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Hertfordshire Business School Working Paper (2014)

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INVESTIGATING THE ADOPTION AND USE OF SMARTPHONES IN THE UK: A SILVER-SURFERS PERSPECTIVE

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Abstract

Smart phones are innovations that currently provide immense benefits and convenience to users in society. However, not all members of society are accepting and using smart phones; more specifically, for this research study silver-surfers or older adults (50+) are a demographic group displaying such an attitude. Currently, there is minimal knowledge of the reasons for older adults adopting and using smartphones. Bearing this in mind, this research study aims to investigate the adoption and usage behaviours of silver-surfers. For this purpose, the conceptual framework applied to this research draws factors from the following theories: Unified Theory of Acceptance and Use of Technology (UTAUT), the Diffusion of Innovations theory (DoI), and TAM3 (Technology Acceptance Model). From the online survey of 204 completed replies it was found that observability, compatibility, social influence, facilitating conditions, effort expectancy and enjoyment are important to the adoption and use of smartphones within silver-surfers. The contributions of this research are an identification and understanding of the factors that encourage or inhibit smartphone use within the older adult population. Second, this research can inform the design of computing devices and applications used for silver-surfers. Finally, this research can enlighten policy makers when forming decisions that encourage adoption and use of smartphones among silver surfers.

***Keywords**: Smartphones, mobile phones, adoption, silver-surfers, older adults,*

1 Introduction

Over the last decade, Information and Communication Technologies (ICTs) have significantly advanced. Admittedly, computing devices, such as laptops, netbooks, tablets and smartphones, have an important role in businesses, education and personal life (Condie and Munro, 2007; Galloway *et al.*, 2004; Line *et al.*, 2011; Selwyn *et al.*, 2003a). These technologies provide benefits for users as they access and manage information faster and easier. Since 1996, one of the fastest growing novel technologies in the mobile phone market is a smartphone. Since its introduction, the numbers of smartphones have reached an estimated 1 billion and expected to reach 2 billion in 2015 (Rushton, 2012). Since 2005 in the United Kingdom (UK), which is the context of this research study, there have been approximately 33 million smartphones sales (Ofcom, 2011b). What has also been learnt is that the arrival of smartphones has impacted not only how people communicate but also business, entertainment and journalism (The Denver Post, 2012). In terms of usage, smartphones can benefit users by providing information, entertainment, travel, healthcare, lifestyle, photography and social networks (Xu *et al.*, 2011).

Mobile phone, a telephone used in wide area wirelessly connect cellular radio system is an umbrella word covering basic phone, feature phone and smartphone (Chang *et al.*, 2009; Oxford Dictionaries, 2014). Basic phone features focus on voice communication and simple services such as Short Message Service (Min *et al.*, 2009; Patel *et al.*, 2011). A feature phone is a less powerful and has a smaller screen compared to a Smartphone. It also provides internet connections, but not using a 3G network. Feature phones also do not proffer application or software downloading. Moreover, the browsing feature is limited for a feature phone (Bridges *et al.*, 2010).

As the term 'smartphone' is used within the paper and is the mobile device of interest, a definition of the device is provided. A Smartphone is defined as a mobile device that allows users to make telephone calls, sends and receives emails, downloads files, provides an internet connection and uses applications (Verkasalo *et al.*, 2010; Aldhaban, 2012; Yuan, 2005; MobileSQUARED, 2010; PCMag.com, 2013; Oxford Dictionaries, 2013; Park and Chen, 2007a; Osman *et al.*, 2011). Current examples of smartphone brands are the Apple iPhone, Samsung Galaxy phones, that proffer operating systems such as, Windows Phone or Android Operating Systems (Verkasalo *et al.*, 2010).

To understand the growth of smartphones in the United Kingdom (UK), in 2010, Ofcom estimated that 59% of the UK population are smartphones owners (Ofcom, 2011a). In the United States of America (USA), approximately 35% of the American population has a smartphone (Smith, 2011). It is also suggested that the direction of smartphones growth is increasing and not declining around the globe (IDC, 2013). When examining the demographics groups of UK society, it can be found that the younger generation is using smartphones more than older individuals (Ofcom, 2011a). For example, in 2010, only 9% of 55 years old and above individuals used smartphones in comparison to 39% of the 35-54 age groups (Ofcom, 2011a). Such differences clearly illustrate that a smartphone adoption gap exists between the younger and older generations.

In terms of the older generation it has been found that due to advances in medicine and improvements in the quality of life, countries around the globe are facing the prospect of an ageing population (UN DESA, 2009). In the UK, currently more than 16.4% of the population is aged 65 years old and above and around 40% is older than 45 years old (Office for National Statistics, 2012; The Telegraph, 2012). In internet research the term 'silver surfers' has emerged where research is more specific to individuals 50 years old and above, which is the demographic group of interest to this research (Netlingo, 2010). This population group is not only approximately 30 of the overall population in the UK, but also a wealth holding group and a group that is viewed to be more affluent than the younger individuals of society (Censky, 2011). Contrastingly, due to the improvements in the quality of life, economic conditions within families, some older adults are still working or becoming entrepreneurs;

thereby owning and managing their firms (Meyer, 2013). Smartphones and the proffered advanced technology that they provide can have an important role in assisting older adults operate their businesses or help with their daily livelihoods (Is4profit, 2010). Moreover, smartphones are viewed to assist business owners, including the older population increase their life quality (Kurniawan, 2006). Furthermore, this research selected the silver surfers (50+) population because this group contains both employed and retired individuals; thereby providing a broader perspective to this research study.

