An investigation of consumer attitudes and perceptions around the use of Smart Home technology for online shopping & purchases

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Abstract

The purpose of this paper is to research the perceptions of consumers around Smart Home technology as it relates to e-commerce and online purchasing. The research aims to ascertain whether consumers perceive that Smart Home devices such as artificial intelligence enabled speakers or other Smart Home devices could and would be used by them to buy online. The paper does not attempt to explore or investigate the actual usefulness of these devices or their ease of use, but rather the customers perceptions of them and whether they would be willing to try purchasing using this new e-commerce channel.

The paper takes a quantitative approach in the form of a survey using the Technology Acceptance Model (TAM) proposed by Davis in 1989 to assess the potential users perceptions around ease of use, usefulness, attitude towards the technology as well as their overall intention to try to use the Smart Home devices for online shopping. The model was adapted with additional factors relevant to the investigation of e-commerce and Smart Home devices.

A total of 200 surveys were issued of which 154 were deemed to be valid and complete. The survey used a 5-point Likert scale divided into sections based on the components of the TAM model. From these a series of 10 hypotheses were constructed to assess the relationship each construct in the TAM survey had on the others with a view to understanding if users perceptions had an impact on their attitude towards and their intention to use Smart Home e-commerce.

Some simple statistical analysis was initially performed to evaluate the elements that respondents deemed important and a Cronbach's analysis was used to determine the internal consistency of the survey and its questions. The hypotheses were then examined using regression analysis.

The findings showed strong relationships between the respondents' attitudes towards the technology and their perception of its usefulness and whether they intend to try Smart Home e-commerce. It also indicated areas for consideration by the suppliers of Smart Home devices as well as ideas for further research.

Keywords: Smart Home, smart technology, technology acceptance model, e-commerce, perceptions, mobile commerce, trust, intention to use.

Submission of Thesis and Dissertation

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Chapter 1: Introduction

1.1 Introduction

One of the barriers for any company when developing a new service or technology is the customers' willingness and readiness to adopt that technology. Liljander et al. noted that as companies struggle to persuade their customers to adopt technologies "it has become increasingly important to understand the factors affecting customers' attitudes and their adoption behaviour" (Liljander et al, 2006). While the number of innovative high-tech products and services is increasing as we speak, consumers' experiences with these products and services are becoming a focal point for companies striving to survive in today's digital world (Demirci and Ersoy, 2008). Often technology products may go to market, and the consumer may not perceive any use for it, or they may determine that the difficulty is not worth the investment of their time. According to Davis, Bagozzi & Warshaw "perceived usefulness and perceived ease of use are primary relevance for computer acceptance behaviours." (Davis, Bagozzi and Warshaw, 1989).

The following study looks at one specific case, that of the emerging Smart Home technology market. These devices have been available for several years and customer adoption is growing rapidly, with Ireland for example showing household penetration will be 10.1% in 2020 and is expected to hit 25.0% by 2025. (Statista 2020). This paper looks at the longer aim of these devices being used as a channel for purchasing, shopping, and paying for services from the home.

1.2 Dissertation Structure

Chapter One will briefly discuss the main technology focus within this paper, e-commerce and Smart Home technology and why the author decided to investigate consumer perceptions around using these new devices for Smart Home purchasing.

Chapter Two comprises a literature review of the areas of e-commerce, the evolution of purchasing online and on mobile phones as well as some early research into Smart Home technology and its applications. It also includes research into customers adoption of new technologies and looks at the history of the acceptance model which will be used later.

Chapter Three outlines the aims of this dissertation and the goals of the research conducted, as well as going into more detail around technology acceptance.

Chapter Four describes the research methodology, the model which was used and its expansion for Smart Home e-commerce specifically and the instrument in the form of a Likert Scale based questionnaire used to gather data.

Chapter Five presents the initial results of the study and the statistical analysis. It then looks at whether the data allows for any meaningful correlation between the results and the proposed hypotheses.

Chapter Six looks at the findings of the research and examines if the results of the investigation support the 10 proposed hypotheses.

Chapter Seven concludes with some recommendations for further research and closes with some brief thoughts from the author.

1.3 Customer Perception

As this new channel, Smart Home e-commerce, is relatively new and the adoption and usage is low, this paper will look at the important issue of the customers perceptions of this technology rather than its actual usage. E-Marketer estimates that by the end of 2020, 21.6 million people will have made a purchase using a smart speaker. This channel will pass a milestone this year when 10.8% of all digital buyers in the US will make a purchase using a smart speaker. (E-Marketer, 2020) As there is little in the way of research about the adoption and actual usage to date, instead this paper will investigate consumer perceptions of the technology and their intention to try Smart Home e-commerce.

1.4 The Story of e-Commerce

Throughout the early 2000's, the increased usage and availability of the internet as well as faster connections and more advanced websites meant more and more people were opened up to the possibility of online commerce and "firms could make use of this technology to open up new opportunities." (Poon and Swatman, 1999). Companies both new and old could move elements of their business online and potentially reach a wider consumer base in other

regions or areas where they did not have a physical presence. With this came the idea of the online store and the ability to purchase goods and services via this new digital channel. Not only that but this has created opportunities for businesses to reach out to consumers in a very direct way and create electronic markets. Also, by virtue of the technology, it has allowed consumers immediate access to these electronic markets according to Klopping & McKinney. (Klopping and McKinney, 2004).

While at first there was hesitation and concern over privacy the usage of online shopping it flourished and developed into the massive worldwide industry with Global e-Commerce hitting $25.6 trillion in 2020 according to the United Nations Conference on Trade and Development (UNCTAD, April 2020) This has seen the rise of giants such as eBay and Amazon quickly surpassing the sales and revenue of even the most established brick and mortar shops and retail companies. “Online shopping is killing brick and mortar retail, and a slew of high-profile downsizes and bankruptcies in recent years seem to support that theory.” (Zohuri, 2020)

“For the past 22 years we’ve been able to shop online and looking back, e-commerce has grown beyond belief. What with the gradual decline of the high street and the growth of some of the world’s biggest brands being down to e-commerce level these days. “
(Zohuri, 2020)

The move for consumers from retail to online shopping and purchases was a relatively quick one. In 2018, retail e-commerce sales in the United States alone totalled $504.6 billion according to www.statista.com which is nearly double that of $274.7 in 2017. (Zohuri, 2020; Statista, 2018).

What is more interesting is the rapid pace at which the medium for which these purchases took place changed. Customers would have initially spent a greater amount of time browsing and shopping online with their personal computer before the early 2010’s and this quickly and almost seamlessly evolved into ‘m-commerce’. (mobile phone-based e-commerce) By May 2013, 56 percent of American adults had a smartphone, and most of them used it to access the Internet. By June 2013, more than one-third of eBay’s active users (in a given

month) were mobile adopters. (Einav, 2014) I.e. they had made a purchase online with their mobile device.

Today in markets and many demographics mobile user has surpassed the use of PC's for e-commerce which makes sense given the number of mobile users has exceeded 5 billion people. (Ahmadzadeh, 2020).

Now technology has potentially opened a new avenue for the customer to shop and make purchases online in the form of IoT and Smart Devices. Look at the example of several features available for smart speakers, such as playing music, controlling devices, and purchasing products. (Haug et al, 2020) These devices will not only potentially make the act of buying seamlessly integrate with daily actions, it may also form the basis for technology such as home appliances being allowed to make purchases on behalf of the customer with no 'human' interaction or involvement.

1.5 Technology, and the Evolution of Buying

1.5.1 What are Smart Devices?

Smart Home devices, which we will discuss in this paper, refers to internet connected devices and appliances in the home. A more detailed definition was proposed by Sovacool, B.K. et al. "Smart Home technologies refer to devices that provide some degree of digitally connected, automated, or enhanced services to building occupants." (Sovacool et al, 2020) Some of these are meant to automate tasks and processes such as switching on devices or lights while others, like home AI (Artificial Intelligence) home assistants answer questions, play music and podcasts, and perform tasks like reminders and alarms. (Haug et al, 2020).

The benefit of these devices is that they can not only communicate with the internet, and therefore allow greater control even when the user is not home, they can also be a gateway to additional services. Many of these devices can also speak to each other and chains can be created to run multiple actions based off the interaction with one, so users can use these devices naturally integrated with their routines. (Sciuto et al, 2018)

There is the potential here, for example for the user to buy milk while standing at their fridge on discovering that they have run out, or to order detergent while loading the washing machine rather than the need to open an app on a phone or browse to a particular website.

This potentially will help users to avoid food wastage and overspending on unnecessary items. (Bhatt, Bhatt and Fiaidhi, 2020). Smart devices could in theory make the process of shopping, particularly for items such as household supplies, more a part of their day rather than a specific time period or action.

While not a specific focus of this paper, IoT or Internet of Things devices will be empowered to make some of these decisions on behalf of the user. For example, an internet enabled refrigerator performs its regular role as a household appliance but now can also manage shopping list checking and monitoring conditions of the refrigerator. (Rouillard, 2012). Taking the above example, the fridge in this case could be instructed that if milk expires or if the weight of the carton drops below a certain level, it is likely that another one is required. This device will then have been given permission to add this to your shopping list, or even complete the transaction with no human intervention needed. (Rouillard, 2012).

> *"The system is designed to identify and manage the food items in the fridge. It identifies which type food is stored in the fridge like fruits, vegetables. The smart fridge has intelligent embedding system to help it communicate with the devices as well as the user."*
>
> *(Bhatt, Bhatt and Fiaidhi, 2020)*

1.5.2 Convergence of technologies – consumer data is already available

While many people may not realise it, there are probably many internet connected devices in their homes already which are sending data on their habits and patterns to their parent companies as well as sharing information of usage which can potentially be used for this new Smart Home commerce in the future. (Acar et al,2020). Over the last few years, we have unknowingly or knowingly allowed internet connected devices into our homes. All smart TVs can collect and share significant amounts of personal data about their viewers. And so can "the dozens—or even hundreds—of third-party apps that work with the platforms." (Consumer Reports, 2018). These devices are internet portals that vary on the amount of human interaction. While you may use the smart features such as streaming services on your television frequently, the device is also using its internet access to feedback meta data, user information, app usage and more.

Consumer Reports examined privacy policies of various smart TV platforms including Roku, LG, Sony, and Vizio. (Wilcox, 2020). They found that privacy policies are often challenging to understand, and it is difficult for users to opt out of different types of tracking. (Varmarken et al, 2020).

All of this is set out in the terms and conditions of these products, but, like many internet services, the majority of people do not read and will blindly accept these conditions in order to use the convenient services that they provide, for example, the FTC reported in 2020, 74% of people skip the privacy policy when signing up for a service online. (Obar and Oeldorf-Hirsch, 2020).

