in favor of these systems, when the pricing factor comes into the picture it is not certain whether they will choose to install these systems or not. This is further studied in Research Question 3.

4.2.2 Research Question 2- Can these benefits affect a prospective buyer's decision?

In order to test whether the benefits of smart home systems affect a buyers decision and whether there is a relationship between them, a correlation analysis was conducted between Variable B1.3 (buy decision) and all the questions of B4 (benefits) . To effectively perform the correlation analysis, all the questions of B4 which measure the benefits were transformed into one variable using the transform-compute variable option and the variable was named (BENEFITSALL). A correlation analysis was then conducted and the results indicated that there is a strong correlation between the decision to buy and the benefits of smart homes r(38)= .51 ,p=.001. Therefore, prospective buyers' decision to buy is linked with the benefits of a smart home system.

Correlations

		B1.3	BENEFITSALL
B1.3	Pearson Correlation	1	.518**
	Sig. (2-tailed)		.001
	N	40	40
BENEFITSALL	Pearson Correlation	.518**	1
	Sig. (2-tailed)	.001	
	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2: Correlation Analysis-Benefits and decision to buy

As with the previous research Question it is shown that participants prefer Smart Homes because of the comfort, security, and the general benefits they perceive from the installation of these systems. Although this is an important conclusion, will a prospective buyer consider smart home facility as the dominant factor to base their decision? Will their preference remain the same if their comfort is affected by possible technical faults that may arise, which is a common characteristic of systems of this nature?

4.2.3 Research Question 3- Perception in terms of the impact of smart homes on cost and price

To test the perception of impact of Smart Homes on price and cost all the items of Question B2 were considered.

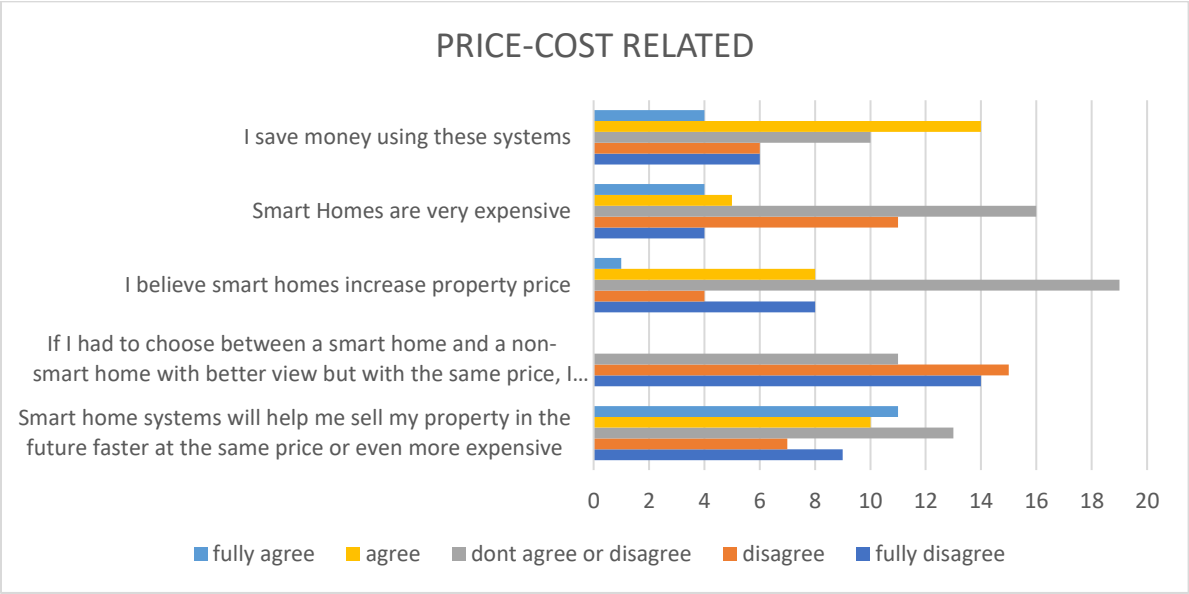


Table 3: Participants-Price and Cost perception

The results indicate that surprisingly the majority of the participants believe that smart home systems do not increase the property price and that although smart home inclusion might help them in selling their property faster in the future, it will not help them sell their property in a higher price. As questioned in the above Research Question it is proved that smart home system is not the dominant factor in which perspective buyers will base their decision on buying a home. More specifically, the participants mainly disagree that if they had to choose between a house with a view and a house with a smart home, they would choose the smart home.