As stated above, smartphones can provide many benefits to users. However, it has also been found that within the older population, the rate of adoption of this novel technology is still low. This research recognises the importance of both smartphones and older people, but was also motivated to reduce the existing research gaps in the area of older people and smartphone adoption and use. For this, an aim was formed, which is: *To identify, examine and explain the adoption and usage of smartphones in the UK within the 50 years old and above population.*

To place this research in perspective, this research is considered to be beneficial for academic research since it extends and enhances the understanding of adoption and use of innovative mobile phone within the UK's older adult population. For practitioners, this research identifies factors that will encourage or inhibit the acceptance of smartphones within the older adult population. For policy makers, this research is beneficial as it forms an understanding of smartphones, devices that could also inhibit or encourage more interaction with government and/or organisations. In the following section, the literature review related to silver surfers, smartphone and adoption is presented. This is then followed by a presentation of the research model, the pursued research methodology, followed by the results. Finally the discussion, implications of this research and conclusion are presented.

2 Literature review

When considering the theoretical foundation of older adults and smartphones, gaps that exist within the older generation research, the digital divide, mobile phones and smartphones were initially identified. This was then followed by considering the theoretical foundations of the conceptual framework that was developed by this research study. These studies are provided in this section.

2.1 Silver surfers and the digital divide

A variety of ways have been used to define and characterise the divisions between individuals, society groups and nations in terms of their associations with ICTs and digital technologies. Such characterisation is widely referred to as 'the digital divide'(Tsatsou, 2011). The following definitions are those widely agreed to capture the criteria of the digital divide.

The digital divide is defined as the divide between "those who have access to a particular technology and those who do not" (Curwen and Whalley, 2010:P.210). It is also posited that "the digital divide (or the global digital divide) is generally referred to as the 'uneven diffusion' or 'gap' or 'disparities' between different socio-economic levels or across countries or between developed and developing nations in terms of 'access' and 'use (usage)' in ICTs"(Hwang, 2006 : P.19). When considering "the digital divide" it was also found that 'typically' this means Internet access, but the term has been broadened to include other ICTs (Anheire and Toepler, 2010).

The digital divide often referred to as the "information gap" or "information inequality" has promoted immense debates that have resulted in the digital divide being considered in a variety of contexts, including socio-economic status, gender, age, racial, region or geography (Tsatsou, 2011).

One significant component of the digital divide is age (Selwyn *et al.*, 2003a). Having lived many years in the world without the internet older adults tends to perceive the internet as a 'non-essential'. Additionally, age related problems such as declining eyesight and arthritis pose as major challenges to overcome when viewing monitors and coordinating mouse interaction. This has resulted in a

significant age-based divide between young and old with internet use declining in every advancing age group (Greengard, 2009).

In the last decade, older adults applications of and benefits of novel technologies have been examined by many researchers. When considering this issue, several diverse aspects have emerged. These have included the digital divide when the gap between individuals who have used ICT and who have not used ICTs has been examined. Of these studies, a recent study has found that there exists a digital divide and the gap is not likely to close in the near future (Kim, 2011a). When delving deeper, it was found that older adults face difficulties when adopting novel technologies (Lee *et al.*, 2011). When considering the use of the internet in the 55 years old and above population of Finland, it was found that around one-third of the respondents do not use the Internet (Vuori and Holmlund-Rytkönen, 2005). In Australia, within the 50 years old and above individuals it was found that the internet is used five time less than the under 30s age group (Willis, 2006). From such studies it was confirmed that a digital divide exists and recognised by many researchers around the world.

Several research studies have attempted to study this issue and identify the factors leading to the age related digital divide. These factors are viewed to be in theoretical terms the factors, perceived lack of benefits (Mann *et al.*, 2005; Melenhorst *et al.*, 2006), lack of interest or motivation (Carpenter and Buday, 2007; Selwyn *et al.*, 2003b), lack of knowledge (Peacock and Künemund, 2007), lack of access (Peacock and Künemund, 2007), cost (Mann *et al.*, 2005; Carpenter and Buday, 2007), and physical limitation (Saunders, 2004; Carpenter and Buday, 2007).