In our move to be more eco-friendly many have signed up for smart thermostats and heating systems. As before these devices capture data on us and often can 'speak to' and share information with other connected devices within your home and beyond, and as pointed out by Lau et al. users "trade privacy for convenience with different levels of deliberation and privacy resignation." (Lau, Zimmerman, and Schaub, 2018).

This does not even take into consideration the emergence of Smart Home assistants such as Amazon's Alexa based echo devices, Apple's Home Kit and Google's Nest home assistant. All of these voice activated services allow users to interact with music services, ask questions, set reminders and alarms as well as control and interact with other appliances and applications within the home, (Haug et al, 2020) but they too are a conduit for information gathering and potentially consumer transactions since they are connected so readily to the internet, and by extension online stores and purchasing channels.

1.5.3 The Increase of Smart Devices in the Home

In 2019 the Consumer Technology Association found that the majority (69%) of U.S. households now own at least one Smart Home device of one form or another. (Consumer Technology Association, 2019). The number of households that have an AI assistant such as Amazon Alexa, Google Nest or similar voice assistant is approximately 40 million. (Statista, 2020).

This is a massive percentage of 12% of US households with a home AI, very quick market penetration considering the first of these, the Amazon Echo only came on the market in 2014 to limited availability. This compared with the penetration of smart phones shows that the

exponential growth of this space is at a similar or greater pace with an annual growth rate expected at 42% between 2017 and 2024. (Ali and Yusuf, 2019). The question here is, will this quick adoption of the technology translate into customers using the devices for online shopping?

Already companies such as Amazon have enabled the ability to complete entire transactions and purchases with only a few voice commands. Although there are other companies attempting this with smart assistants, in terms of online shopping only Alexa could do it as of 2017. (López et al, 2017).

An example of this is as follows: If you have previously purchased a brand of batteries for an item in your home using the Amazon website, you can mark this as a favourite. You can then, using the Amazon app or website, save your payment details and allow voice purchasing. From there it is a simple matter of asking the voice assistant to purchase batteries and the request is sent straight from the device to the fulfilment side of the e-commerce store and the transaction completed.

1.6 Foundations of our Story

Now that there is a basis for understanding Smart Home devices and e-commerce it is necessary to look at any research that has already been conducted in this area. As the industry is relatively new, we would expect to find relatively little in the way of literature on Smart Home commerce when compared to the study of traditional e-commerce and mobile e-commerce.

1.7 Motivation for this Study

This topic is of interest to the author who works in Information Technology and currently has an online channel discussing and examining the applications and new advancements in Smart Home technology. It is hoped that this research will lend itself to the growing part of the authors career that deals with the convergence of IT, Smart Homes, and the customer interaction.

Chapter 2: Literature Review

2.1 Introduction

The following chapter will look at some of the prominent literature which is relevant to Smart Home devices, e-commerce and attitudes of people adopting a new technology.

For this research we are not interested in the actual usage of the technology in question, but the user's perceptions of its usefulness and ease of use. For this the author has examined the Technology Acceptance Model (TAM) proposed by Davis in 1989. (Davis, 1989). This allows us firstly to get a model for measuring how the potential users will adapt to a new technology or a new application of an existing technology.

A brief review of e-commerce, that is shopping and making purchase online, gives us the background for the potential use of the technology we will be investigating, and finally we will look at Smart Home devices and the literature and study that is already available. These elements will form the basis for the study which will assess potential consumers' perceptions and, according to the TAM model, intent to try Smart Home devices to perform e-commerce.

The Smart Home market is relatively new but in the United States alone according to Statista (Statista, 2020) there is approximately a 20.3% year on year increase. Currently there is limited research into the idea of purchasing using these devices but Barlow and Venables point out that underlying technologies for supporting the Smart Home are developing rapidly for e-commerce (Barlow and Venables, 2003) and expanded on by Turban et al. (Turban, et al, 2018) who examine the potential convenience of Smart Home e-commerce.

> *"Efforts have been made over time to simplify and automate many tasks of e-commerce. Just think of the day that your refrigerator will be able to measure and evaluate its contents and place orders for goods that need replenishment. Such a day is not too far in the future and the task will be supported by the IoT."*
> *(Turban, et al, 2018)*

Most of the research and use cases have thus far centred around home automation and lifestyle improvement which can be traced back the roots of Smart Homes back to 1970's

home automation (Yamazaki, 2006). But continued slow adoption rates persist attributed to privacy risk and innovation resistance limiting perceived value. (Kim, Park and Choi, 2017).

Some work was done by Yang et al, in 2017 around the consumer acceptance of these devices and whether this would lead to the hoped e-commerce behaviour. (Yang, Lee and Zo, 2017).

It is important before looking at the area of Smart Home commerce to look at the transition from e-commerce through to mobile commerce as well as the perceptions around these channels. E-Commerce is the act of purchasing goods and services online (Turban et al, 2009), while mobile e-commerce or m-Commerce are those transactions, conducted through mobile devices using wireless telecommunications networks and other wired e-commerce technologies. These have proven their huge earning potential and appeal versus traditional e-commerce. (Siau, Limand and Shen, 2001).

Research suggests that the rapid move by suppliers to engage with customers first from e-commerce then to mobile commerce will, almost inevitably lead to consumers using Smart Home devices and internet connected devices because of the unprecedented business opportunities this may produce according to Singh & Singh. (Singh and Singh, 2015).

We must also not limit our research to devices such as voice activated home assistants but also to internet connected appliances. Referred to as the Internet of Things, or IoT, a phrase coined by a member of the Radio Frequency Identification (RFID) development community in 1999, IoT looks at connecting any device to the internet in order to achieve smart recognitions, positioning, tracing (Patel and Patel, 2016) and, which is the hope of giants like Amazon, to make purchases and even do regular commerce and shopping without the 'physical' interaction with a device. (Amazon, 2020)

2.2 Technology Acceptance

2.2.1 Customer adoption

To investigate the technology in question here and the use case we are examining, that of e-commerce, it is important to first investigate the customer attitude towards new technology. The attitudes and perceptions of customers plays a key role in the success and adoption of new products and services (Liljander et al, 2006) and we must look at both the perception of the new devices they may be using, and the e-commerce usage through them. For this we

need a mechanism to examine how people will act based on their attitudes and behaviours. For this we use the Technology Acceptance Model (TAM).

2.2.2 The Technology Acceptance Model

Much of this research relies on the technology acceptance model, TAM by Davis in 1989 (Davis, 1989) which examines the factors affecting technology adoption. Originally created to assess attitude and intention to adopt technology for work purposes this has since been adapted and expanded to where it can be effectively used to gauge the perceptions around any new technology. In particular, an example investigated is the work by Wu and Wang around mobile e-commerce adoption (Wu and Wang, 2005) and (Mijoska, 2017) which looked at a specific small market while expanding the TAM to include trust and customer experience.

We will also examine the addition of an element of trust amended to this model which is of importance for privacy and security both with Smart Home devices but also with e-commerce. In 2003 for example Pavlou looked at incorporating trust given the implicit uncertainty of the e-commerce environment. (Pavlou, 2003).

2.2.3 Perception versus actual usage

This TAM model seeks to examine not the actual usage of the devices and the customers experiences but rather their perceptions of its ease of use, usefulness, and their intention to use it. This was based off the work of Fishbein and Ajzen on their theory of reasoned action. (Fishbein and Ajzen, 1977).

The theory of reasoned action (ToRA or TRA)

"The theory of reasoned action (ToRA or TRA) tries to create a relationship between attitudes and behaviours whenever people decide or take an action. Fishbein and Ajzen proposed the theory to attempt to predict how individuals will behave based on their pre-existing perceptions, attitudes, and intentions. "
(Fishbein and Ajzen, 1977).

The model suggests that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it, notably:

Perceived usefulness (PU) – This was defined by Davis as "the degree to which a person believes that using a particular system would enhance his or her job performance". (Davis, 1989). In this case whether someone perceives that technology to be useful for what they want to do.

– Davis defined this as "the degree to which a person believes that using a particular system would be free from effort" (Davis, 1989). If the technology is easy to use, then the barrier is conquered. If it is not easy to use and the interface is complicated, no one has a positive attitude towards it.

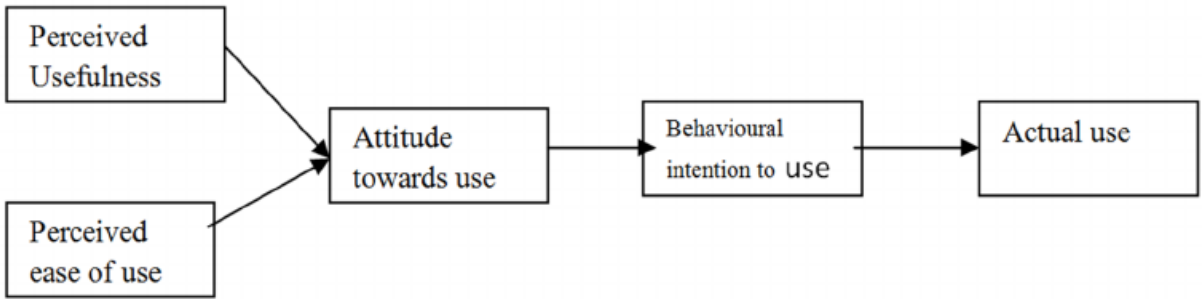

Figure 1: The Davis TAM Model

Finally, Davis looked at the Attitude (ATT) towards the technology in question and with the above elements of the TAM in place, whether people have the Intention to Use (INT) the technology. However, he noted that this is an imperfect tool as "the perception may change depending on age and gender because everyone is different." (Davis, 1989).

2.2.4 Extensions to the TAM model

The TAM has been continuously studied and expanded—the two major upgrades being the TAM 2 (Venkatesh and Davis 2000; Venkatesh 2000) and the Unified Theory of Acceptance and Use of Technology (or UTAUT), (Venkatesh et al. 2003). A TAM 3 has also been proposed in the specific context of e-commerce with an inclusion of the effects of trust and perceived risk on system use (Venkatesh & Bala 2008).

In 2004 Shih applied this model successfully to Internet usage adoption (Shih, 2004) and in 2015 Wong applied TAM using an adapted model and examined how this could be applied to mobile commerce. (Wong et al, 2015). Because of the similarities, as well as the

complimentary nature of the action, this model can be readily applied to the readiness and attitudes of consumers to use Smart Home technology for e-commerce.

2.2.5 Different Levels of Adoption

It has been noted that consumers differ in their adoption of new products, services, and shopping methods. (Yang, 2012). Since consumers perception of technology characteristics also differ, their adoption behaviour may differ. (Moore and Benbasat, 1991) and (Denis et al, 2003) It's also been noted that adoption and continuous usage are not the same thing and according to Almazroa and Gulliver continuance usage is less studied when compared to the adoption research. An investigation of repeated or continuous usage may be warranted. Consumers may purchase once but not repeat the action. (Almazroa and Gulliver, 2018).