However, on the other hand, they believe that by using these systems they save money but on the contrary, they believe that Smart Home Systems are very expensive.

In order to further test the impact of smart home on price and whether smart home price (B2.4) affects property price (B2.3), a correlation analysis was conducted. The correlation analysis showed that there is no statistical difference ($p > .01$) between the two variables, therefore it is safe

to say that there is a perception between the participants that the amount spend for smart home systems does not affect property price in a degree which would be of an essence.

These results indicate that although the participants believe that Smart Homes in nowadays are considered to be an essential element in a house, it is not essential element in terms of pricing a property, although sometimes these systems might be expensive. It is accepted though that it is an extra specification that gives an advantage to a property in general.

4.2.4 Research Question 4- Is perception for Smart Homes related with savings?

In order to statistically test whether prospective buyers believe they will save money with smart home systems and whether it affects their perception for these systems, a One way ANOVA was conducted between the perception of the participants and their belief on the savings of the systems. In order to achieve this, all the questions of B1 that were related with the perception were transformed into one variable using the transform-compute variable option (PERCEPTIONALL). The belief on the savings was then categorized into 3 groups using variable B2.5. The participants were categorized into 3 groups based on their response to item B2.5. Group 1 included participants which fully disagree and disagree that smart home systems help them save money and in that case they selected options 1 and 2 on the questionnaire Likert scale. Group 2 included all the participants that were neutral to this question and answered that they do not disagree or agree and Group 3 included participants that agree and fully agree on this and selected options 4 and 5 on the questionnaire.

The results showed that there is a statistical difference ($p<0.05$), between the perception on the smart homes and savings. More specifically through post hoc tests that were generated, it seems there is a statistical difference ($p<0.05$), between the ones that believe they do not save and the ones that believe they save and no statistical difference between the participants that are neutral.

