ANALYSIS OF SMARTPHONE ACCEPTANCE THROUGH TECHNOLOGY ACCEPTANCE MODEL

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Certificate

Certified that the contents of thesis document titled ñ**ANALYSIS OF SMARTPHONE ACCEPTANCE THROUGH TECHNOLOGY ACCEPTANCE MODEL**ò submitted by **Mr. Mohsin Ikram** have been found satisfactory for the requirement of degree.

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DEDICATION

Firstly, I dedicate my work to Almighty Allah who gave me the strength and courage to complete my research. Then, I would like to dedicate my work to my parents and teachers who stood by me and guided me, especially when I needed them the most.

CERTIFICATE OF ORIGINALITY

I hereby declare that the research work titled ñ***ANALYSIS OF SMARTPHONE ACCEPTANCE THROUGH TECHNOLOGY ACCEPTANCE MODEL***ò is my own work and to the best of my knowledge. It contains no materials previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any degree or diploma at SEECS or any other education institute, except where due acknowledgment, is made in the thesis. Any contribution made to the research by others, with whom I have worked at SEECS or elsewhere, is explicitly acknowledged in the thesis.

I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the projectôs design and conception or in style, presentation and linguistic is acknowledged. I also verified the originality of contents through plagiarism software.

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Mohsin Ikram

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LIST OF ABBREVIATIONS

3G	**Third Generation mobile phone standards and technology**
AU	**Actual Use**
BI	**Behavioral Intention**
CTAM-TPB	**Augmented TAM / Combined TAM & TPB**
DTPB	**Decomposed Theory of Planned Behavior**
GPRS	**General Packet Radio Service**
GPS	**Global Positioning System**
GSM	**Global System for Mobile Communications**
ICT	**Information and Communication Technologies**
IT	**Information Technology**
MWT	**Mobile Wireless Technology**
PC	**Personal Computer**
PCS	**Perceived Cost Savings**
PDA	**Personal Digital Assistant**
PEOU	**Perceived Ease of Use**
PLS-SEM	**Partial Lease Square Structural Equation Modeling**
PU	**Perceived Usefulness**
SEM	**Structural Equation Modeling**
TAM	**Technology Acceptance Model**
TPB	**Theory of Planned Behavior**
TRA	**Theory for Reasoned Action**
UTAUT	**Unified Theory of Acceptance and Use of Technology**

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ABSTRACT

Smartphone is an enabling technology that is bringing people together in todayôs world, via provision of essential communication services. The Smartphone market in Pakistan as well as around the world is growing rapidly. Pakistan has become the fifth largest Asian mobile phone market. It is therefore important to understand the reasons behind the exponential growth in mobile phones market in Pakistan. We focus on smart phones, as they are the upcoming standard in cellular technology and communication. This research is focused on evaluating the factors that affect the acceptance of Smartphone among its users.

We use Technology Acceptance Model (TAM) to explore the said phenomenon. We have adopted a survey-based methodology for understanding Smartphone adoption. The survey was conducted on the target population composed of undergraduate, postgraduate students and academic faculty members from a large university in Pakistan.

Results show the existence of diverse factors that play a positive and significant role for Smartphone acceptance amongst Pakistani consumers. Analysis supported the importance of multimedia capabilities and effective application base for a Smartphone. Similarly, Social Norms plays a significant role for using a Smartphone. Pivotal socio-technical factors that contribute in Smartphone adoption include After Sales Service, Applications, Multimedia, Social Norms and Technical Barriers.

Chapter 1:

INTRODUCTION

Smartphone technology is imminent in changing people behavior due to its penetrating as well as effective functionality [59]. Today people are becoming dependent on Smartphone and the services it offers. Smartphone became available in 2007 and are constantly evolving with cutting edge technologies [59]. Smartphone combines computing power along with memory capabilities for running complex software and storing large amount of data. Mobile operating system of Smartphone allows user to install and execute different software. Smartphone incorporates different functionality allowing high usability and tightly focused applications [60]. Smartphone capabilities are complimented with a broad range of applications. Such as office applications for increasing productivity, location-aware interactive application services, media production tools, web browsing, social media, communication and entertainment.