2.3 e-Commerce, the Internet & Smart Phones

The internet created a new channel for people to make purchases and to engage in commerce, and it was only a short time from its creation for e-commerce to become somewhat commonplace, particularly in more developed countries with access to better and faster internet connections as well as the ability to more readily make purchases online with credit and debit cards. E-commerce has been attributed to the slow decline in the brick and mortar stores over the last 3 decades, (Zohuri, 2020) and as PCs become more ubiquitous in the household, combined with the ready availability of products both from local physical stores, but also from further afield, more and more people have turned to purchasing online.

The traditional store browsing has been augmented and at times replaced by online research, and many people are purchasing items online that they would not readily have access to in their vicinity as well as buying items from overseas that previously they would not have had access to. (Mijoska, 2017).

2.3.1 Move to Mobile

Like with most uses of PCs, over the last few years we have seen a shift towards mobile phones or so-called Smart Phones. As these devices became more and more powerful it was possible for consumers to browse the same websites and make their shopping decisions while on their mobile. As the technology evolved and devices put the internet in our pockets a sub industry of mobile e-commerce or 'm-commerce' was born. (Agrebi and Jallais, 2015) This was aided by more responsive design and mobile friendly sites which have shortened steps to making a

purchase as well as made the overall user experience a more pleasant and at times more efficient one.

2.3.2 Dedicated Mobile Apps & Shopping Systems

Dedicated mobile apps for the major operating systems Apple iOS and Android have simplified this process even further with the devices able to retain and process payment details with very few steps and at the same time feed data back to their retailers about the users preferences, browsing history and wants. (Gibler et al, 2012) This all combines to have 2 effects, firstly the process of shopping is quicker and facilitates more impulse buys as sites like Amazon can store preferences and offer 1-click purchasing on many items. Secondly the product and service suggestions that the consumer is exposed to are more tailored to their individual likes and preferences. (Demetriou et al, 2016)

2.3.3 Consumer Data

All this leads to greater data gained from each and every user, and leads to a cycle of commerce where the user browses, makes a purchase, sees something related to their previous history and each time the websites get better at predicting what the client wants. (Neelima and Rodda, 2016).

On mobile phones this is even more important to note as each website and app can potentially access data and preferences from other sites and apps in the form of tracking data and website cookies. According to Nohria and Lesstma this channel generates much more abundant consumer information. (Nohria and Leestma, 2001). Should you choose to login to an app using your Facebook details you are often prompted to give certain access to each company to share data. This is no accident and is a key method that retailers gather information from you as well as allowing companies to get better consumer data to serve up more targeted and relevant adds for you, the user.

2.3.4 Adoption of e-Commerce & Mobile Commerce

Much of the previous research into adoption of mobile commerce and e-commerce has centred around the behaviour assumed by individuals which is partly influenced by perceived enjoyment (PE). Qualitative research done by Agrebi and Jallais suggested that using the phone to make purchases can be perceived as pleasant (Agrebi and Jallais, 2015) which may be a key factor in the adoption of Smart Home shopping.

According to Novak, Hoffman, and Duhachek (2003), a high consumer interaction with computers can lead to flow experience, which, in turn, has the potential to create a pleasant shopping experience. (Novak et al, 2003). A second factor that has been investigated is the perceived usefulness (PU) of the technology. For this research PU will refer to the utilitarian shopping values (e.g. convenience, price comparisons, infinite choice, and greater information availability). (Groß, 2015)

To achieve a meaningful sample size and quantitative data Agrebi and Jallais (2015) suggested following the model used by Gerbing and Anderson in 1988 which recommended a sample of 400 people (Anderson and Gerbing, 1988). Due to time constraints this research will take a sample size of 200. Previous relevant studies used a 5 or 7-point Likert-type scale (Yang, 2012) which are often found on survey forms, that measures how people feel about something.

As we've examined mobile shopping is now commonplace (Wang et al, 2015), it is interesting that according to Holmes, Byrne and Rowley the most frequent location is the home for mobile commerce. (Holmes, Byrne, and Rowley, 2014). This would suggest that consumers are open to devices in their home that would make their purchasing quicker and more efficient and GhaffarianHoseinin suggests that Smart Home devices might be the inevitable next steps and soon be the normal paradigm. (GhaffarianHoseinin et al, 2013). Indeed, the World Economic forum has indicated that by 2025 connected devices and appliances will constitute over 50% of the internet traffic through homes. (Hendriks, 2016).

2.3.5 Progression to Smart Home Commerce

Although the progression from PCs to mobile phones was a natural one, just as users were initially cautions about e-commerce and buying online, there was the same scepticism about using phones for the same. (Kim et al, 2017). It will be interesting to see if this same reluctance and technology resistance is present in the transition to using Smart Home devices and IoT for purchasing. This is an area which still has some uncertainty, as although the sale of Smart Home devices such as Amazon Echo's and Google Home / Nest devices has increased exponentially over the last few years, (Statista, 2020) Smart Home services have not yet been widely accepted for reasons such as high cost of devices, limited demand and long device replacement cycles compare to PCs and mobile phones. (Yang et al, 2018).

2.4 Smart Home Technology

Despite the existence of Smart Homes and Smart Home technology for some time, their prevalence is not yet widespread. (Balta-Ozkan et al, 2013). As the area of Smart Home technology is relatively new the majority of the research has been around the technology and its applications as well as the integrations and standards used rather than focusing on the area of e-commerce, that being said, there are many aspects that bear more than a passing resemblance to the study of e-commerce and mobile commerce adoption, (Holmes, Byrne and Rowley, 2014) namely that of technology resistance, adoption, scepticism and attitude and the research reviewed draws many parallels with this research.

In the last 2 years there has been a vast increase in penetration of Smart Home products into the market. “Smart home services are considered one of the most promising potential markets…. the demand for Smart Home services and home security products has increased exponentially.” (Park et al, 2018).

It is important to note though that Smart Home devices are not simply a tool for the e-commerce giants to have another avenue into your home although this is a vital component for them. For both the consumer and the service providers Smart Home technology and IoT is the next progression for consumers to purchase and “the prospect of your devices making your buying decisions autonomously, looking after your health and providing entertainment is fast becoming a reality for families.” (Li and Yu, 2011)

It is likely that in the next few years a shift towards purchasing through IoT devices and Smart Home tech will be commonplace. (GhaffarianHoseini, et al, 2013). Will we see customers purchasing for examples groceries on devices?

2.4.1 IoT and the Future

In 2018, Baswani et al researched and catalogued current and potential future IoT enabled online shopping which they termed IoTOS. This was looking at the alternatives to using laptops, smartphones and tablets while being able to conveniently shop at home. (Baswani, George and Townsend, 2018). They discussed the major players already in this market from Samsung, Google, and Amazon, however this research was very western centric and failed to

investigate the rapidly growing smart technology markets in China and the rest of Asia which is 2nd only to the United States in Smart Home start-ups and companies. (Ali and Yusuf, 2019).

> *"Apple, Samsung, and Alphabet (Google) seem to be the most aggressive investors in Smart Home technologies. "*
> *Ali, S. and Yusuf, Z., 2019. Mapping the smart-home market.*

2.5 Challenges & Concerns

2.5.1 Privacy

Research shows though that consumers regard their mobile as 'personal' devices and are resistant to any form of marketing or commercial messages, and view these as intrusion into their personal space (Muk, 2007). This would indicate the same will be true for Smart Home devices.

Privacy and security will again play a part, and indeed already has been a topic of discussion in terms of smart technology. (Robles et al, 2010). It should definitely be a concern to the manufacturers as they have to content with this as well as the paradigm shift in how the customers interact with these devices when compared to PCs or Smart Phones. "Privacy risk and innovation resistance were perceived to limit value" (Kim et al, 2017). This could potentially slow the adoption of this new form of e-commerce.

This is a challenge for the big companies who have been for years collecting data and buying patterns from online behaviour. But this has not been limited to large online companies as retail stores have used this technique for decades in the form of loyalty cards and club reward and use this data to predict buying patterns and behaviours. (Kao, 2013). These companies are embracing the move to Smart Home devices as they will potentially be able to gather data, not only directly from you the user, but also from the other devices and products in your home, giving them a more holistic view of you the consumer. (Nohria and Leestma, 2001)

2.5.2 Complexity

Currently the research is telling us that Smart Home technology is too complex for most household users, needing more user-friendly interface for general users who have little or no

experiences of using computer. (Luo, Jin and Li, 2009). Coupled with this security and privacy remain a major challenge.

2.5.3 Security

Dorri et al noted that IoT security is gaining a lot of attention these days from both academia and industry. Existing security solutions are not necessarily suited for IoT (Dorri et al, 2017) and this could be cause for consumers to hesitate.

Lin and Bergmann while researching IoT security noted that consumer fears over security may be warranted. Security breaches are on the rise; 90% of large organizations experienced cyber breaches in 2015 compared to 81% in 2014 (Lin and Bergmann, 2016). Literature shows that trust is a big factor for uncertainty and the concern about the Internet-based commerce. (Groß, 2015)

When it came to online e-commerce and using mobile devices and PC's, Kini and Choobineh in their investigation found that trust was defined "as a belief in the system characteristics, specifically in the competence, dependability and security of the system, under conditions of risk." (Kini and Choobineh, 1998).

The topic of privacy and security when it comes to e-commerce has become an important topic and has created some push back to the large tech companies to be more transparent about the data they have on their users. While some people have tried to opt out of tracking and other personalisation services while online, as there was a flurry of activity in the last few years about this, particularly in the light of large scale mishandling of data by agents like Cambridge Analytica, like most technology it is likely that in the long run that "convenience will inevitably overcome these concerns as tends to happen with many new technology adoptions." (Lau, Zimmerman, and Schaub, 2018).

2.5.4 Technology Anxiety

Consumers with a high level of technology anxiety rely more on social influence in the use of mobile shopping than consumers with a low level of technology anxiety. (Yang and Forney, 2013). It was also investigated by Randall when a group of households were studied that families showed themselves to be uncomfortable with any facilities which they felt monitored their behaviour, even when it was for the best of reasons, such as health monitoring. (Randall, 2003). This poses a challenge as the use cases around Smart Home technology involve family

security, family medical treatment, family data processing, family entertainment and family business. (Li and Yu, 2011).

2.6 Gaps & Next Steps

The literature review has identified the clear gap in the investigation of e-commerce when applied to Smart Home devices. There has been little study done to see if consumers are interested and inclined to use this channel for online purchases and yet the manufacturers are heavily pursuing these devices. (Newman, 2018). While there is revenue to be made from the sale of the Smart Assistants and automation products, the real selling point for a business like Amazon will be in getting consumers to use these devices to make more frequent purchases and incorporate shopping into their everyday routine rather than taking time out or specific days to take the actions. (Sciuto et al, 2018). It is hoped that the following research will identify whether consumers perceive the technology as useful, easy enough to use and, ultimately if they intend to use it.