2.2 Mobile phones and Smartphones

As advances and familiarity with smartphone technology continues, research findings are continuously emerging (Aldhaban, 2012). For instance, in 2000 in the USA, it was learnt that a digital divide of mobile phones and the internet in terms of age, gender, income, work status and education was evident (Rice and Katz, 2003). Further, similarities in the adoption and use of mobile phones and Internet were apparent (Rice and Katz, 2003). Research was also conducted on the differences in gender terms in aspects of health related information, where within females aged 50 years old and above, age is a serious factor in amplifying the age divide as older adults are less aware of novel technologies (Xue *et al.*, 2012). In 2011, a study of health and caregiving among the 50 years old and above population identified that 79% of the silver surfers owned mobile phones, but only 7% adopted the smartphones. It was also learnt that within this age group, approximately half of the 50 years old and above groups used or intended to use mobile technology for health related matters. When considering the use of technology for only health purposes, 11% of the sample population used the technologies for basic health matters such as, weight, blood sugar and blood pressure measurements (Barrett, 2011). Such research studies assisted this research team to identify the benefits of smartphones for the older population and identified the existing gaps in adoption studies associated with older adults.

2.3 Theories related to smartphone adoption

As stated above, adoption and use are imperative for this research. In terms of the Information Systems (IS) discipline and adoption research, it was identified that research in this area has matured, but studies related to adoption are still developing. The main theories applied in adoption studies are the Diffusion of Innovation (DoI) theory (Rogers, 2003); Unified Theory for the Acceptance and Use of Technology (UTAUT) (Venkatesh *et al.*, 2012, 2003a); Technology Acceptance Model (TAM) (Davis, 1989) and Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980). In addition to these theories, the factor of Enjoyment was used in the previous research studies and applied to examine and understand the adoption and use of smartphones in this research study (Song and Han, 2009; Chtourou and Souiden, 2010).

To determine the combination of the theories, a review of the main and combined theories of adoption in IS was conducted. It was found that TAM is the most popular, followed by UTAUT and TRA (Aldhaban, 2012). However, there was also a preference towards combining two or more classic IS adoption and use theories for research. For instance, DoI and TAM were combined to explain the adoption of smartphones in a logistic industry (Chen *et al.*, 2009). This combination was also applied to research the adoption of smartphones within medical practitioners, doctors and nurses (Park and Chen, 2007b). UTAUT and Enjoyment were combined to examine the importance of Enjoyment in mobile services (Song and Han, 2009). Using this as reasoning it was decided to combine more than two classic adoption and use theories to provide a better understanding of the adoption of smartphones in the Silver-surfers population in UK.

3 Theory building and research model

The proposed conceptual framework assumed that the dependent variable of this research, the behavioural intention to use and adopt smartphones is influenced initially by Observability and Compatibility that have been drawn from DoI (Rogers, 2003). The second group of constructs include, social influence, facilitating conditions, performance expectancy and effort expectancy that are drawn from UTAUT (Venkatesh *et al.*, 2012, 2003a) Thirdly, Enjoyment (Song and Han, 2009; Chtourou and Souiden, 2010) is also integrated in the model. Finally, the dependent variable Actual use is influenced by the intention to use smartphones. Usage was measured by the features of a smart phone, which are e-mailing, browsing, using social media, taking a photo and playing games.

DoI: Observability and Compatibility

An innovative product can be defined as a new product where the features are new or improved significantly from the predecessors. The new features may develop using new technologies, knowledge or materials currently available (Rogers, 1998). Smartphones, therefore, can be considered as an innovative product because firstly, they have been introduced in 2007 with new design and sophisticated technology such as iPhone (Honan, 2007). Secondly, they can install applications and have many more advanced features compare to a feature phone. Therefore, Rogers's DOI is applied to this framework. Observability is defined as the degree which smartphones are visible to adopters. Compatibility is the degree which smartphone is compatible with adopter lifestyles (Rogers, 1998). Previous research studies related to smartphone also show that Observability and compatibility are important for technology adoption (Mallat, 2007; Putzer and Park, 2010; Koenig-Lewis *et al.*, 2010; Park and Chen, 2007c; Wu and Wang, 2005). Therefore, the following hypothesises are proposed.

H1: Observability has a positive influence on the behavioural intention towards smartphone adoption.

H2: Compatibility has a positive influence on the behavioural intention towards smartphone adoption.

UTAUT: Social Influence

Social influence, one of the factors drawn from UTAUT can be defined as the degree to which an individual perceives that other individuals important to the individual, such as, family, friends or other close peers believes that he or she should use the new system such as a smartphone (Venkatesh, 2012). It has been learnt that when individuals consider adopting new technologies, they are normally influenced by other individuals, particularly, those who are close to them; for instance, their family and good friends. If the influencers have a positive view towards using a smartphone than individuals could probably adopt and use a smartphone. Previous research studies associated with smartphones also show that social influence is important for technology adoption (Zhou, 2008; Zhou *et al.*, 2010; Song and Han, 2009; Shin, 2007; Kim, 2008; Bouwman and Reuver, 2011; Boulos *et al.*, 2011). Therefore, the following hypothesis is proposed.

H3: Social Influence has a positive influence on the behavioural intention towards smartphone adoption.