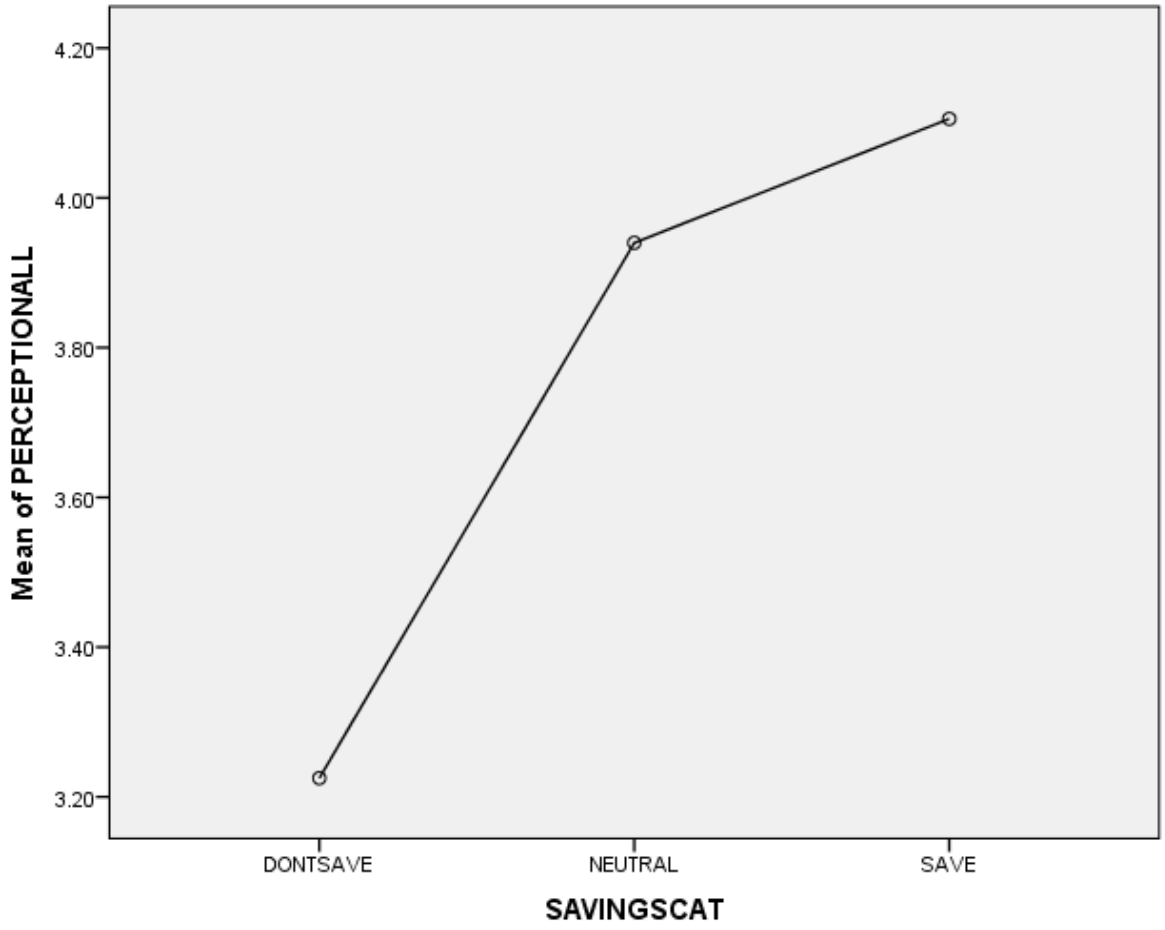
ANOVA

PERCEPTIONALL

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.844	2	2.922	10.709	.000
Within Groups	10.096	37	.273		
Total	15.940	39			

Table 4: ANOVA Analysis-Perception and Savings

However, although there is a statistical difference between the DONTSAVE group and SAVE group, the difference observed in the means of these two groups is small. More specifically the DONTSAVE group achieved a mean of (Mean=3.22, St. Dev.=0.6268) and SAVE group a mean of (Mean =4.10, St. Dev.=0.4345). This is graphically presented on the below graph.



Graph 7: Perception-Savings Graph

These results indicate that there is a statistical difference between the perception for Smart Homes and the savings participants believe they benefit from, by using these systems.
Therefore, the perception is somehow related with savings. However, taking into account the means of the responses, the perception is not affected in a major degree by the savings they achieve. Therefore, it raises a question on whether savings is the crucial factor that will make an impact into a prospective buyer's decision.

4.2.5 Research Question 5 – What are the main disadvantages of Smart Home Systems?

As for the main disadvantages, 47% (n=19) of the participants believe that these systems are sometimes not user friendly and a large percentage, 25%, (n=10), controls the system mainly from their phones because they find the main console not that easy. However, on the other hand, 25%, (n=10), of the sample disagrees with this opinion and 40%, (n=16) disagree that there are configuration and connectivity problems regularly. In this perspective taking into account the responses in Research Question 1, in terms of the comfort offered by these systems, user friendliness is an aspect which might be a problem in the future and achieve the opposite result of comfort.

One additional important aspect that has been studied by the items in Question B3, is the safety of these systems and whether they can be breached easily. In this view 45%, (n=18), of the participants disagrees that their personal data are not safe and 60%, (n=24), are of the opinion that smart homes cannot be breached easily.

Although this is the general opinion of the participants, due to the fact that this is a survey between a relatively small group and within the scope of residential dwellings only, it is a question that must be raised on a broader context taking into account other types of property also.