Chapter 3: Dissertation Purpose, Aims and Considerations

3.1 Introduction

This dissertation's primary objective is to study the perceptions consumers have around using the new technology of Smart Home devices to engage in e-commerce and online purchasing. It is important at this point to clarify that the objective here is not to understand, study or critique their actual usage of the technology, or their experiences of e-commerce, but rather their perceptions around this new channel.

The study will attempt to gain a wide range of demographics to assess if there are differing perceptions in different age groups, education levels and between genders. One area which would be difficult to assess but may warrant further research is the level to which the respondent is tech savvy, but for the purpose of this research a cross section of responses and demographics should naturally capture people at different levels of comfort with technology.

3.2 Research Aim

The primary aim is to assess if consumers are at a level where they perceive Smart Home e-commerce as a useful and safe option to make online purchases and whether they intend to actually use the technology for this purpose. The goal here is to add to research on existing e-commerce channels and add value by potentially providing insights that companies providing this service may not have experienced when offering e-commerce and mobile e-commerce solutions. While it is expected that many of the challenges and issues raised in the research and by the respondents will be similar to those broached by similar research into e-commerce in the past, it is anticipated that the dramatically different type of interaction may show increased resistance from customers.

3.3 Objectives

3.3.1 Evaluate the perceived usefulness and ease of Smart Home technology in purchasing.

The first objective is to evaluate whether respondents perceive that they will have an easy time using Smart Home technology in their online purchasing. Again, this does not examine their actual experience of e-commerce and using Smart Home technology, it looks to assess

their perception of the difficulty or ease of the action. This may be coloured by their previous experiences of shopping online, word of mouth, notable mentions in the media or many other factors.

3.3.2 Evaluate the level of trust consumers feel in this emerging e-commerce channel.

From research, a key area that has been identified as a factor in e-commerce, irrespective of the channel used is the idea of trust. Over the past few years, some high profile data breaches and mishandling of consumer data has come to light (Swinhoe, 2020) which has caused online retailers and social media companies in particular to address the trust that their customers have in the service they provide. It is an important component and will be investigated as a specific element of the TAM model used in the research. This dissertation will look to examine the perceptions the potential users have about the safety and security of purchasing using Smart Home devices and what level this plays in their intention to try Smart Home e-commerce.

3.3.3 Explore other factors such as user experience and customer service which may impact consumer intention to use Smart Home commerce.

While the model proposed to examine customer perceptions is broad, it allows for refinement and the addition of other factors. Based on the research conducted and in particular when it came to e-commerce and mobile e-commerce, it was identified that user experience, more specifically the interface, speed and ease of navigation on websites had a big impact on the customers willingness to shop online. (Wu and Wang, 2005) Again, the 'interface' of interacting with Smart Home devices is a new experience and a different paradigm so this is an important factor which will be looked at and how does the customer perceive their interactions with the devices and what role this will play on their intention to shop.

Another factor identified was the overall customer service. (Davis and Heineke, 1998). While standalone pieces of technology or a new service may be very transactional and require little after support or further interaction with customers, e-commerce has many points where there is interaction. From conformation e-mails, to tracking details as well as potential refund and returns policies. While these can be made clearly visible to the purchaser on websites,

this visual is absent and therefore this study will aim to gauge the customers perception of customer service through an interactive device in the Smart Home.

Through this study the author aims to get some preliminary data on the potential challenges that the consumer may face such as and whether there are barriers such as:

- User experience
- User perceptions
- Trust and customer service / after sales.

3.3.4 To propose recommendations to the manufacturers to help improve adoption and comfort around Smart Home commerce.

While this is preliminary research, it could be built upon with more detailed investigation as well as going beyond the perceptions of the users and deal with their real-world experiences. It is therefore important to note that this research primarily look at:

- Do customers perceive the technology can be useful for purchasing?
- Does the customer feel that the user interface and experience is easy for them to grasp?
- Have consumers reached an impasse with privacy and security or will convenience override this as it has in the past with online shopping?
- What do companies need to do to ensure a smooth and frictionless perception for customers?

All the above can be used by manufacturers and companies to change positioning, marketing and customer awareness to improve the adoption of Smart Home e-commerce.

3.4 Other Considerations

3.4.1 How will we buy? What will this look like? What does it already look like?

Smart Home commerce may fundamentally change the way in which we purchase. Gone is the browsing or selection of an item, we have already designated the products, brands, and regular items we want and enjoy, and this system simply makes it quicker and more convenient to purchase. For the consumer then, this can be done in 'flow' (Novak et al, 2003) with little to no interruption in their day and very little thought.

There are a couple of important things to note here as there are still some limitations around Smart Home e-commerce, as well as some potential advantages both to the customer as well as the company facilitating the transaction.

- While currently you need to select in advance the products you are purchasing due to limitations, as the technology and in particular the speech recognition improves, it may be possible to request specific brands, products, flavours and more without the need to have previously selected the items.
- This allows the future potential for an instant marketing to sale experience. You are watching a movie, see a particular product and can order it via the voice assistant as you are viewing.
- Companies such as Amazon and Google, who already have vast amounts of data on their customers browsing, spending and buying habits (Gobble, 2013) when actively using their phones or PC for internet access can augment this with the habits and consumption patterns of these same clients as they go about their daily lives. This allows more targeted marketing, and improved algorithms that will show them products they might like.

3.4.2 Large companies capitalising on large consumer data

Large companies can capitalise on huge amounts of customer data, trends, and habits in order to facilitate this new consumer channel, (Gobble, 2013) but this will lead to a challenge in terms of marketing. Amazon, again as the example, have been for several years producing and selling its own brand versions of vast numbers of diverse products from cables, batteries all the way to household items and now, with their purchase of whole foods, even groceries. This means that, if the customers do in fact move to making purchases or shopping via their Smart Home devices, they are poised to sell their own products in place of other brands.

This may pose problems even for the most established big names. This is not a new occurrence as we can look no further than the likes of Tesco who have increasingly marginalised other brands in favour if its own basics and finest ranges. For the customer there may be a cost saving, and in many cases they may not notice a difference in the quality, taste or functionality so this should be a cause of concern for the large established brands who find their name value and recognition being diminished.

For Amazon this is a piece of the puzzle which, when put together makes them the one stop shop for all your items and enables them to profit from all levels of their vertical and horizontal integration. (Gobble, 2013) The simplicity of asking your device for batteries, and the purchase being an Amazon own brand means they win from every angle, but the customer also benefits from the convenience and cheaper cost of the item.

Chapter 4: Methodology

4.1 Introduction

While there are also different definitions as to what online shopping or e-commerce is, the primary focus is that of purchasing or engaging in some of the buying process using the internet via a connected device. From the beginning the term electronic commerce or e-commerce was used to describe this activity, and since the 2010's where people could more easily and readily purchase through smart mobile phones or smart phones, either via their web browser or dedicated application the term mobile commerce, or m-commerce has become more common place both in academic research as well as in common usage.

By 2017 the digital buyer penetration, i.e. those who have a sufficiently fast internet connection and the ability to purchase online was as 46.4 percent according to Statista (Statista, 2020) with Amazon, Apple, Alibaba and Wal-Mart being examples of the major retailers in this field. In 2020 for example, Amazon's sales exceeded $79 billion which accounted for approximately 75% of their entire revenue. (The Guardian, 2020)

More and more though, aside from the big players, smaller retail and brick and mortar stores have been leveraging the relatively low barriers to entry to allow them to sell online and capitalise on e-commerce. Much research has been conducted since the 1970's about consumers attitude to technology and their perceptions of its usefulness and ease of use, which in turn would indicate or influence their willingness or intent to try a certain technology. One of the major models used for this is the Technology Acceptance Model or TAM developed by Davis in 1989. (Davis, 1989).

4.2 The Technology Acceptance Model

For this research, TAM was applied since it is not a general model and relates directly to the usage behaviour of technology. Although initially developed to assess the usage and adoption of technology in the workplace, based on whether the user would find the PC or other device useful in their work and its perceived ease of use, there have been several revisions over the past few years including TAM 2 (Venkatesh and Davis, 2000) which was adapted to include the users intent to use a piece of technology and an expansion to TAM 3 (Venkatesh and Bala, 2008) which allows for external factors such as user experience or trust to be taken into consideration.

4.2.1 Why TAM Was Chosen

TAM then was chosen for this research as the model can be adapted and expanded depending on the purpose and scope of the research and specific variables can be used with it to formulate different hypotheses depending on the technology being studied and the use case for the technology.

It's important to note at this point that TAM3 is used in the case of e-commerce using Smart Home devices here as it assesses and analyses the respondents attitude to the technology and their intention to use it rather than investigating the technology itself. This is important for 2 reasons: For the purpose of this research we are interested in the consumers attitudes towards using the technology while attempting to pass no judgement on the technology itself and secondly, as this is a behavioural measurement it will help to formulate recommendations around the marketing and customer education around the technology rather than suggesting features and functions.

4.2.2 Elements of the TAM Model

TAM is made up of the following elements which are explored:

Perceived Usefulness (PU): Initially this was looked at as the 'degree to which a person believes that using a particular system would enhance his or her job performance.' Obviously in the case of e-commerce and online shopping, unless this forms a core function of the persons role, this is probably not accurate, however as the model was constructed in the 80's long before most people had home PC's and before the mass adoption of smart phones, this seemed like a good definition. For our purposes, the underlying element is the same, will this enhance the person's day to day life or make them more efficient or productive. What we will specifically look at is whether the ability to purchase using a Smart Home device will save them time and effort, and therefore make their home and daily life easier.

In order to measure this, seven statements were created to measure whether their perception is that using this technology would save them time and make their day more efficient. Again it's important to note that in all of these elements of TAM we are not measuring whether there is in fact an impact on their day, but rather their perception of this as this will help to inform whether they would use the technology.

For perceived usefulness questions please see Appendix 1, part 1.

Perceived Ease of Use (PEOU): The second looks to assess whether the user perceives that using Smart Home devices, and to make online purchases or engage in e-commerce will be an easy and straightforward process. For this section we are examining their perception of whether they will be able to make purchases with few barriers and little friction. Seven statements are used to gauge the perception of Smart Home devices ease of use for this section.

Again, here we are not examining whether the devices themselves are easy to use, but the customers attitudes and belief that they are easy or difficult. Much research has been devoted to the barriers that are created when a customer finds a technology challenging and it's believed will have a direct impact on their willingness or intent to use the technology. Davis described this section as "the degree to which a person believed that using a particular system will be free from effort". This can be said to be true regardless of whether we are looking at a piece of technology for their job or something in the home so is equally valid for both.