Smartphone technology can easily be connected to Internet through different technologies and protocols such as WiFi, 3G, and Bluetooth [61]. This feature of connectivity enables data access from anywhere at any time and allows users to distribute their content using various media to others. Therefore a Smartphone provides an ample set of mobile computing functions along with Internet connectivity, these features liberates users from desktop based ICT that is associated with conventional computing in education. Smartphone is an accessible and ubiquitous device that enables users the access to services on the go thus empowering users to respond to situations, needs and emerging ideas.

Smartphone are powerful computing devices in the use of students and academic staff in acceptable sizes and shapes that can be held or kept in pockets of its users. There is an exponential growth of multifunctional mobile devices amongst students [62].

1.1 SMARTPHONE:

It is a mobile phone with advanced computing ability that incorporates the essence of a Personal Digital Assistant (PDA) with a combination of functions. Functionality includes media player, offers mobile Internet connectivity [60], built-in GPS and camera devices. A Smartphone has a quality to run a rich set of third party applications (for example games, communication software and services including weather alerts or traffic information etc.) [60].

In the mobile technology industry, there is no current industrial standard for defining a Smartphone [66]. Generally it is a combination of PDA, mobile phone, with multiple applications of different functionality along with Internet connectivity and features of portable Personal Computer [63].

Litchfield [64] attempted to define Smartphone by examining the top five accepted definitions but concluded that there is no single acceptable definition. This is due to the continuous evolution of mobile phone technology. He concluded in his research by defining Smartphone as a phone that "runs an operating system and is permanently connected to the Internet" [64, Page 1, Paragraph: 20]. Today Smartphone's are like PCs having their own operating system allowing different add-on applications/software. A large number of applications that are available for Smartphone allow users to perform tasks of their own choice. This facility forms the main source of convenience. Smartphone provides customizability to fit to user's choice of interface, thus the device is adaptive to user needs. These devices are rapidly evolving the computing power and its capabilities as compared to the old featured phones. The QWERTY keyboard structure either physically or virtually increases ease in typing. Finally it is noted that almost every Smartphone in market have a touch screen. Smartphone also incorporates basic functions of featured phone like text messages, call conferencing etc. These features of Smartphone have same capabilities as computers but with an added bonus of mobility [65].

Smartphones are replacing featured phones because Smartphone offers more functionality. The use of Smartphone is increasing because it is being used widely in business, office, daily tasks, entertainment, education, along with the general mobile phone capabilities. Smartphone can provide many services and help automate many business functionalities on the go.

The extensive use and increase in technology evolution of Smartphone has made it necessary to understand the reasons for acceptance by individuals and how the technology is being utilized. Thus Smartphones today are incorporating more and more functionalities along with increasing use in everyday life; therefore the factors affecting the adoption of Smartphone as a next generation product might not be the same of featured phones or other similar technologies.

Kang, et al. [66] research explained that market change from traditional phone to Smartphone is caused by the increase in the consumption of Smartphone which has affected the mobile phone market. The interest of common consumer is increasing towards Smartphone use. According to Pan et al. [80] and a press release by comScore.com which relates to the Mobile subscriber market share, describing that there are 30,000 mobile phone users in USA with a Smartphone share of 51.9% (October 2012), and is higher than 6% as compared to stats of July 2012. While considering China, Smartphone usage is extended from high end consumer group to low end consumer groups where college students are the main stream of these consumer groups [80]. So students present a sizeable market opportunity for Smartphone consumption, which at the same time is a challenge to design and deliver appropriate Smartphones for use by this group. Understanding Smartphone use and its determinants is critical in IT business prospect. Kang et al., [66] quotes the figures of 'Pyramid Research' and predicts sales to reach up to 60% for Smartphones by 2014. This shows a rapid growth in Smartphone market, which implies manufacturers of Smartphones to improve production for winning the bigger market share.