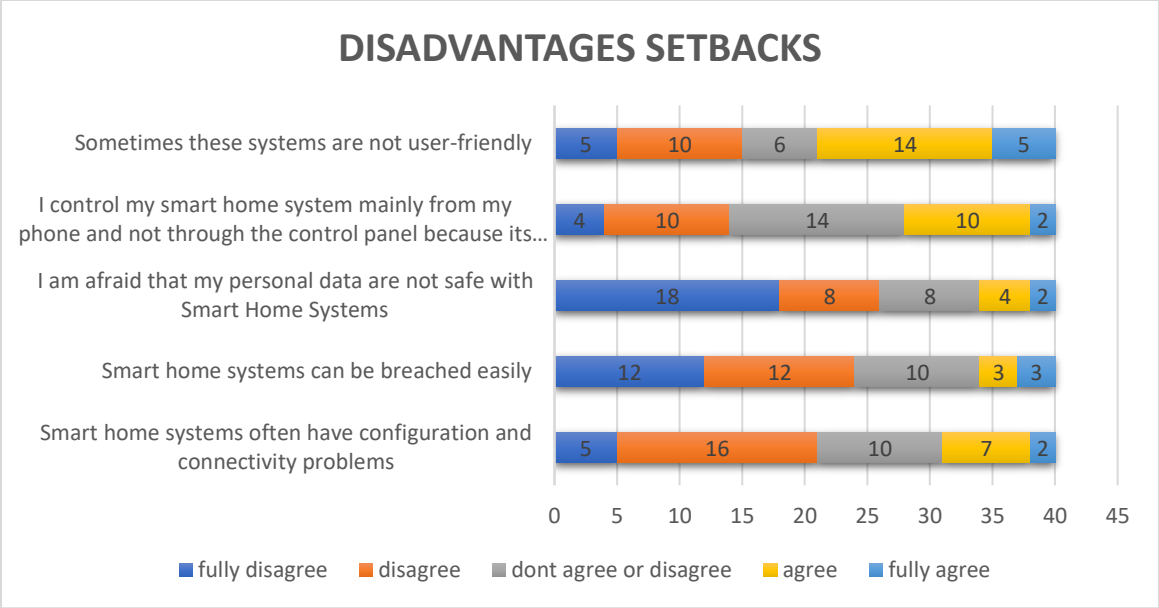


Table 5: Disadvantages-Setbacks

5.Discussion

From the initial results it turns out that participants rank comfort within the most important benefits of Smart Home systems which is amongst others the core of them. Although comfort can be categorized into various forms, it is widely accepted that comfort in the scope of these systems reflects to the indoor environment of a home which is achieved by the usage of these systems. This has direct relation to the climate inside the house in terms of the temperature and in general to the environmental comfort which is indirectly related with the HVAC equipment (Cooper, 2008). Participants have expressed their liking on the control of the indoor environment through these systems which in extend improves their comfort, however, although these technologies provide the extra comfort it is not certain if they prefer replacing manual functions with new technologies forever. In this perspective, Cooper (2008), supports that even if these systems prevail in the market it is not always the case that they will completely replace old technology or manual functions. Although comfort is within the participants preferences it is not clear if they are willing to pay an extra premium for this comfort. Maybe this is due to the fact that comfort is perceived differently amongst people? Madsen (2018) suggests that it is necessary to understand the relationship between people and their homes in order to understand better the type of comfort they seek, and that comfort depends on many aspects of a house.

However, with the continuous change in Building Regulations and Construction practices worldwide, it is accepted that energy technologies (including Smart Home Systems) will "disrupt" the way comfort within homes is perceived, since sustainability and in extend energy efficient technologies, that must be included in new projects, presuppose a behavior pattern by residents (Madsen, 2018).