For perceived ease of use questions please see Appendix 1, part 2.

Attitude towards Smart Home e-commerce (ATT): This element is important as the respondents attitude, either positive or negative will have a direct influence, not only on their willingness or intent to try purchasing through Smart Home devices, but also how they perceive everything else about the technology.

This section could be expanded in the future with additional research as there may be a disconnect between a customer's attitude towards e-commerce in general and their attitude towards using Smart Home devices for purchasing and shopping. While the questions here attempted to assess their attitude towards both, there is a high degree of probability that their answers are influenced by the topic of the survey. Seven statements were constructed here to assess their attitude towards Smart Home commerce, 5 of which directly address Smart Home devices and 2 of which refer more generally to e-commerce.

For attitude towards the technology questions please see Appendix 1, part 3.

Intention to use Smart Home commerce (INT): This gets to the heart of the question whether they would actually use the technology and perform e-commerce using Smart Home devices.

As before we are not measuring whether they have in fact engaged in the action or their experiences around this, but their intention to do so. There is an interesting point here as there is a possibility that some of the respondents have already tried Smart Home commerce and therefore their perceptions and willingness could be markedly different, however this is outside the scope of this research.

Seven statements were again used 4 of which directly reference Smart Home devices and 3 are more generally about e-commerce and online purchasing. Again it is difficult to separate the technology here from traditional e-commerce as the Smart Home devices simply offer a new channel or method for the consumers to purchase and further research or follow up would be necessary to see if the general answers provided here are impacted by the previous questions about Smart Home devices.

For intention to use questions please see Appendix 1, part 4.

4.2.3 Extension to the TAM Model

The 4 elements above all originate from the TAM model, but as mentioned the decision to adopt the TAM3 for this research is its flexibility and with this in mind 3 additional elements will be added consisting of 7, 5 and 5 questions. The most crucial of these being the first element, that of **Trust (TRUST).** Consumer trust and the fears around online security and fraud as well as the misuse of personal data have become more are more prevalent and hinder perceived usefulness. (Kim et al, 2017). Mindful that Trust is a key factor when reading about Smart Home technology in the media at the moment, as well as explored in the past as a vital role in the relationship between businesses and their consumers this will be an important factor to investigate. In effect, according to Jarvenpaa, Tractinsky and Vttale (2000) the customer is in a sense vulnerable to the seller and the customer has little control over the actions of the vendor. This is even more true in the case of purchasing using Smart Home devices as less information is provided at point of sale.

Trust is often cited as one of the primary reasons why consumers choose not to engage with a seller online or do not complete a transaction. It will be important for the seller therefore to show that they have nothing to gain by cheating the customer and that there are relevant and effective security systems in place. However, Gefen et al in 2003 (Gefen et al, 2003) noted that having a typical interface and one that is easy to use were important factors, both are

questionable when it comes to purchasing through Smart Home devices. With that in mind it is important to get information about the perception of trust around Smart Home devices specifically.

For trust questions please see Appendix 1, part 5.

There have also been previous studies around e-commerce which have introduced elements such as website usability and overall customer service as additional factors that influence the decisions made and the intention to use by respondents.

Based on this, the TAM model here will be adapted to include:

1) **User Experience (UX)**, which takes a similar view to website design, in that it explores the interface that the customer has to use in order to make purchases, however as these Smart Home services are either automated or voice controlled user interface is a more general term to describe the interaction between the user and the purchasing. As Smart Home devices are attempting to use a more natural interface the responsiveness and interactivity may be critical in the customer experience and therefore their intention to use.

2) **Customer Service (CS)** there are fundamental differences between purchasing via a website where you may have the option of seeing reviews, returns policies and even web chatting with customer service reps, absent when buying using Smart Home devices. While the term customer service will be used, this will investigate how they feel the customer service, after service and overall marketing and use of their data in the sales experience will impact their buying and decision making.

For UX and CS questions please see Appendix 1, part 5.

4.4 Revised TAM Model & 5 Point Likert Scale

Using the elements above a revised version of the Technology Acceptance Model 3 has been created which includes the original elements as well as adding trust as an important factor towards the attitude towards using the devices to purchase or to shop as well as the intention to use said devices. Using this model and the proposed questions with answers graded on a 5-point Likert scale the aim is to test the following hypotheses:

4.4.1 Hypotheses

- Hypothesis 1: Perceived usefulness of using Smart Home devices has a direct impact on attitude towards Smart Home purchasing.
- Hypothesis 2: Perceived usefulness of using Smart Home devices has a direct impact on intention to use Smart Home purchasing.
- Hypothesis 3: Ease of use has a direct impact on the perceived usefulness of Smart Home purchasing.
- Hypothesis 4: Ease of use has a direct impact on the intention to use Smart Home purchasing.
- Hypothesis 5: Attitude towards Smart Home technology will have a direct impact on the perceived usefulness of Smart Home purchasing.
- Hypothesis 6: Attitude towards Smart Home technology will have a direct impact on the intention to use Smart Home purchasing.
- Hypothesis 7: Trust and the perception of security will have a direct impact on the intention to use Smart Home purchasing.
- Hypothesis 8: Trust and the perception of security will have a direct impact on the attitude towards Smart Home purchasing.
- Hypothesis 9: Customer service from the suppliers will have a direct impact on the intention to use Smart Home purchasing.
- Hypothesis 10: User experience and overall interface will have a direct impact on the intention to use Smart Home purchasing.

Chapter Five: Statistical Results and Initial Findings

5.1 Questionnaire

The questionnaire was broken into 8 sections, 7 for each of the above-mentioned elements followed by a section to capture some basic demographics about the respondent. The surveys were sent using a variety of mediums including e-mail, social media, word of mouth as well as the direct connections and extended networks of the researcher. A 5-point Likert scale was used as this has been used in similar research around e-commerce and technology adoption using the TAM model in previous studies including Mikoska (2017) which expressly looked at similar elements to validate their hypotheses around the impact of the same core elements on e-commerce adoption in developing markets.

The survey was open from July to August 2020 and received a total of 200 respondents, however of those 46 were incomplete and therefore were disqualified as they contained missing data, or the respondent failed to complete fully the survey. In total this represented 23% of the total replies, a completion rate of 77% in total. There were 52 questions in total on each survey, not including the opening consent question for the respondent to take part in the study meaning the entire dataset consists of 20,800 data points not taking into consideration the demographic data on the respondents.

5.2 Demographics

When we look at the demographics below, we can observe that most of the respondents are full, or part time employed and in the age group between 35-44. The breakdown of the respondents is male at 46% versus 52% female. The majority (75.97%) would shop or make purchases online more than once per month, so it would stand to reason that they are an ideal target audience or market for manufacturers who wish to promote Smart Home commerce.

Interestingly the percentage using their phone as the primary device for e-commerce is lower at 42.86% versus the global 70% reported by Statista (Statista 2020). This may warrant further research into specific regions or markets where the use of mobile is greater and the driving factors behind this.

Table 1: Demographics of respondents

Demographics	Categories	Percentage	Frequency
Gender	Male	46.75%	72
	Female	52.60%	81
	Other	0.00%	0
	Prefer not to say	0.65%	1
Age	18-24	1.30%	2
	25-34	30.52%	47
	35-44	45.45%	70
	45-54	14.29%	22
	55-64	4.55%	7
	65+	3.90%	6
Education	Secondary School	3.25%	5
	Professional Qualification or Similar	9.09%	14
	3rd Level Diploma or Equivalent	11.69%	18
	3rd Level Degree or Higher	72.73%	112
	Other	3.25%	5
Occupation	A full-time student or engaged in full time studies	1.95%	3
	Full or part time employed	81.82%	126
	Other	16.23%	25
Online Shopping	Every day	1.95%	3
	A few times a week	25.32%	39
	About once a week	20.78%	32
	A few times a month	27.92%	43
	Once a month	14.29%	22
	Less than once a month	9.74%	15
	Never	0.00%	0
Device Used	Laptop / Desktop PC or Tablet Device	56.49%	87
	Mobile Phone	42.86%	66
	Smart Home Device	0.65%	1
	I do not shop or buy items online	0.00%	0

Table 1: Demographics of respondents

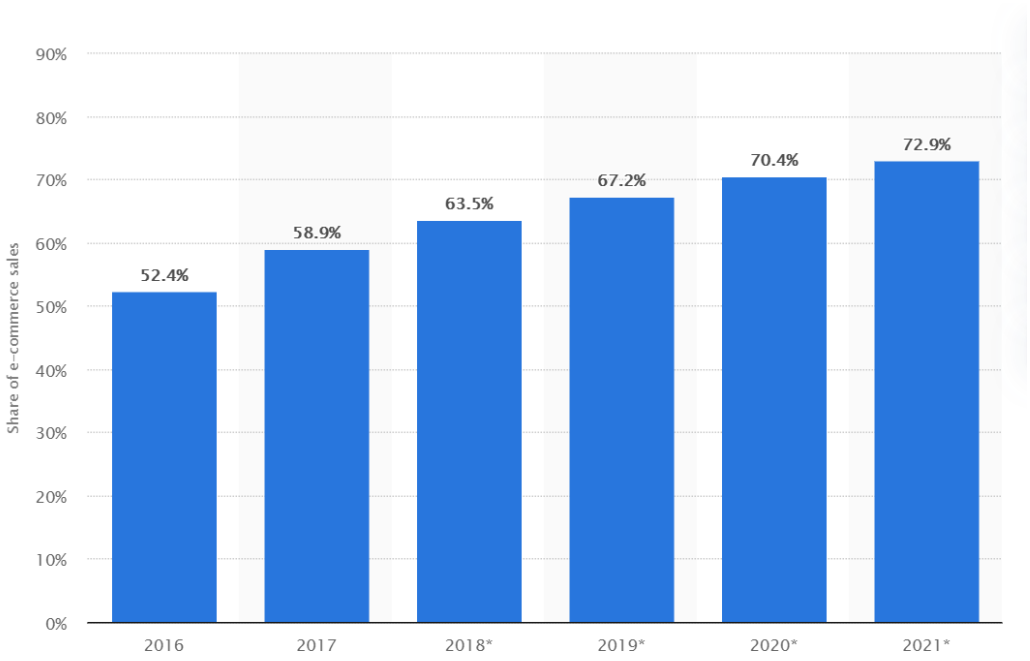

Figure 2: Global mobile retail commerce sales share 2016-2021 (Statista, 2020)

Taking each of the 7 elements of the Technology Adoption Model a simple descriptive statistical analysis was performed. Unexpectedly, the trust construct had the lowest mean value which indicates it may be the least important for the users. While the highest were ease of use and attitude towards Smart Home e-commerce.