In a report by Smith [81] a senior researcher of Pew Research Center the percentage of adult American Smartphone ownership is up to 56% in June 2013 including Android and iPhone. In the research [81], it is evident from statistics that two major portions of American population are considered the leaders in terms of Smartphone owners; including adults having higher income and those individuals falling under the age of 35. Percentage of changes in terms of Smartphone ownership from 2011 to 2013 in U.S.A. [81] is shown as follows:

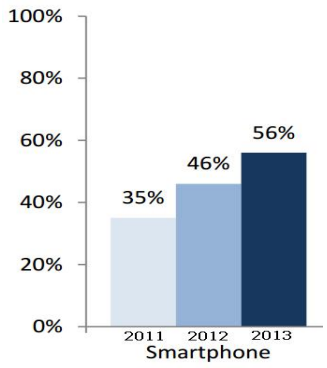

Figure 1: Smartphone Ownership in U.S.A. 2011-2013

Demographic trends were monitored for 3 years revealing a higher Smartphone ownership amongst young adults between twenties and thirties [81]. It was also noted that considerable majority of mid forties and fifties are now part of Smartphone adopters especially those with high income and educational attainment [81]. Each of the demographics experienced Smartphone growth with passing years and statistically 18% Americans of age over 65 also own a Smartphone [81].

China is predicted by analysts to become the number one Smartphone manufacturer for export by the year 2017 [82]. Therefore Pakistan being its neighboring country where Chinese Smartphone brands are being sold, will exhibit a major impact due to the growing Smartphone industry of China in the world market [82]. According to International Data Corporation (IDC) about 213 million Smartphone handsets were shipped by vendors, which is double as compared to the figures in 2011 [82], and implies a positive trend for Pakistan industry to gain benefit

from the influx of Chinese Smartphone market. This trend of Chinese production of Smartphone can result in a downfall of prices causing an increase in Smartphone acceptance in the Pakistani market, which is considered as a research opportunity [82]. Government officials and regulators consider the growing Smartphone and its applications market of high significance [82]. So companies are considering development of applications for the new Smartphone industry and by an estimate about 1,400 companies only inside Pakistan are designing & developing Smartphone applications [82]. This is because of low cost of labor and higher quality of product, thus resulting in Pakistanôs IT industry to an estimated global share of $2.8 billion with global sales revenue of $1.6 billion [82]. Pakistan is the fifth largest Asian mobile phone market [83] with 80% phones costing less than $100. There are fifteen million users out of thirty million internet users who use mobile web browsers [83].

Extensive use of Smartphone and the ability to incorporate newer technologies into this small sized hand held device is making its way into the lives of common people and is highlighting the technological advancement in use of IT. This high pace of increased serviceability and potential of technology use, its designing and application of ICT features for achieving various goals is showing the types of devices and application that need to be developed in future to assist and automate various tasks in our daily life. These include increased processing, ubiquitous access, mobile service availability, health care, educational support, potential to gain information and increase knowledge and more importantly to stay connected in a society with effective communication.

Across the globe Smartphone and its evolution into newer more advanced technologies is increasingly being studied and utilized to design better more efficient, more usable devices that can improve our life style. How Smartphone usage can really change our lives is a critical question concerning available functionality, its adoption as well as acceptance and the storage of data. Such technology is not only used in business but is also bringing people together along with services such as health care and education.

Lots of research is being carried out about Smart devices and their associated technologies. In this light it is essential to understand its adaption, behavioral use in a society, such as in Pakistan. It is also known that GSM companies tend to know more about us then we do and in this way they can plan and change their business processes, strategies and services. In the positive way they are already contributing to enhance the style of living amongst people in Pakistan. In recent years Smartphone use has increased rapidly in Pakistan. With the availability of mobile infrastructure that is used by such devices, people in Pakistan are also tending to utilize Smartphone services. We need to know that are we really using the technology such as Smartphone and are we pushing it to its limits. That is the advanced functionalities that make a Smartphone similar to a mobile computer with many useful on the go features that can contribute in making our lives easy and help accomplish tasks quickly with some degree of automation. Are we contributing towards evolving its services or are we barely scratching the surface? Smartphone could be utilized in many different life changing and useful purposes.

Therefore it is deemed necessary to understand Smartphone usage for which we need to conduct this study. This study will also contribute towards understanding how the technology should be utilized and to which extent are we using it. The information from this research can help us to design advanced services incorporated in such devices, understand how Smartphone and other technologies such as cloud applications be used. Since in Pakistan such study at this scale is not conducted we consider it as an opportunity and as a challenge to conduct this study and to derive associated information that meets this purpose.