UTAUT: Facilitating Conditions

Facilitating conditions drawn from UTAUT can be defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of a smartphone (Venkatesh, 2012). This factor can be explained by users having necessary resources such as expertise, knowledge and money to adopt information technology (Zhou, 2008; Venkatesh *et al.*, 2003b). As a new technology, users who want to adopt a smartphone will need to have some knowledge when using the new device. Additionally, the costs of using a smartphone, a handset and the monthly fee are also included within this factor. If a fee for using the smartphone is acceptable and viewed as most beneficial to users, than a positive experience occurs and the users can then encourage more individuals to use the smartphone. From previous research on mobile acceptance, the construct facilitating conditions is viewed to be one of the main factors leading to acceptance; in other words, adoption (Zhou *et al.*, 2010; Zhou, 2008). Therefore, the following hypothesis is proposed.

H4: Facilitating Condition has a positive influence on the behavioural intention towards smartphone adoption.

UTAUT: Performance Expectancy

Also drawn from UTAUT, Performance Expectancy is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job (work related) performance (Venkatesh, 2012). Theory also revealed that performance is also one of the factors that affect user behavioral intention (Venkatesh, 2012). Performance expectancy is explained in a similar way to usefulness from TAM and relative advantage from DoI (Venkatesh *et al.*, 2003b). UTAUT identifies a user's perception of the benefits of a smartphone such as mobility and always connected connections. If users recognize the potential benefits that a smartphone provides, then those individuals are likely to adopt and use a smartphone. Therefore, the following hypothesis is proposed.

H5: Performance expectancy has a positive influence on the behavioural intention towards smartphone adoption.

UTAUT: Effort Expectancy

Effort expectancy, also taken from UTAUT, can be defined as the degree of ease associated with the use of a system (Venkatesh, 2012). Effort expectancy mirrors the perceived effort construct when users adopt a new system; in this case, a smartphone. This factor is comparable to the perceived ease-of use construct of TAM and the complexity construct from DoI (Venkatesh *et al.*, 2003b). It explains a user's perception of the difficulty associated with using a smartphone. If using a smartphone is considered to a strenuous and difficult task, than fewer individuals will adopt and use a smartphone. Thus, the following hypothesis is proposed.

H6: Effort Expectancy has a positive influence on the behavioural intention towards smartphone adoption.

TAM3: Enjoyment

Perceived enjoyment drawn from TAM3 can be defined as the extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use (Venkatesh, 2012). A smartphone, which has additional capacities such as, playing music, watching video, installing and playing games, and surfing some entertaining content, can be a device that provides enjoyment for users. Perceived enjoyment was found to effect significantly to the intended use of new technology (Davis *et al.*, 1992). This factor was studied in both the contexts of using software in smartphones (Song and Han, 2009; Verkasalo *et al.*, 2010) and using mobile Internet (Shin, 2007). Therefore, the following hypothesis is proposed.

H7: Enjoyment has a positive influence on the behavioural intention towards smartphone adoption.

Behavioral Intention/ Use Behavior

From UTAUT (Venkatesh, 2012), Behavioral Intention is the middle factor between the dependent variables and Use behaviour. Behavioral Intention is considered to influence the adoption or usage of the smartphones in this research. Some previous research based on UTAUT display the strong relationship between the dependent variables and Behavioral Intention (Venkatesh *et al.*, 2003b). Therefore, the following hypothesis is proposed.

H8: Behavioral intention has a positive influence on the smartphone usage

To illustrate and understand the combination of factors, their relationships and the formed hypothesis, a structural model was formed that is shown in Figure 1.

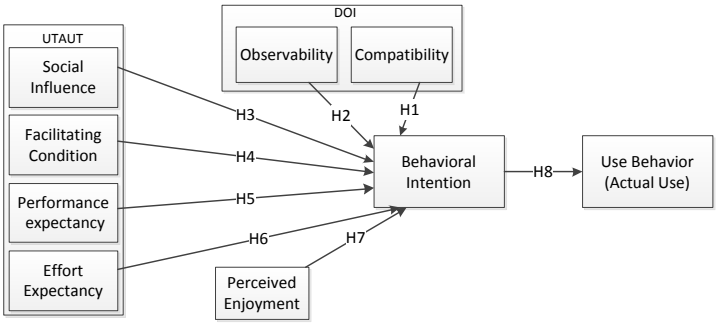

Figure 1. A Structural model in this research

4 Research design and methodology

The principal constructs measurement items for this study were borrowed directly from existing literature measures in order to ensure validity (Stone, 1978). The detailed measurements and their sources from defining the principal constructs are shown in Appendix 1. The survey instruments were pretested with 12 specialists including university lecturers, PhD students and smartphones users, who were sought for their expert opinions for assessing the psychometric properties of the measurement scales, general understanding and English language proficiency (Churchill, 1979). The survey instrument was posted online at SurveyMonkey.com for approximately 3 weeks. The questionnaire utilised in this research consisted of 2 sections. The first section examined the demographics and background details of participants. The second section sought to ascertain whether respondents did use or did not use smartphones. If the respondents currently used smartphones, the questionnaire continued to seek reasons for using smartphones including the question related to main construct of the research model.