Table 2: Mean & Standard Deviation

Variables	Mean	Standard Deviation
Perceived Usefulness	3.1543	0.2612
Perceived ease of use	3.6129	0.3099
Attitude towards Smart Home e-commerce	3.3343	0.1437
Intention to try Smart Home e-commerce	3.2971	0.7113
Trust	2.8057	0.2908
User Experience	3.2640	0.1297
Customer Support / Service	2.7360	0.4277

Table 2: Mean & Standard Deviation

5.3 Sample size

The survey captured a total of 154 completed questionnaires. While the survey was not aimed at any country or target market, it was primarily given to Irish residents, however as the data was anonymous it is possible there is a small percentage of survey respondents from outside Ireland. If we were to look at the sample size relative to Ireland, which given Ireland's current population of 4,937,786 according to the most recent UN data, gives us a sample confidence level of 95% with a confidence interval of 7.9. In further research it would be wise to obtain a sample size of approximately 384 for a confidence interval of 5 if we wanted to specifically look at the Irish market. It would also be necessary to capture country data such as IP address to ensure that the respondents were indeed in the Irish market, and any from outside potentially excluded.

5.4 Internal Consistency

Before we proceed with any further analysis on the responses, it is necessary to determine if the survey used and the Likert scale applied to it were a reliable measure. In other words are the responses and the data a true reflection of the respondents state of mind and true feelings at the time, or, if they were to take the test again back to back with the same perceptions, would the survey give us different results. To measure this reliability or 'internal consistency' a Cronbach's Alpha test was applied.

Cronbach's alpha gives us a simple way to measure whether a score is reliable. It is used under the assumption that you have multiple items measuring the same underlying construct: for example, in this survey we aimed to measure 7 elements above with a series of questions. For anything above a level of 0.70 which is the generally accepted level (Taber, 2018) we can state that the values and data are sufficient for further study. This is the case for all the elements in this construct. Overall, the construct had a Cronbach's Alpha of 0.9626 (Table 3: Cronbach's Alpha) which indicates a strong internal consistency.

Table 3: Cronbach's Alpha

Cronbach's Alpha	
Number components	45.0000
Sum of variances	45.23237477
Variance of total scores	768.7939
Cronbach's Alpha	0.9626

Table 3: Cronbach's Alpha

Each individual element or component was also tested to ensure that the constructs were also individually consistent and therefore an accurate representation of the current beliefs and mindset of the respondents. All proved to be strong with 3 of 7 above 0.9, and the lowest, user experience at 0.7750 still above the accepted level of 0.7. Based on this the decision was made to continue with further analysis although a more refined survey may be advised to align the lower scoring elements more closely to the higher scoring ones at a later stage.

Table 4: Variables with Individual Cronbach's Alpha Scores

Variables	Number of Components	Cronbach's Alpha
Perceived Usefulness	7	0.9112
Perceived ease of use	7	0.9220
Attitude towards Smart Home e-commerce	7	0.8955
Intention to try Smart Home e-commerce	7	0.7846
Trust	7	0.9004
User Experience	5	0.7750
Customer Service	5	0.7964

Table 4: Variables with Individual Cronbach's Alpha Scores

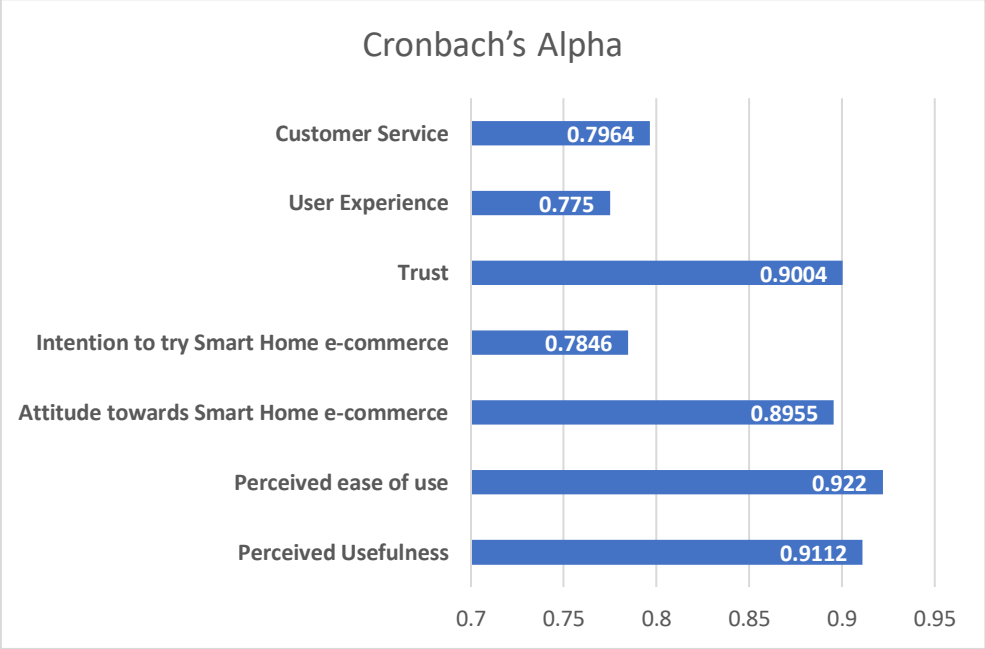

Figure 3: Cronbach's Alpha Bar Chart

5.5 Correlation and regression analysis

Before looking at the 10 hypotheses that have proposed investigating for this research it was then necessary to determine if there was a strong correlation or relationship between each of the elements of the construct used. In other words, is there a strong relationship between each of the areas tested and the others in the construct. If there proves to be a strong correlation then it is possible to analyse if one has a positive effect on another, and therefore we can examine our hypotheses.

To do this, Pearson's correlation was used, (Pearson, 1896) and the results displayed in a matrix below (table 5). Pearson's correlation coefficient (r) is a measure of the strength of the association between the two variables and positive scores indicate a positive relationship whereas negative scores would indicate a negative relationship. A score of 0.1 to 0.3 is considered small correlation, 0.3 to 0.5 medium and scores between 0.5 and 1.0 a large correlation, with above 0.7 considered a strong correlation. (Lee Rodgers and Nicewander, 1988).

A correlation analysis was performed based on each of the constructs defined in the research model. The results of the correlation analysis are given in the Table 5 below. All coefficients proved to be significant, with only the relationships between perceived ease of use and the attitude towards the technology and perceived ease of use and customer service showing the smallest 'medium' which at below 0.4 is often referred to as a 'weak' correlation. This may indicate that customer service and ease of use are not large factors for consumers in today's e-commerce literate world, or perhaps the lack of understanding and experience of using Smart Home technology plays a factor here. This would merit further study and research.

The strongest correlation observed is that of the relationship between the attitude towards the Smart Home e-commerce and the intention to use the technology. This would tend to back up previous research conducted and was mirrored in the literature review where attitude plays a large role in a customer's intention to try a particular technology.

Table 5: Pearson correlation matrix of study variables

	Perceived Usefulness	Perceived ease of use	Attitude towards Smart Home e-commerce	Intention to try Smart Home e-commerce	Trust	User Experience	Customer Service
Perceived Usefulness	1						
Perceived ease of use	0.4278	1					
Attitude towards Smart Home e-commerce	0.7791	0.3985	1				
Intention to try Smart Home e-commerce	0.7528	0.4356	0.7838	1			
Trust	0.5867	0.4513	0.6698	0.6385	1		
User Experience	0.6276	0.5501	0.6384	0.6532	0.6869	1	
Customer Service	0.5309	0.3153	0.5976	0.5373	0.6582	0.6517	1

Table 5: Pearson correlation matrix of study variables

	Perceived Usefulness	Perceived ease of use	Attitude towards Smart Home e-commerce	Intention to try Smart Home e-commerce	Trust	User Experience	Customer Service
Perceived Usefulness	1						
Perceived ease of use	MEDIUM	1					
Attitude towards Smart Home e-commerce	LARGE / STRONG	MEDIUM / WEAK	1				
Intention to try Smart Home e-commerce	LARGE / STRONG	MEDIUM	LARGE / STRONG	1			
Trust	LARGE	MEDIUM	LARGE	LARGE	1		
User Experience	LARGE	LARGE	LARGE	LARGE	LARGE	1	
Customer Service	LARGE	MEDIUM / WEAK	LARGE	LARGE	LARGE	LARGE	1

Table 6: Pearson correlation matrix of study variables (Simplified)

As it can be seen from the matrix, there is a significant relationship between the intention to online shopping and attitude towards Smart Home e-commerce as well as the perception of its usefulness. While the perceived ease of use shows a smaller correlation to the intention to use. Although the relationship varies in strength from one construct to another, with most of the correlations being medium to strong, the decision was taken too continue to test the proposed hypotheses against these correlations.

Now that we have identified the correlation between the different elements of the construct, we need to determine if these elements have an impact on the others. What we are looking to examine is, now that we know there is a strong relationship between the elements of our TAM survey, is there also a measure of the impact one will have on the other. I.e. will perception have a quantifiable impact on the intention to use Smart Home e-commerce? Or will the perception that there is trust between the consumer and the supplier have a positive effect on the intention?

To do this the results from above were put through a regression analysis test to determine the impact one element had on another, and therefore whether we could make a claim about the proposed hypotheses.

Regression analysis is a reliable method of identifying which variables have impact on a topic of interest. The process of performing a regression allows you to confidently determine which factors matter most, which factors can be ignored, and how these factors influence each other. Using the 10 hypotheses, regression analysis was performed on the following relationships to determine how each impacted each other.

Table 7: Hypotheses Relationships

Element 1 – Element 2	**Short Code**
Perceived Usefulness (PU) – Attitude towards Smart Home purchasing (ATT)	PU-ATT
Perceived Usefulness (PU) – Intention to try Smart Home purchasing (INT)	PU-INT
Perceived Ease of Use (PEOU) – Perceived Usefulness of Smart Home purchasing (PU)	PEOU-PU
Perceived Ease of Use (PEOU) – Intention to try Smart Home purchasing (INT)	PEOU-INT
Attitude towards Smart Home purchasing (ATT) – Perceived Usefulness (PU)	ATT-PU
Attitude towards Smart Home purchasing (ATT) – Intention to try Smart Home purchasing (INT)	ATT-INT
Trust and the perception of security (TRUST) – Intention to try Smart Home purchasing (INT)	TRUST-INT
Trust and the perception of security (TRUST) – Attitude towards Smart Home purchasing (ATT)	TRUST-ATT
Customer service (CS) – Intention to try Smart Home purchasing (INT)	CS-INT
User Experience (UX) – Intention to try Smart Home purchasing (INT)	UX-INT

Table 7: Hypotheses Relationships

In the Table below, we summarize the findings regarding the research hypotheses.