The contribution in the literature would be of analyzing and understanding Smartphone adoption. The study would also focus on social influences, technological change and any relating factors such as behavior or costs that affect the individual's decision for choosing such technologies for their benefit. Intentional use is extended in prospect of Smartphone adoption. The research will result into a framework for exploration of Smartphone acceptance and adaptation with respect to certain

demographic setup such as students of SEECS. How they use or perceive Smartphone to be useful and how the technology is best utilized in terms of IT services.

Wide scale variability is observed in the case of technology as a result of fast evolution and different possible circumstances under which a group adopts a particular technology for use [84]. Consumers vary with respect to their skills for using technology; similarly their attitudes are directed to meet different objectives. Therefore, technology adoption is defined [84] as an awareness process composed of five major steps namely Awareness, Assessment, Acceptance, Learning and Usage. Further in the same context these steps are elaborated as; Awareness meaning to learn about the technology for using it for their benefit and reaching a decision, Assessment meaning to measure the usefulness of the technology along with ease of using that technology, Learning means to build an understanding to effectively use the technology, Usage meaning the actual relevant use of the technology.

Organizations adopt a technology that suits their goals and the company exerts certain pressure along with regimes such as training / support, to introduce such technologies to their employees. Every technology passes an adoption cycle which includes experienced as well as inexperienced users, and is dependent on market potential for that technology with respect to the total number of people using or willing to use that technology [84]. Adoption in an enterprise or within a group is influenced by many changing, uncontrollable, dynamic and market oriented factors generally described as internal or external factors. They can also be enforced by regulators, community or the organization itself.

Ordinary technology adoption life cycle (TALC) is a model for marketers to build strategy for different phases of life cycle of a product [85]. TALC is related to marketing strategies and includes following markets based on customer usage: Enthusiasm, early market, chasm (gap between market trends or uncertainty), mass market, main street (Stable mass market) and finally total assimilation (Skepticism) [85].

For adoption of a technology consumers or members of a group weigh the possible benefits & costs associated by using a particular technology [86]. And these benefits and costs help consumers in making decisions pertaining to adoption of a technology [86].

Consumer attitudes are dependent and based on analytical assessment of risk and benefits along with communication of analysis [87]. Consumer acceptance or rejection of technology and its products have determinants such as ethical / moral consideration, effects of use, uncertainties, trust, regulatory system [87]. Frewer clarifies that technology adoption amongst consumers can be developed by creating a sense of transparency in the adoption process of a technology [87].

The technology adoption Awareness process model seems to be similar when comparing it to TAM, as these factors are already a part of TAM. The definitions of the five adoption steps indicate constraints already existing or incorporated in TAM; for instance Awareness can be related to Job relevance in TAM, similarly Assessment is related to Perceived Usefulness (PU) & Perceived Ease of Use (PEOU). Acceptance can be explained by following TAM model coupled with empirical analysis; acceptance in organizational context may correspond to cost savings if a particular technology is adopted, which is also present in modified versions of TAM in the form of Perceived Cost Savings. The operational definition of Learning can be related in modified TAM as constructs of Perceived Learning or Experience as in the case of UTAUT. Usage in technology adoption imitates actual use of TAM. Thus Technology Acceptance Model already engulfs the adoption concepts in a structured way, which are verified and validated through associated empirical analysis.

Modern Technologies growth is evolving constantly and at a rapid pace. This pace is so fast that the new technologies which enters the markets holds the potential to completely replace the previous technology thus making the previous obsolete and therefore allowing a very little or no adoption period, which can be considered as a period of stable main street market for a technological product. One can relate to the

emergence of Smartphone companies such as Samsung, apple, Nokia, which are becoming the market leaders and high competition has resulted in bringing BlackBerry Company (once a dominant organization in Smartphone business) to be engaged in a deal of $4.7 billion dollars to Fairfax Financial Holdings Ltd [88].