In this perspective, saving money was also one of the main pillars of the benefits participants supported their responses which in extend it contributes to energy efficiency in the total operation of a household. Smart Home technology can be beneficial in this aspect by measuring the consumption and the cost of lifestyle with the use of smart meters and intelligent systems (Roessler, Teich, Franke, 2012). With this way the occupants can adjust and activate energy use of appliances and equipment according to their needs and simultaneously reduce the operational cost.

However, the full potential of these systems has not yet been unleashed due to the lack of user friendliness, complexity of their operation and sometimes lack of technological support (Reinisch, Kofler, Iglesias, Kastner, 2010).

On the other hand, data from the usage of these systems can become very useful in terms of analyzing and examining different perspectives that can unleash various dynamic ways of reducing energy consumption and hence costs (Yapp, 2018). By the data collected from the participants, it is already shown that some of the basic "home habits" have been replaced with automations and the results showed that there is a statistical difference ($p<0.05$), between the perception on the smart homes and savings. Taking into account that the residential sector is responsible of large amount of energy load and consumption, with the usage of these data, there is an interesting field of interest to be covered (Chan, 2014).

An important element of the perception of Smart Homes proved to be the Security aspect as well which is considered to be amongst the top "ingredients" of consumers choice for these systems. Through their responses the participants supported that their security is increased with smart homes and one of the most sought-after elements, is the control of their security through sensors, cameras, and alarm notifications.

However, is this really the case? By using these systems, is security really guaranteed? Zhang, Wang, Wang and Tian (2018), argue that since these systems can be easily accessed through mobile devices, occupants of buildings with smart home systems are exposed because these systems are collecting sensitive data about them such as location, motions and other details that can be used against them if breached.

This is also supported by Adiono, Tanduawan and Fuada (2018) which argue that security is one of the major challenges in the Internet of Things era taking into account the exchange of large amount of personal data. Olawumi, Vaananen, Haataja, Toivanen (2017), also support this opinion and suggest that a possible solution to this problem is to install internal data breach detection to these systems in order to track possible intrusions. Batalla, Vasilakos and Gajewki (2017), also agree and conclude that indeed smart home systems are vulnerable and suggest the support of network companies which have access to the networks of homes.

Although it is clear that the participants are in favor of these systems and the security they offer through their sensors, it is not clear whether the participants understand that on the contrary their safety is exposed.

On the other hand, taking into account our dependance to technology, anything that is connected to the internet is vulnerable therefore it's up to the users discretion to take precaution measures through their usage

It is also not certain when the pricing factor comes into the picture whether future property buyers will choose to install these systems or not.

More specifically from the responses it is shown that the majority of the participants neither agree nor disagree that smart home systems are expensive. It is widely known though that smart home systems are quite expensive if somebody wishes to install them in a later stage rather than buying a property which already incorporates it.

An interesting fact is that participants retain the same opinion in terms of the price increase of houses which include these systems. More specifically most of the respondents neither agree nor disagree that prices of properties increase with these systems.

However, the number of people that agree that the price of homes increases with these systems is the same with the participants that disagree. A worth noting point though is that when participants were asked if they had to choose between a property with a smart home and a property with a good view none of the respondents chose the smart home property. This fact proves that there are other more important factors that potential buyers take into consideration when buying a home. A potential buyer takes into account other more important aspects such as the location and the surrounding area of the property and more importantly the distance to amenities but also their workplace. According to Manciu (2015) an additional important element is the reputation of the developer and the quality of previous completed projects but also one of the most crucial factors is the advice of family members and friends.

On the same page, Levy, Murphy and Lee (2008) agree on this perspective and support that buying a home involves many parameters such as economic and social interactions which includes discussions with friends and family members and involves advice from a number of sources.

Therefore, it is unlikely that smart home systems could constitute the dominant factor in which perspective buyers will rely their decision to buy a property. Although it is not a determinant factor, on the contrary it is considered to be an essential element if included within a house.

However, will this opinion prevail forever? Yapp (2018) supports that there is a huge field to be exploited with smart homes since data become more detailed and easier to access by using these systems. The author supports that in the future these systems will bring radical changes and will be most of value if at the same time are easy to use and install.