4.1 Data collection and analysis

Following corrections of the questionnaire, the online questionnaire was distributed in two ways. Initially, the link to the survey on a web based questionnaire website, Surveymonkey along with an introductory letter stating the purpose of the questionnaire was posted within three Facebook community pages in UK. The second way for seeking replies was by email. The link as well as the introductory letter, informed consent and purpose of the research study was emailed to the network of the researcher that contains entrepreneurs, university officers and lecturers, translators and office workers. A snowball sampling method was pursued at this point. The e-mail participants were requested to forward the email to people they thought would have an interest in the topic. The link was opened for three weeks and closed on February 2013, which led to 204 complete responses from all over the UK. However, the survey received only 181 completed response and only 160 could be utilised with the research model.

Following data cleansing, data analysis was performed using the component-based approach to structural equation modelling (SEM) and associated statistics for validity and reliability. Specifically, this study used Partial Least Square (PLS) technique with the help of SmartPLS version 2.0M3 (Ringle *et al.*, 2005). It is recognised that although 160 is a relatively small size of sample, it is sufficient enough to gain reliable results from the PLS results. This is due to the responses being more than 10 times of the reflective indicators (factors in conceptual framework)(Chin, 1998).

5 Results

5.1 Demographics and background

Following closure of the survey, 204 replies were received: 65 males and 139 females. In terms of age, 42.2% were 20-29 years old; 29.4%, 30-39 years old, with the 40-49 and 50-59 years old age groups an approximate 10 %. This meant that 85.3% were from the younger than 50 years old and 14.7% from the 50 years old and above age groups. In terms of education, there were three main categories, which are: Higher Degree, 1st degree and BTEC/College Diploma. In terms of location, the responses were from the UK, with more than half of the responses hailing from the London area. Approximately 34.8% of the replies were from students, both in full and part-time education. In terms of employment, 34% were in both full and part time employment. Self-employed and entrepreneurial individuals were at an equal 10.8%. In terms of occupation, around 43% of the replies were from students, 23%: Service and sales; 11.0%: Freelance, and 10.5%: Legislators or managers.

5.2 Smartphone, network and fee used and pay by respondents

The results found that 88.7% of respondents currently have smartphones. For those aged below 50 years old, 93.1% were users of smartphones. However, 63.3% of older than 50 years old used smartphones. Comparatively, 63.3% of the 50 years old and above still did not adapt to smartphones. Also considered was the duration of using smartphones. Overall, more than half of the replies indicated using smartphones for more than three years. This percentage also applies to the over 50 years old group. However, for the over 50 year old age group, 21% began using smartphones since 2012. This is in contrast to 7.1 % in the below 50 years old age group. These findings assisted the research team to confirm that the above 50 years old age group is slower at adopting new technologies. In terms of the brand of smartphones, in overall terms, the Apple iPhone was most popular followed by Blackberry, Samsung and HTC. However, the percentage of older adults using the Apple iPhone is lower than the younger participants.

With reference to the Network providers in the UK, O_2 was most popular followed by 3 UK, Vodafone, Orange, Giffgaff and Lebara. The numbers of the below 50 years participants using O_2 and 3UK were much higher in comparison to the over 50 years old adult population.

5.3 Uses of the smartphones

In terms of usage, the top ten features were: making a phone call, taking a photograph, text messaging, emailing, browsing a website, using social networks, downloading applications (apps), mapping and navigator functions, playing games, and using smartphones for transport management (bus and train). Interestingly, for users above 50 years, the numbers of respondents using smartphones to make a phone call, SMS, emailing, taking a photo, and browsing the website were rated as important. However, the sixth to the tenth-filming a video, playing games, mapping downloading app, and using social media are far less than the top five. Moreover, filming a video is more popular in the above 50 years age group in comparison to the below 50 years user. Contrastingly, the above 50 years users use less of downloading of apps and social media. Additionally, the over 50 year group played games, which was also confirmed by the enjoyment hypothesis as shown in Figure 2.