New technologies such as Smartphone incorporate the functionality of previous mobile devices along with many other services, therefore suddenly pruning the traditional mobile phone handset business. Adoption steps / path for one technology might not be the same for another technology, which can incorporate different new functionalities or infrastructures that the previous technology might not have, thus having a different path for adoption. Pricing and regulatory factors extremely effect the adoption of a technology, no matter how good it is, we can refer the term monopoly or trust issues, so adoption analysis for one technology might not be consistent to another. TAM is a far more stable model and is evolved to incorporate and keep its pace with changing technology as well as its adoption.

Measuring adoption only, might not reflect the true adoption prospective as it is usually limited to a certain group or enterprise, which can have many unpredictable variables such as external or internal factors. This induces a degree of uncertainty in an enterprise setup, variables such as enterprise goals, market situation, business dynamics, competition, maturity of organization and its processes, Organizational people and culture, relationships (business partners).

In a study "Adoption of mobile Technologies for Chinese consumers" the authors studied the adoption of mobile technologies in China using an advanced version of TAM called UTAUT and applied Structural Equation Model (SEM) for empirically analysis [89]. China is the world's largest mobile market in which mobile industry is growing at a tremendous pace with 282 million cell phone subscribers only in the year 2004 [89]. Yan considered the diffusion rate of mobile Internet use in China, which was 49.2 million subscribers in 2002, while having 206.6 million mobile

communication subscribers suggesting a higher acceptance rate of wireless Internet in China than the wired Internet [90].

Adoption has a highly grouped/enterprise based or organization oriented study, with limiting scope as enterprises have their own goals with long or short term prospect in accordance to their operations. So Adoption study cannot be generalized towards a technology use for all populations and different groups exposed to use a certain technology. Whereas Technology Acceptance Model can be applied on any type of community, technology, demographic and can still map in a structured way the acceptance trend and use empirical based reasoning to predict factors along with its evolutionary prospect. TAM has been modified and upgraded keeping in view all adoption concepts in literature. Thus TAM is more robust, relevant as well as consistent model for mapping acceptance including adoption of a technology in any social setup, any enterprise and virtually any evolving technology. Adoption has a very limited scope for studying the overall acceptance of a technology amongst individuals and for business oriented enterprises. Adoption is more related to management, having more organizational context then technology emphasis.

The research into such technology is useful in terms of IT adoption of new devices that are mobile and offer powerful computational services. This research can be extended towards other new technological entries such as new tablet based computers that are smaller than a general PC and slightly bigger than a Smartphone. The new trend of technology is handy mobile use offering same or greater computing capability that encompasses more and more service oriented applications and resources. A simple example of this trend includes devices such as Samsung Galaxy Tab or Apple iPad. As technology is improving devices are becoming capable to communicate with each other, which certainly affect the behavior of device usage along with individual orientation and intentions to use devices to their benefit (actual use). It is astonishing to note the role of such devices in today's business such as marketing of different products and associated software based services and network of devices supporting various platforms. The contribution of this research would also be

interesting for Smartphone manufacturers and retailers. Companies may implement certain changes to devices in a demographic based on the demographics perception or consideration of a useful service. This study will also attempt to understand if there is any anxiety towards Smartphone usage and adopting it for personal use. Anxiety may be related to individual's trust boundaries or awareness of Smartphone technology, similarly the study may also relate towards device compatibility or technology evolution.

Main goal is to understand and analyze Smartphone acceptance in a University environment such as SEECS where intellect meets education and technological resources. We will be using a modified version of TAM for this research and the model along with its hypothesis will include empirical analysis and testing, for discovering possible factors of Smartphone usage. Furthermore, the study will also try to unravel user expectations and requirements regarding the Smartphone and the possible relations / factors affecting the intentions.

As in Pakistan no data relating to Smartphone is available therefore we will be collecting data by adopting a survey using questionnaire approach. Target population will be the students of SEECS and data collection objectives include Smartphone user interaction, application usage etc. We will be using a modified TAM model to check technology acceptance of Smartphone.

There has not been a considerable research to discover the existence of digital divide in terms of Smartphone usage as ICT that has targeted the population of this region. Due to the absence of research, this research will be first one to assess, analyze and report different aspects of Smartphone usage in a fairly sizable population base within the university environment.