Table 8: Hypothesis testing results from regression analysis

Hypothesis	Variable	β
Hypothesis 1: Perceived usefulness of using Smart Home devices has a direct impact on attitude towards Smart Home purchasing.	PU-ATT	0.7282
Hypothesis 2: Perceived usefulness of using Smart Home devices has a direct impact on intention to use Smart Home purchasing.	PU-INT	0.8788
Hypothesis 3: Ease of use has a direct impact on the perceived usefulness of Smart Home purchasing.	PEU-PU	0.4232
Hypothesis 4: Ease of use has a direct impact on the intention to use Smart Home purchasing.	PEU-INT	0.5031
Hypothesis 5: Attitude towards Smart Home technology will have a direct impact on the perceived usefulness of Smart Home purchasing.	ATT-PU	0.8336
Hypothesis 6: Attitude towards Smart Home technology will have a direct impact on the intention to use Smart Home purchasing.	ATT-INT	0.9789
Hypothesis 7: Trust and the perception of security will have a direct impact on the intention to use Smart Home purchasing.	TRUST-INT	0.7398
Hypothesis 8: Trust and the perception of security will have a direct impact on the attitude towards Smart Home purchasing.	TRUST-ATT	0.6214
Hypothesis 9: Customer service from the suppliers will have a direct impact on the intention to use Smart Home purchasing.	CS-INT	0.4664
Hypothesis 10: User experience and overall interface will have a direct impact on the intention to use Smart Home purchasing.	UX-INT	0.4339

Table 8: Hypothesis testing results from regression analysis

All predicted relationships proved to be significant and all the tests showed that the is a positive relationship between the elements in each of the hypotheses. From the above it can be observed that H6: 'Attitude towards Smart Home technology will have a direct impact on the intention to use Smart Home purchasing' showed the strongest positive relationship. H3: 'Ease of use has a direct impact on the perceived usefulness of Smart Home purchasing' while still having a positive relationship, had the smallest out of the 10 hypotheses proposed.

From the regression analysis and the proved relationships between constructs we can conclude that the modified TAM3 model that is tested is good representation of real factors influencing online shopping behaviour among respondents in the sample market.

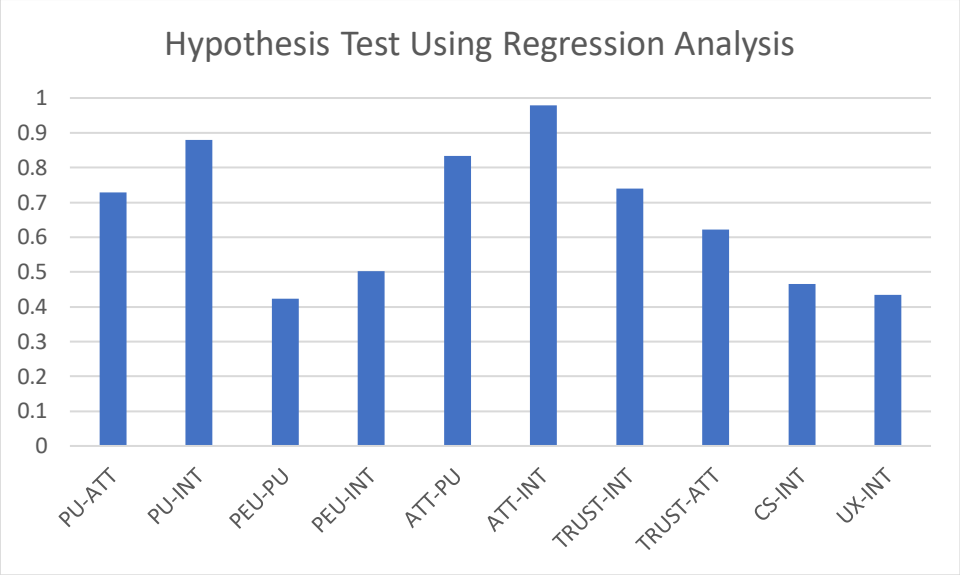

Figure 4: Hypothesis Testing Using Regression Analysis

It would be interesting to do further research on customer service and user experience as this researcher had anticipated a larger impact from these, however it is possible that the largely tech literate respondents combined with the increasing comfort level of e-commerce means that the impact of these may be diminished with the introduction of new technology.

Overall, from the regression analysis and the proved positive relationships between all the elements in the construct, we can conclude that the modified TAM3 model that is tested is a good representation of factors influencing the attitudes and intention towards Smart Home e-commerce within the sample group.

Chapter Six: Findings of the Research

6.1 Introduction

During research for this paper it was apparent that the attitude of consumers played a considerable role in the intention of the person to adopt a new technology. (Liljander et al, 2006). As the Technology Acceptance Model was specifically aimed at the attitudes and intention towards technology rather than any other product or service it was ideal to measure this. Broadly the findings of the research were in line with what had been anticipated in that there was an interest in the idea of Smart Home commerce, but the attitude towards the technology played a large part in deciding whether a customer would actually try.

What was also of note, in contrast to previous studies around e-commerce adoption and mobile e-commerce adoption, customer service and user experience played less of a role than expected. This may be attributed to the fact that online shopping and mobile shopping is not new and the experiences of the consumers have been standardised to an extent and there may be less anxiety around shopping online than there had been in previous years. This would warrant further study to see if technology anxiety is still a factor for many people or if this paper's research caught a sample of tech literate users.

This would make sense as approximately 76% of the respondents in the survey stated that they shop or make purchases online between a few times a month and every day. This reinforces the idea that the consumers are more comfortable with online shopping and customer service and experience are less factors as they are comfortable with the terms and conditions, after sales service as well as the overall buying online experience.

Table 9: Online Shopping Frequency

Online Shopping	Every day	1.95%	3
	A few times a week	25.32%	39
	About once a week	20.78%	32
	A few times a month	27.92%	43

Table 10: Online Shopping Frequency

6.2 Demographics

The two largest demographics that responded to the survey were the 25-34 age bracket and the 35-44 age bracket at 30% and 45% respectively. This is a positive sign for retailers as these

constitute two of the largest brackets in terms of purchasing power, marketing spends and technology usage.

The 18-24 provided less replies and this may be as this has a high percentage of renters and students, and renters are less likely to use Smart Home devices (Balta-Ozkan, Boteler and Amerighi, 2014). There are two potential reasons for this; firstly, the cost of the devices may be outside of their purchasing power as they are new and as a result a luxury item even in the tech space. Secondly, the adoption of Smart Home devices is most prevalent with homeowners and long-term renters as they tend to augment their living space with these devices. (Balta-Ozkan, Boteler and Amerighi, 2014).

6.3 Hypotheses

As observed above, all 10 hypotheses showed positive impacts. The thing that companies are looking for first and foremost is whether or not the consumers actually intend to try the technology. Before looking at what they potentially need to do in terms of understanding their clients, it's important to look at the results of the consumers intention to use the technology.

6.3.1 Hypotheses Surrounding Intention to Use

For this let us look at the results of the hypotheses surrounding the intention to use the technology.

A) *Hypothesis 2: Perceived usefulness of using Smart Home devices has a direct impact on intention to use Smart Home purchasing:*

From the results (β 0.8788)we can state that if a consumer perceived that they would find a benefit in using Smart Home technology for e-commerce this would have a strong positive impact on whether or not they intend to use the technology.

For companies looking to get customers to adopt this channel for online purchasing its important therefore to illustrate the benefits of this method. There are some that are self-evident such as using voice to make purchases rather than having to open a mobile device or PC, but there is also the potential to allow customers to allow their devices to make purchases for them.

B) *Hypothesis 4: Ease of use has a direct impact on the intention to use Smart Home purchasing.*

While not as important according to our research (β 0.5031), it is still important that customers do not have additional barriers in their purchasing experience. Any challenges or complications could potentially lead to a negative experience and mean the customer will not try this channel again. As already discussed, though this may be less of an issue as people are more accepting of technology and many younger people for example do not know or feel any technology anxiety as previous generations may have done. (Yang and Forney, 2013).

C) *Hypothesis 6: Attitude towards Smart Home technology will have a direct impact on the intention to use Smart Home purchasing.*

By far the strongest impact we can observe from the research is the correlation between people's attitude to Smart Home technology and their intention to use the technology for online purchases. (β 0.9789) This high figure indicates that there is an 'almost' perfect relationship between a customer's attitude towards the technology and whether they are prepared to make the leap to online purchasing using it.

In the case of this research, based on the positive questions that were asked we can confidently state that if the customer has a good impression of Smart Home technology, they are inclined to try making a purchase. Interestingly the mean score in terms of the attitude towards the technology was 3.33 which shows that there is a moderately positive attitude to the technology which coincides closely with the mean score of 3.29 in the element regarding the intention to use the technology for e-commerce.

In other words, this research would indicate that there is a moderately positive attitude towards Smart Home technology, and those who have this positive attitude would be strongly impacted to try the technology for e-commerce.

While this doesn't go into the specifics of why people would or would not have a positive attitude towards Smart Home technology it is a good indicator that if companies could paint the technology in a good light then people would be more inclined to purchase using this medium.

D) *Hypothesis 7: Trust and the perception of security will have a direct impact on the intention to use Smart Home purchasing.*

As noted throughout the research, the trust element has proven to be a strong factor in terms of whether people adopt a technology. In e-commerce this has been with respect to the safety and security of the site, the protection of credit card or payment details, and whether there is a perception that the seller is acting in good faith. This again plays a strong role here, (β 0.7398) but again this may require further in depth study as to whether the traditional factors such as customer data, reliability and the belief that the seller is acting with good intent are still at play or if there is a new element or tangent because of the nature of the technology.

E) *Hypothesis 9: Customer service from the suppliers will have a direct impact on the intention to use Smart Home purchasing. (β 0.4664)*

With one of the lowest impact scores according to this research, although there is a positive relationship between customer service and the customers intention to try Smart Home e-commerce, it is not as strong as this researcher had expected. Again, as with factors above, this may be because of people being more comfortable and familiar with e-commerce as well as the challenges and dangers of buying online. Further study could differentiate whether this is the case or if the respondents have not yet considered how customer service and after sales might be different when purchasing using a Smart Home device as opposed to the traditional PC or mobile device.

F) *Hypothesis 10: User experience and overall interface will have a direct impact on the intention to use Smart Home purchasing. (β 0.4339)*

This result was among the more interesting results as there is a paradigm shift in the interaction with how a consumer will interact with these devices and therefore make their purchases versus the mouse, keyboard and / or screen from PC's or mobile devices. This again may not necessarily be a factor for an increasingly tech literate and savvy population, but it is interesting that this does not seem to have more of a correlation on whether people are inclined to use Smart Home devices for purchases. Suggested future research may focus on the experience and the act of using the technology in real world situations to see if this has a different result on the intention.

6.3.2 Hypotheses Surrounding Attitude Towards the Technology

When we look at the results of Hypothesis 1 and Hypothesis 8, we see that attitudes are impacted strongly by perceived usefulness. This tells us that only if a consumer sees a real use for or a need to make purchases will they have a positive attitude towards the technology. This may be a learning point for large organisations and e-commerce stores who will need to drive home the sense of urgency or need around using this new channel.