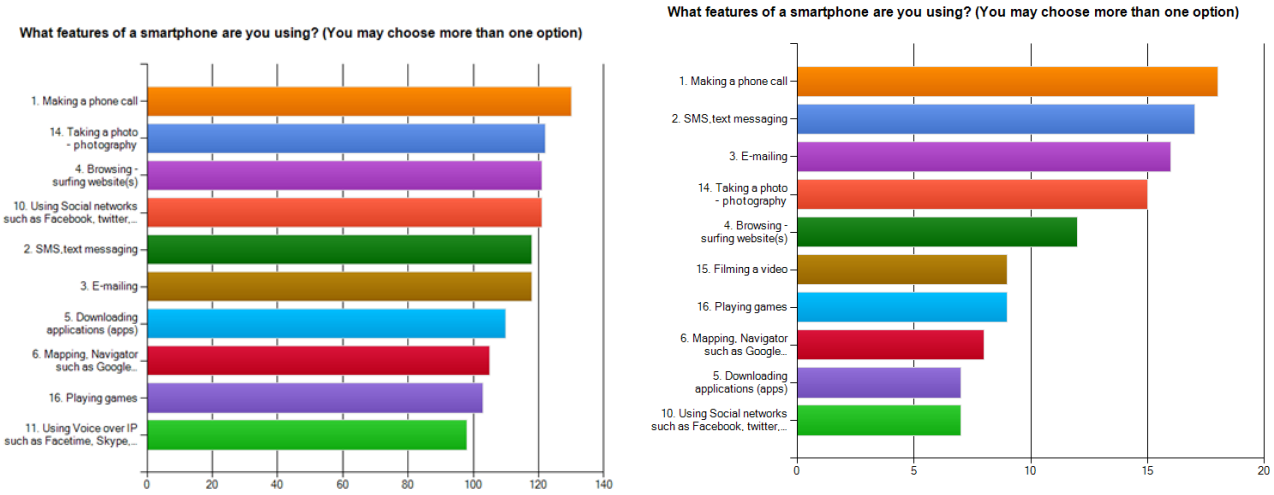

Figure 2. Smartphone usage of below 50 years old (left) and above 50 years old (right)

A question explored what are the considerations when respondents want to purchase a smartphone. The top ten consideration factors were considered to be: brand, price, appearance, camera, screen size, operating system, battery life, size of memory, weight, and quality of applications. However, the 50 years old and above age group were far less concerned with the price and operating system.

Another question asked about the source of information. These were the reviews and the information about smartphones, word of mouth from friends and family, media (TV, Radio and Newspapers), online social networks, high street stores, professional technology review websites, magazines and Peer technology reviews respectively. The responses in the below 50 years old were diverse with word of mouth, media and online social being most popular replies. In contrast, within the over 50 year old respondents were more dependent only on the word of mouth. Moreover, the older group also relied less on social networks compared to the younger age group.

5.4 Analysis results on adoption smartphones

As addressed in section 3, the following results are developed based on the behavioral intention measures of UTAUT (Venkatesh *et al.*, 2012, 2003a), DoI (Koenig-Lewis *et al.*, 2010) and TAM3 (Song and Han, 2009; Chtourou and Souiden, 2010). The results were analysed using SmartPLS. The analysis included reliability test, validity test and assessment of structural model. The assessments of the model are illustrated in tables 1 and 2.

When initially examining the measurement model, there were 27 observed items where an overall nine latent constructs were measured. Table 1 shows the results on reliability and consistency. As evidenced, composite reliability (CR), which measures the internal consistency, exceeds the 0.7 threshold for all constructs; thus ensuring their reliability. Next, the items loaded well on their respective factors, exceeding 0.7. Furthermore, all the constructs' AVE was above or almost above 0.5. Finally, according to Fornell and Larcker (1981) on discriminant validity, the square root of AVE for all constructs needed to exceed all the other cross-correlations. This criterion was also satisfied for all constructs. As such, the model exhibited satisfactory discriminant validity as well.

	Cross-correlations								Item loadings	AVE > 0.50	CR > 0.70	R^2	CA > 0.70
	COM	**EE**	**FC**	**ENJ**	**IN**	**OB**	**PE**	**SOC**					
COM	**0.89**								0.87 – 0.91	0.80	0.94		0.91
EE	0.61	**0.96**							0.95 – 0.96	0.92	0.96		0.91
FC	0.82	0.71	**0.92**						0.91 – 0.92	0.84	0.91		0.81
ENJ	0.56	0.63	0.63	**0.94**					0.94 – 0.95	0.89	0.94		0.88
IN	0.65	0.63	0.70	0.63	**0.81**				0.80 – 0.82	0.66	0.88	0.62	0.83
OB	0.53	0.42	0.49	0.49	0.43	**0.85**			0.80 – 0.90	0.73	0.84		0.64
PE	0.75	0.61	0.73	0.55	0.67	0.47	**0.85**		0.81 – 0.89	0.72	0.89		0.81
SOC	0.29	0.23	0.27	0.27	0.39	0.25	0.26	**0.93**	0.93 – 0.94	0.87	0.93		0.85
ACU									-			0.15	

Table1. *Cross-correlations, Item loadings, Average variance Extracted (AVE), Composite Reliability(CR), R-square and Cronbach's Alpha (CA) of the research model. The diagonal elements in bold in the cross-correlations matrix are the square root of AVE.*

Hypothesis	Path coefficients and their significance		
	All age	Over 50	Below 50
1. Observability -> Behavioral intention	Not support	0.131*	Not supported
2. Compatibility -> Behavioral intention	Not support	0.196*	Not supported
3. Social Influence -> Behavioral intention	0.177***	0.207**	0.154**
4. Facilitating -> Behavioral intention	0.215*	0.417***	0.188*
5. Performance expectancy -> Behavioral intention	0.231***	Not supported	0.242***
6. Effort Expectancy -> Behavioral intention	0.144*	0.314***	Not supported
7. Enjoyment -> Behavioral intention	0.213**	0.282***	0.209***
8. Behavioral intention -> smartphone usage	0.389***	0.801***	0.320***