As in Pakistan no data relating to Smartphone is available therefore we will be collecting data by adopting a survey, using questionnaire approach. This will form the basis for future studies. Since in Pakistan such study at this scale is not conducted we

consider it as an opportunity and as a challenge to conduct this study and to derive associated information that meets this purpose.

There are many factors relating to Smartphone adaptation or acceptance. For example economic, social, technology, behavior, usage intention etc. For this we use Technology Acceptance Model.

Demographic factors contributing towards beneficial use of Smartphone technology includes:

a) Residency b) Employment Status

The research will result into a framework for the exploration of Smartphone acceptance and adaptation. The main goal is to understand and analyze Smartphone acceptance in a specific demographic group. We will be using a modified version of TAM for this research and the model along with its hypothesis will include empirical analysis and testing for discovering possible factors of Smartphone usage. Furthermore, the study will also try to unravel user expectations and requirements regarding the Smartphone and the possible relations / factors affecting the intentions.

Chapter 2:

LITERATURE REVIEW

With the expeditious growth of wireless network and mobile telecommunication technologies in the last decade, along with the development of various applications, online shopping and mobile services there has been much attention in the field by researchers. Understanding individual's perception to use a technological device such as Smartphone is considered important as supported by different research paper reviews and academic journals. Literature adopts a structured focus and a standard approach using TAM (Technology Acceptance Model) to understand and explain consumer behaviors, their attitude and intentions towards adoption of technologies from mobile to Smartphone.

2.1 SMARTPHONE / MOBILE PHONE:

First commercial telephonic technology like cell phones were introduced in 1979, which began to operate and attracted a higher subscriber base for its services by the mid 1980's [69]. As the mobile phone technology evolved it started to become smaller in size and began to introduce multiple features. As technology improved mobile devices started incorporating multiple types of technologies along with connectivity such as Internet access, text functionality, full color screens, inclusion of multimedia functions such as mp3 and embedded camera etc. The trend of mobile phone developers is that the devices along with associated technologies are becoming smarter and more user-friendly. It is necessary for understanding the "smart features" and new services / functionality being offered by technologies such as Smartphones today. Smartphone are constantly evolving in terms of computing power, processing capabilities and networking as opposed to old "featured phones". Today Smartphone users have constant Internet access along with media capability allowing individual's to stay more informed. This enables the consumers to use unlimited services which are available at their fingertips. Much research has been conducted from consumer prospective for analyzing diffusion of Smartphone technology.

A study by Kim [2] extends TAM to understand individual intentions to use Mobile Wireless Technology (MWT). Two new constructs along with two causality relationships were introduced [2]. New constructs were named as Perceived Cost Savings (PCS) and Company Willingness to Fund (CWF). The new relationships were Job Relevance and Experience, which acted as moderators.

The paper used Smartphone as the target technology. Due to the difference in the nature of jobs, individuals observed different perceptions regarding MWT, which in turn affects the choice of technology that fits user needs.

It was found that individuals adopt a certain technology if it is within or related to their prior experience, and was proved to act as a significant moderator between CWF and Behavioral Intention. A paper by Kang et al., [66] drives its focus towards the investigation of various factors affecting the adoption of Smartphones with respect to common consumer. The paper uses Technology Acceptance Model as a method for analyzing the acceptance of new technology and for empirical analysis Structural Equation Modeling was used.

Due to previous research it is shown that attitude has a weak relation to behavior intention. As a consequence the subsequent research omitted the variable called attitude from the Technology Acceptance Model.

The significance of defined paths of research model for TAM was analyzed. Results showed that most functional attributes affect perceived usefulness and perceived ease of use. The research results provided a useful explanation of market characteristics relating to Smartphone and its consumers. This information may be utilized to design new devices and to improve marketing strategy of Smartphones.

Smartphones today are similar to small sized PC's having an Operating System that can run add-on applications and software on top of the Operating System [65]. Students who use such devices gave an overall positive feedback because in their opinion such devices give a sense of belonging and enabled them to academically excel in terms of knowledge and awareness.