With the above mentioned, the easiness to install and the easiness to use, amongst others, is considered to be one of the main disadvantages of Smart Home systems.

Through the responses, the majority of the participants supported that sometimes these systems are not user friendly and a significant percentage of them supported that they often experience configuration and connectivity problems. However, there is a significant number of participants that disagree with this statement which leads to the conclusion that brand type and technical support of these systems may play an important role. This is something that needs to be taken into consideration by Smart Home provider Companies as it opposes the main advantage offered by these systems which is comfort. Although the participants supported their comfort is increased by

using these systems, when user friendliness impacts their comfort, it is not certain whether they will continue to use these systems and still have a positive opinion for them.

Hargreaves, Wilson and Baldwin (2018) support that smart homes promise significant domestic comfort and this ability is achieved mainly from how the users interact with these systems. An additional aspect that may have to be considered is technical faults which happen to occur many times especially with electronic equipment. Will the preference of the users remain the same if their comfort is affected by possible technical faults that may arise?

On a general level Smart Home Systems are widely accepted by users as an additional specification of a home that will enhance their overall experience within their home environment.

However, although there is a wide acceptance and positive comments on the benefits, it is understood that there is still a huge perspective for improvement as well as advancement on these systems to accommodate more functions and enhance their usage.

Hargreaves, Wilson and Baldwin (2018) suggest that these systems should be adaptable and be able to support the social goals and values of households instead of only their aesthetics and daily routines.

They also support that the systems should be able to adjust according to the different patterns of the home occupants since they have different knowledge on technology and different interests, therefore the offering of many options and controls should be avoided.

Overall, from the participants responses, the main points taken is that Smart Homes provide many benefits for their users and that there is a huge acceptance on their necessity in nowadays. However, it is not accepted that these systems constitute a necessity.

This means that even if a property does not include a smart home system it does not affect the overall experience and comfort of their users. On the other hand, with Smart home compatibility a house can be more pleasant and provide easiness on a number of functions that can be done and controlled via the web even if the house is not occupied.

In addition, in terms of resale probability the chances are that houses with smart systems that can prove savings through efficient energy management, can be sold easier. Although many the participants believe the opposite, the majority of them agree with this perspective.

6.Conclusions

On a general level, through the participants answers it is well understood that Smart Home Systems have wide acceptance. Although the benefits are quite many for those who use them frequently, from the bibliography it is shown that there is still a huge prospective that must be exploited in the near future and a world of opportunities may arise through the dynamics these systems offer. There are still many aspects of these systems that have not yet been studied and many daily operations that can be facilitated by these systems. It is a fact that in the forthcoming years all homes will most likely include a smart Home system, as technology advancement is “pushing” towards this direction.

On another note, these systems may contribute towards sustainability as it is quite common these systems to control basic home automations that are connected with energy consuming equipment. Through the participants answers, it is well understood that users seek comfort and a pleasant home environment through these systems.

However, comfort may be affected if these systems do not offer user friendliness which has been proven to be a main disadvantage. Concluding, although Smart Home Systems offer many advantages there is still a great way ahead until these systems become the decisive factor on future buyer’s preferences.

7.Limitations-Recommendations

Although this research has been focused to determine the effect of Smart Home Systems on the decision of property buyers in Cyprus, it has been focused on a relatively small sample and within the age group of 18-45. The results indicate the general picture that is prevalent however, it is recommended that the same research is conducted on a more general level to the population of Cyprus which may include participants with a variety of age levels.

The research has captured the opinions of 40 participants that have already purchased a property and have experienced these systems. Therefore, it would be interesting to study the opinion of people that are thinking to buy a property and compare the results.

It would also be beneficial to study the opinions of some property developers and their perception on these systems and how these systems affect the property absorption of their portfolio.

On another note, it has been proven that the participants do not feel that their personal data are in danger, however from the bibliography it seems that safety and data breach is one of the main disadvantages of these systems. Therefore, a research on the aspects of safety would be an interesting field to study taking into account other types of property also, other than residential.