Table2. *Conclusion of the Hypothesis test of all age groups, over 50 years old and below 50 *significant at 0.1 level, **significant at 0.05 level, ***significant at 0.001 level*

With regards to PLS, it should be highlighted that reasons for selecting the method is that it emphasises the explained variance and the statistical significance of the estimated paths in order to illustrate the predictive strength of a given theoretical mode (Reinartz *et al.*, 2009). The R-square in Table 1 suggests that the model explains 62.3% of the variance in Behavioural Intention's values and 15.1% of that is Actual Use of smartphones.

In order to test the statistical significance of the Path coefficients, this research applied a bootstrap analysis that examined the theoretical model for each age group separately (see Table 2). From Table 2, for both the age groups, Observability (H1: $p>0.05$) and Compatibility (H2: $p>0.05$) were found to have a statistically non-significant effect on Behavioural Intention to use smartphones, while all other hypotheses were supported, with Performance Expectancy having the strongest impact on Intention (H5: Path coefficients = 0.231, $p < 0.001$). What is interesting however is that, while Behavioural Intention for the total sample appears to have an important effect on Actual Use (H8: 0.389, $p < 0.001$), it explains solely around 15% of the variance in Actual Use. Focusing on the two different age groups, it can be learnt that our model for older adults manages to explain a little over 80% of the variance in Behavioural Intention's values (R^2 = 80.90%) and a little over 64% in the variance of Actual Use's values (R^2 = 64.20%). Therefore, our model's predictive strength can be said to be quite strong (Hair *et al.*, 2011). Interestingly enough, Performance expectancy does not have a statistically significant effect on Behavioural Intention (H5: $p > 0.05$). Facilitating Conditions on the other hand proved to exert the strongest influence (H4: Path coefficients = 0.417, $p < 0.001$), followed by Effort

Expectancy (H6: Path coefficients = 0.314, $p < 0.001$). Most importantly however, for silver-surfers, Behavioural Intention has quite a significant effect on Actual use, reaching Path coefficients = 0.801 ($p < 0.001$).With regards to the younger population, our theoretical model manages to explain 61.50% of the variance in the values of Behavioural Intention and 10.30% of the variance in the values of Actual Use. Furthermore, of the eight hypotheses overall, the three were not supported; namely H1, H2 and H6.

6 Discussions

This research provides new insights into the adoption and use of smartphones in the older adults population of the UK by building upon classic theories of IS adoption theories. The findings suggest that half of the proposed factors influence Behavioural Intention almost similarly in both age groups. Specifically, Social Influence, Facilitating Conditions and Perceived Enjoyment proved to be important for the younger population and the silver surfers. Observability, Compatibility and Effort Expectancy were also important for the adoption of smartphones, while for those belonging to the 50 years old and below age group, Performance expectancy was important. What these results also show is that there is a digital divide within the population.

In terms of smartphone use, making phone calls, taking photos, texting, e-mailing, general internet browsing, navigating, online social networking, and VoIP proved to be the most popular use cases among both age groups. Previous research has shown that e-mail, an application proffered by all smartphones, is identified as an important feature (Kim, 2011b). Smartphones also support online shopping, which has led to several online stores adapting their websites and developing applications so as to accommodate small screen devices. Our findings show that online shopping reached 44.70% within the total sample, and 48.90% and 11.10% within the younger population and the silver-surfers respectively. This total percentage is much higher than that indicated by a Nielsen report, which found that 26% of UK smartphone users use their smartphones for shopping (Moth, 2013), yet lower to that found by Google (2011), that indicated that 79% of smartphone users use their devices for shopping-related activities. Such activities include checking and comparing prices, or searching store locations. Most importantly however, while 74% of smartphone users purchase products as a result of smartphone use, only 27% actually conclude their purchases through a smartphone (Google, 2011). Therefore, the findings, combined with extant market reports, illustrate that for the time being, smartphones provide a fast and easy way to unearth information for online and traditional shopping.

7 Implication

From a theoretical perspective, this study has explored the knowledge of the factors influencing smartphone adoption in the UK by comparing young and old age groups. It is also illustrates that there is a digital divide of smartphone adoption among young and old generations. The key theoretical contribution of this study is the development of the conceptual framework of smartphone adoption from the components of UTAUT, TAM3 and DoI. The results can shed light on the research related to adoption of innovative technology such as tablets or wearable computers. As increasing numbers of the population have grown old, the knowledge on how older generation adopt and use the new technology is very important in order to increase their quality of life and wellbeing.