It is presented that Smartphone technology has an unquestionable potential towards its use as a learning tool by professors and students alike, that it provides its services in and outside the classroom context. Smartphone will be the tool of choice in future. For future research & methodology the digital divide between the students and the professors with respect to Smartphone usage needs to be investigated practically by a survey methodology.

This paper explores the potential for the evolution of Smartphone technology as a powerful learning tool [65] by providing a literature review on the use of Smartphone towards Higher Education, and lays a foundation for future research that focuses on examining the digital gap between teachers and students relating to knowledge and use of Smartphone in an existing university setting. This is because the author speculates that a gap does exist especially within the classroom context.

The paper by Woodcock et al., [59] is based on a collaborative case study conducted by an undergraduate student with the support of two academic members of staff. The research was carried out to establish the extent to which students use the Smartphone technology to support their learning. Initial exploration was conducted by student interviews.

The study showed that students who started using Smartphone for learning, they began to appreciate the benefits and its further possibilities in the current frame of reference. The study also suggested that the academics and educational developers should continue to increase their understanding of personal technologies such as Smartphone and Tablet.

In a comprehensive study of Smartphones by Hossein et al., [70] international user activities were characterized. The study involved user interaction with the device and its applications to study the impact on network and energy usage. A qualitative similarity was the main focus to learn about the Smartphone user behavior.

The study demonstrates the value of adapting to user behavior in context of mechanism to predict future energy drain. The study is directional to find ways for enhancing the Smartphone platforms. An effective adaptation will require future platforms to support light weight tools for monitoring and studying user behaviors.

2.2 TECHNOLOGY ACCEPTANCE MODEL:

Technology Acceptance model (TAM) was proposed by Davis [23] in 1989 to explain behavior intention of users to accept and utilize technological innovation. TAM is based on TRA also known as Theory of Reason Action, which is a psychological theory that tends to explain behavior. TAM involves two main predictors that are perceived usefulness (PU) and perceived ease of use (PEOU), along with a dependent variable known as behavioral intension (BI). TAM is a widely used and accepted model in Information Systems (IS) research because of its understandability, effectiveness and simplicity.

TAM is more specialized than TRA due to decades of Information Systems research, which is more suitable for modeling system acceptance of new technologies [44]. The research explored the ability to anticipate user acceptance of computer technology by measuring their intentions [44]. Therefore Smartphone acceptance can also be measured by understanding user intentions, which is termed as behavioral intentions. This construct will help us in explaining user behavior as well as future behavior of individuals for using a Smartphone. Variables including perceived usefulness, perceived ease of use and social norms are measurable for justifying and explaining user intentions for using a technology [44]. In TRA behavioral intention is defined as an individual's act to follow certain behavior (i.e. performing certain actions on a system) and this behavior is caused due to his or her own intentions [44]. Behavioral intention can be considered as a measure of individual's strength to perform a task that helps in achieving an outcome [44]. In both models, behavioral intention of a user can be influenced by other factors [44]. For example social norms (in TRA) can influence behavioral intention of a user [44]. Similarly perceived

usefulness and ease of use (in TAM) can influence behavioral intention of a user [44]. In TAM, usefulness relates to behavioral intention directly, which means an individual can develop an intention for using a system such as a computer and this intention is based on that user's awareness for using the technology for improving his or her performance [44]. Performance in this context refers to the ability to perform certain tasks by using a system. Thus in both models namely TAM and TRA, Behavioral Intention is a very important determinant of usage behavior or actual behavior [44]. The research emphasized that behavior is predictable from measures of behavioral intention [44]. Davis et al., [44] further elaborated this concept that even if any other factor imposes an influence on actual use (i.e. actual behavior) of a system by users then it is influenced indirectly through Behavioral Intention. The research proved that individual use for technology such as computer can be predicted through intentions, with perceived usefulness acting as a major determinant towards people intentions and the perceived ease of use also contributing a significant role towards people intentions [44].

A research by Verkasalo et al., [71] explains as well as proves that TAM model and other models should not consider mobile services as a generic concept instead specifically address individual mobile services. The research demonstrates the value of combining objective usage measurements along with traditional survey data. Results give evidence of discriminant validity amongst components and constructs. Findings also provide strong scales reliability.