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Appendix A: Questionnaire

"Measuring the effect of Smart home Systems on the decision for property purchase in Cyprus"

Questionnaire

Dear Friend

This questionnaire forms part of a research conducted as part of my MSc Degree in Real Estate Management in Neapolis University. The questionnaire measures the impact of Smart Home Systems on Cyprus property buyer's perception. The results will be useful to property Developers in Cyprus, Future Property Buyers, Non-Governmental Organizations and Technology Companies that wish to exploit the results in their favor.

The questionnaire is anonymous, and the answers will be exclusively used for the purposes of this research.

Thank you

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QUESTIONAIRE

PART A. DEMOGRAPHICS

Note with ✓

A1. Gender: Male ☐ Female ☐

A2. Age Group: 18-30 ☐ 31-45 ☐

A3.Country of Origin: .....

A4. Occupation: .....…….....

A5. Income (€): 500-1500 ☐ 1500-2500 ☐ 2500-3500 ☐ >3500 ☐

A6. Education: Bsc ☐ Msc ☐ Other ☐

A7. Price of property purchased (€): 150-200 K ☐ 200-250K ☐ 250-300K ☐ >300K ☐

PART B: SMART HOME SYSTEMSA1

B1. In which degree do you agree with the below statements? Circle your answer in each question/statement (1=fully disagree, 2=disagree, 3= I do not agree or disagree, 4= agree, 5= fully agree).

Frequency:		**1**	**2**	**3**	**4**	***5***
POSSIBILITIES-PERCEPTION						
B1.1	I know that smart home systems will be a "must" when buying a property in the future	O	O	O	O	O
B1.2	I am willing to pay a premium for a property with smart home system since it offers great facilitation	O	O	O	O	O
B1.3	I will not buy a property without a smart home system	O	O	O	O	O
B1.4	I believe these systems should be included in all future development projects	O	O	O	O	O
B1.5	There is a huge space for advancement of these systems	O	O	O	O	O
B1.6	I believe these systems will help me save energy	O	O	O	O	O
B1.7	Smart home facilities increase security	O	O	O	O	O
B1.8	Smart home systems data can be used from various Industries to develop innovative products	O	O	O	O	O
B1.9	Smart home Systems make me feel safer	O	O	O	O	O
B1.10	I would definitely recommend to friends to install a smart home system	O	O	O	O	O

PRICE RELATED

B2.1	Smart home systems will help me sell my property in the future faster at the same price or even more expensive	O	O	O	O	O
B2.2	If I had to choose between a smart home and a non-smart home with better view but with the same price, I would choose the smart home.	O	O	O	O	O
B2.3	I believe smart homes increase property price	O	O	O	O	O
B2.4	Smart Homes are very expensive	O	O	O	O	O
B2.5	I save money using these systems	O	O	O	O	O

DISADVANTAGES-SETBACKS

B3.1	Smart home systems often have configuration and connectivity problems	O	O	O	O	O
B3.2	Smart home systems can be breached easily	O	O	O	O	O
B3.3	I am afraid that my personal data are not safe with Smart Home Systems	O	O	O	O	O
B3.4	I control my smart home system mainly from my phone and not through the control panel because its not easy	O	O	O	O	O
B3.5	Sometimes these systems are not user-friendly	O	O	O	O	O

ADVANTAGES-BENEFITS

B4.1	I think smart home systems have many benefits	O	O	O	O	O
B4.2	My life is easier using smart home installations	O	O	O	O	O
B4.3	Smart Homes increase energy efficiency	O	O	O	O	O
B4.4	These systems increase comfort within the property	O	O	O	O	O
B4.5	The advantages of smart home systems outweigh the disadvantages.	O	O	O	O	O
B4.6	I replaced basic home habits with smart home automation (such as water heating).	O	O	O	O	O
B4.7	Smart home facilities increase security	O	O	O	O	O

Thank you very much for your time.