This research also provides practical implications for stakeholders in the smartphone industry, which are smartphones manufacturers, network providers, and application developers. This research suggests that to increase wider uses of Smartphones, information and advertising should be communicated using word of mouth, TV, Radio, newspaper and online social networks. Moreover, from the older adult framework that identified the facilitating and effort expectancy being the two strongest factors, smartphone providers should provide older adult friendly sales representatives. The sales person should provide knowledge in an easy and understandable way for older adults. For application developers, the research found that older adults still have adoption gaps. In other words, older adults

are fewer in adoption numbers than the younger generation. Therefore, application developers should provide knowledge including how to use applications and features of the application that can benefit older adults. Furthermore, older adults seem to be not aware of health features of Smartphone that can help maintain their good well being; therefore, the application developers and related organisations should provide more information in this regard for the older adults.

For policymakers of the government, this research shows that increasing numbers of people are using smartphones, but only 17% have used their phone to contact the government. Therefore, government should consider providing some efforts to increase the level of awareness on Smartphones within this population group.

8 Conclusion

This research aimed at understanding the differences regarding the adoption and use of smartphones between UK's younger and older adults. With the questionnaire-based online survey, this research received 204 responses of which 14.8% were older adults, and 88.7% had used smartphones. Within the older adults, 63.3% had their own smartphones. This study has shown that older adults use smartphones much differently to the younger generation, and that they are less frequent users. Admittedly, there are several common factors driving the adoption between two age groups; namely Social Influence, Perceived Enjoyment and Facilitating Conditions. However, while older adults also consider Observability and Compatibility to be important, the younger population seems indifferent to them and emphasises ease of use. The findings suggest that silver-surfers use smartphones much less than younger ones; therefore, it may be suggested that there is a market segment still available for providers- older adults. Therefore, smartphones providers may consider expanding their markets base to this demographic. However, due to the differences from the younger generation in adoption drivers, smartphone manufacturers, phone providers and developers alike will need to modify their approach method and adapt it to this age group's needs, drawing from the most appreciated factor of Facilitating Conditions- time, money and knowledge. Regarding knowledge, stakeholders can help other users by providing the learning resources on smartphones use and interesting applications, compatible with their lifestyle, so as to ensure continued use.

However, this research has some limitations. By the nature of quantitative research, this research may not capture additional views apart from the proposed factors. In addition, the sample size of this research is considered small, and especially that of the silver surfer population. This means that generalisations regarding the population cannot be made; however, an understanding of the adoption, use and diffusion of Smartphones within the older adult population can be made. Due to the use of OSNs again a sampling bias emerged that future research such as, using a diverse mode will overcome. Also, PLS was employed specifically in order to handle better the smaller sample size. Future studies would benefit on verifying the research framework's application by seeking to increase the respondents' numbers. The references in this paper are also limited as smartphones were introduced in the past few years; therefore research related to smartphones is not yet mature enough. This led to the team to apply news or reports from other related fields such as, marketing which is much more up-to-date. In terms of theories, this research currently focused on mainly adoption theories; therefore, the theories related to usage were not included.

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Appendix

Appendix 1 Constructed questions

Observability
OB1. I have had a lot of opportunity to see smartphones being used.
OB2. It is easy for me to observe others using smartphones. (For example, I saw my friends use smartphones)
Compatibility
COM1. I believe that using the smartphone is suitable for me.
COM2. I believe that using the smartphone will fit my life style.
COM3. I think that using the smartphone fits well with the way I like to work.
COM4. Using the smartphone fits into my work style.
Social Influence
SOC1. People important to me think I should use a smartphone. (For example, friends and family)
SOC2. People who influence my behaviour think that I should use a smartphone.
Facilitating Condition
FC1. I have the resources necessary to use the smartphone. (For example, time and money)
FC2. I have the knowledge necessary to use the smartphone.
Performance expectancy
PE1. I feel a smartphone is useful.
PE2. Using a smartphone enables me to finish tasks more quickly.
PE3. Using a smartphone increases my productivity.
Effort Expectancy
EE1. I find that using the smartphone is easy.
EE2. Learning how to use a smartphone is easy for me.
Enjoyment
ENJ1. I think it is fun to use a smartphone.
ENJ2. I find a smartphone fun (I had fun using a smartphone).
Behavioral intention
IN1. I intend to use a smartphone as much as possible.
IN2. I intend to continue using a smartphone in the future.
IN3. Whenever possible, I intend to use a smartphone in my job.
IN4. I intend to increase my use of a smartphone in the future.
Smartphone usage
ACU1. Making a phone call
ACU2. SMS, text messaging
ACU3. E-mail
ACU4. Browsing – surfing website(s)
ACU5. Downloading applications (apps)
ACU6. Using Social networks such as Facebook, twitter, LinkedIn, Foursquare, Google+
ACU7. Using Voice over IP such as Facetime, Skype, Oovoo, Google Talk, Viber, Fring
ACU8. Taking a photo- photography
ACU9. Playing games

Note: All items were measured on a 5-point Likert scale anchored from 1(strongly disagree) to 5 (Strongly agree), except Actual Use which was measured on a 5-point Likert scale anchored from 1(never) to 5 (many times per day)