A) *Hypothesis 1: Perceived usefulness of using Smart Home devices has a direct impact on attitude towards Smart Home purchasing.* (β 0.7287)

What is interesting is that trust appears to play a lower impact in this regard than the usefulness. Again, this supports the notion that convenience will win out over the concerns about privacy and security. (Lau, Zimmerman, and Schaub, 2018).

B) *Hypothesis 8: Trust and the perception of security will have a direct impact on the attitude towards Smart Home purchasing. (β 0.6214)*

6.3.3 Hypotheses Surrounding Perceived Usefulness

The low impact score between the ease of use and the perceived usefulness (β 0.4232) is interesting, and again suggests that either this group of respondents is tech savvy or that the ease of use is less of a factor, and even if something is deemed difficult to use it may still be useful to the consumer.

A) *Hypothesis 3: Ease of use has a direct impact on the perceived usefulness of Smart Home purchasing.*

By contrast though the attitude people have towards the technology plays a large part of their perception as to its usefulness. (β 0.8336) This would suggest that the suppliers of this technology will need to ensure that the attitude of its users and potential customer base is positive which would lead to more consumers converting to seeing them as useful devices for e-commerce.

B) *Hypothesis 5: Attitude towards Smart Home technology will have a direct impact on the perceived usefulness of Smart Home purchasing.*

6.4 Overall Results

Overall, this study has shown a clear relationship between customers attitudes to this new technology and their willingness to use it. The survey proved internally consistent and therefore could be said to have provided a clear representation of the respondent's attitudes and perceptions at the time. There are clear areas from these results that could be built upon to further understand the attitudes of potential consumers and provide insights to the companies looking to capitalise on this potential new e-commerce channel.

Chapter Seven: Conclusions, Limitations and Recommendations

7.1 General

This research, very much following on from previous work around adoption of general PC based e-commerce and subsequently mobile e-commerce, was aimed to be a continuation of this work while looking at a new medium to engage in online purchasing, that of Smart Home devices.

7.2 Authors thoughts and further considerations

While there are significant barriers to the mass adoption of this new method of e-commerce the benefits to both the consumer and the retailer are clear, however there is a possible implied bias towards the companies that provide the smart technology or their partners. If Samsung sell you a smart fridge that allows purchases from, for example, the touch screen at the front of the door, it stands to reason they will want to capitalise on the transactions that take place using this technology.

While this may or may not be the case it is a model that Amazon are already actively pursuing in their own brands and the integration with their Smart Home assistants, however in the case of Amazon, they will still benefit from you purchasing from any brand or supplier through the device as you are still using the Amazon shopping platform to complete the transaction and therefore the seller is paying a percentage premium to sell you the product. Amazon wins either way.

For the consumer, at present there is a user interface and user experience challenge, but the research indicates that consumers are willing to work past these. This combined with the fact that the AI, or artificial intelligence, is limited at the moment and may not necessarily understand if you ask to order brand X versus brand Y, so there is a possibility of incorrect products being ordered. Moreover, there is a notable delay currently with voice commands and their completion. This is dependent on the speed of the connection to the internet, the complexity of the voice command and the power of the AI on the platform. This means that the experience is not as fluid for the customer as the companies would like and there is the need to confirm actions as well as the AI or voice assistant to confirm that it has understood the instructions and orders.

7.3 Learning Curve

We may also experience a learning curve challenge with this technology. In store we can browse to an aisle to select products and similar products, and see, hold, and interact with them in the real world. Online, while we do not have the tangible product at hand, we at least have a visual and lots of description, specifications, and reviews. If we move to purchasing sight unseen via voice, this will be a shift in the pre-purchasing habits of the customers as they will potentially rely on the memory of the product or the audible descriptions that the device may provide.

In the case of smart devices such as your fridge, you may have a screen to browse, but given that you will be standing in front of the appliance, the providers will want to streamline the interaction as much as possible knowing that the longer the transaction takes and the more they have to investigate themselves, the less likely they are to make a purchase as part of their normal 'daily flow'. We may well simply see representations of products such as a generic icon for milk and the preferences already set in the background, or a simple finger swipe to choose from one brand or another with little or no information or further details, save perhaps the price.

7.4 Move to IOT

All the challenges and barriers above may be exacerbated and highlighted with the move to IoT purchasing. This next step would effectively create peer to peer purchases between technology devices and platforms and eliminate the human interaction completely. Already certain Smart Home devices have this capability and the adoption is growing exponentially.

As an example, if you have a smart device that is battery powered, the device can be set to automatically reorder batteries for itself with no customer interaction once the power level drops below a certain percentage. Your payment details are saved, and the device makes the decision when to purchase based on the need to replace its own power supply. This saves the owner having to worry about the device running out of power as it will order the replacement units but means that this could potentially be an unexpected purchase for the owner.

The same may be true for your milk in the fridge. Just because you have run out of milk does not necessarily mean that you need milk in each period. But without an improvement in the artificial intelligence to understand your usage or a calendar entry such as a holiday, or the increased usage because of guests, all it recognises is that the milk is empty, and it should

order more. If you are then on holiday for the proceeding 2 weeks this is an unnecessary transaction, a waste of money, and an increase in food waste.

It is necessary then for these IOT devices to be interconnected with other technology such as your calendar and it to be coded to recognise that you will be away and therefore not to order until your return, or to understand periods where you are at home more for whatever reason and adjust accordingly. This level of contextual awareness is not present in technology and requires much more advanced coding and pattern recognition before it is at a level where it will change its behaviours based on other triggers.

7.5 Limitations and Suggestions for future research

While this research is in its infancy, it would be wise for the manufacturers and e-commerce giants to consider that the customer's perceptions are critical when it comes to the adoption of this new channel for purchasing. Again, the primary limitation of this research is that it focused on the perceptions of the consumers and not their experiences when using the technology in real life.

There are many questions that need to be answered around whether the technology is at a place where it can be used efficiently for purchasing and are there barriers in terms of the user interface and if so how could they adapt so that the average customer can use easily? What do companies need to do to ensure a smooth and frictionless transition for customers? Is there an education needed for the consumers or, more importantly have consumers reached an impasse with privacy and security with this radical new technology portal or will convenience override this as it has in the past with online shopping?

7.5 Final Thought

Finally, even if someone tries Smart Home e-commerce, this is not the same as continuous usage and as highlighted by Almazroa and Gulliver "continuance usage is less studied when compared to the adoption research." (Almazroa and Gulliver, 2018) Once the technology becomes more widely utilised, study into repeated usage, trends and patterns is advisable.

Thank you.

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Appendix 1: Survey Questions:

Part 1: Perceived usefulness of Smart Home technology commerce (7)

Please choose on a scale of 1-5 (1 = Strongly Disagree, 5 = Strongly Agree)

[(1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly Agree]

1. Smart Home technology devices would help me to make purchases and shop more quickly and save time.
2. Using Smart Home devices to make purchases would save me money
3. Smart home devices would make it easier to make buying and shopping decisions.
4. Using Smart Home devices to shop and make purchases would make me more productive in my day.
5. Using Smart Home devices to shop and make purchases would be a more effective use of my time.
6. Using Smart Home devices to shop and make purchases would make my daily life easier.
7. I would find purchasing and shopping via Smart Home technology useful in my daily routine.

Part 2: Perceived ease of Use Smart Home Commerce (7)

Please choose on a scale of 1-5 (1 = Strongly Disagree, 5 = Strongly Agree)

[(1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly Agree]

1. Learning to make purchases using Smart Home devices would be easy for me.
2. I would find it easy to get Smart Home devices to purchase what I want and do what I want them to do.
3. I would understand and be able to interact with these devices easily.
4. I would find it easy to find the right products I am looking to purchase using Smart Home commerce.
5. It would be easy for me to become skilful at using Smart Home commerce.
6. I would find Smart Home commerce overall easy to use.
7. I find Smart Home devices overall easy to use.

Part 3: Attitude towards Smart Home Commerce (7)

Please choose on a scale of 1-5 (1 = Strongly Disagree, 5 = Strongly Agree)

[(1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly Agree]

1. Purchasing at home from devices is more convenient and simpler than a retail store.
2. I enjoy the process of buying online and would likely enjoy Smart Home buying in the future.
3. I have a positive attitude towards Smart Home commerce.
4. I like the idea of using Smart Home devices to make some purchases.
5. I believe I could find the right products I am looking to purchase using Smart Home commerce.
6. Making shopping and purchases easier as part of my daily routine is important to me.
7. Shopping and making purchases using Smart Home devices would be fun or interesting.

Part 4: Intention to Try Smart Home commerce / online purchasing (7)

Please choose on a scale of 1-5 (1 = Strongly Disagree, 5 = Strongly Agree)

[(1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly Agree]

1. I would probably try Smart Home commerce / online purchasing in the future.
2. I would allow Smart Home devices to make some purchases for me.
3. I would use Smart Home commerce more than once if I had a good experience purchasing.
4. I'm comfortable with the idea of not seeing or researching my product before purchase.
5. I would buy things online that I would not necessarily purchase in a traditional store.
6. I would tend to use the same websites and services to make purchases or to shop.
7. I would prefer to use Smart Home devices to make a routine purchase than going into a retail store.

Part 5: Trust (7)

Please choose on a scale of 1-5 (1 = Strongly Disagree, 5 = Strongly Agree)

[(1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly Agree]

1. I believe that Smart Home devices will adequately protect my personal data.
2. I believe I am safe against fraud and online theft using Smart Home devices.
3. The companies providing these devices are reliable and trustworthy.
4. I am confident of getting the correct product or service ordered.
5. I believe my payment details are safe and secure using Smart Home devices.
6. I believe I can rely on the technology to function correctly when I purchase.
7. I believe that the companies providing these devices and services will not mishandle my personal information.

Part 6: External Factors (10)

Please choose on a scale of 1-5 (1 = Strongly Disagree, 5 = Strongly Agree)

[(1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly Agree]

I have hypothesized the influence of Smart Home device usability and customer service on the perceived usefulness defined and measured through 5 and 5 statements respectively)

1. Using the Smart Home devices will be quick and natural buying experience.
2. The Smart Home devices will be able to understand my wants and preferences.
3. I will be given enough detailed information using the device before purchasing.
4. Initial setup and registration will be simple and straightforward.
5. Smart Home devices will have less steps to buying than online stores.
6. The suppliers will actively sell me the best product for my needs and wants.
7. Smart Home solutions will provide clear policies and support.
8. Ads and other targeted marketing will not be intrusive using this technology.
9. I will be able to cancel or return as easily as if I purchased from a website.
10. My personal data will not be used by 3rd parties to sell me additional products.