Paper by Dulcic et al., [72] describes using TAM model for research due to the only model that has acquired wide scale attention in the information systems community.

Researchers in literature used a revised TAM model for evaluating PU and PEOU in terms of BI and actual use [73, 74]. Previous research concluded TAM to be a popular model for explaining as well as predicting system use [75] and provides consistent results.

Another research provides a study for assessing the use of Personal Computer Technology (PCT) in public organizations of developing countries especially South Asia and in particular 'Pakistan' [76]. The paper applies the Technology Acceptance Model by including additional external variables factors such as "Organizational Culture" & "Individual Factors". The expanded Technology Acceptance Model was used in this paper.

Positive association exists between Perceived Usefulness and Attitude implies that users take into account whether the system is useful for improving efficiency in the organization. The association between Attitude and Behavior Intention was also found to be positive as well as significant. There was a negative association between 'Level of Education' and 'Perceived Personal Utility'.

This research showed that personal utility plays an important role in individual choice to use or not use the available information technologies. There is a significant positive correlation between increasing levels of education and PCT use.

2.3 TECHNOLOGY ACCEPTANCE THEORIES

Various models with associated theories are used for understanding and surmising the acceptance and adoption of technologies across different domains. Main goal is to identify key factors and their relationships towards technology usage by analyzing individual intentions. Therefore it is necessary to investigate different models and theories that can be applied to understand, predict and help elaborate technology use such as Smartphone and its trends in IT. Use of Smartphone empowers mankind in many fields of life, so much so that it is now considered as basic necessity.

The focus of such studies is to understand and promote usage of IT, also for examining the barriers of technology use and intentional use with respect to actual usage. Different types of research models have different premise and directional benefits. Such theoretical framework and concepts need to be applied for developing a model for studying technological use in real scenarios for demonstrating the

acceptance of Technologies (such as Smartphone) in a particular demographic for reducing the gap known as digital divide. Various TAM models that were considered during the model design for Smartphone are explained as follows:

2.3.1 Theory for Reasoned Action (TRA):

A multifaceted model supported with theory was presented in 1980 [41]. That model was related to attitude and behavior relationship [41]. This model was used in business and academics [42]. TRA affirms that beliefs affect attitude as well as social norms that define the behavioral intention [41]. TRA has two main determinants namely attitude and subjective norm that are associated with behavior. Here attitude towards behavior implies the previous attitude of an individual for performing a behavior. In this model attitude towards a behavior is positive or negative, if the individual believes that the outcome of a behavior is positive or negative respectively. In this model subjective norm refers to the social pressure in decision making of an individual for performing a particular behavior. It is an individual's perception about what the social group prefers towards performing a behavior and how close the group is related to an individual. Many of the technology acceptance model initiate from the TRA model. An author named Han referred that this theory is frequently used by researchers to investigate determinants of IT innovation and usage behavior [43]. Theory of Reasoned Action (TRA) is widely used in technology acceptance research although it was not developed with a specific aim of acceptance of technology [44]. However, TRA was observed to provide useful indications about user intentions to use an information system [45].

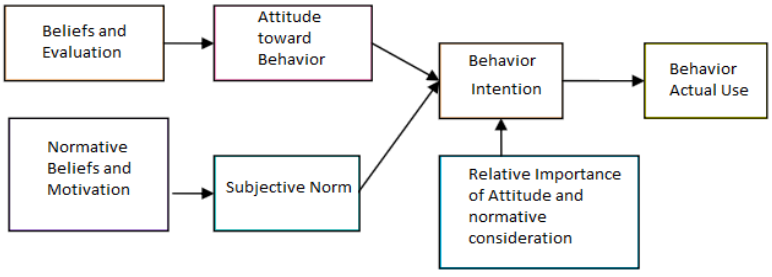

Figure 2: TRA Model

2.3.2 Theory of Planned Behavior (TPB):

Due to limitations of TRA in terms of voluntary behavior and behavioral control, another theory TPB was introduced as an extension of TRA. TPB was introduced by Ajzen [33]. TRA main focus was to determine actual behavior of people through their intentional behavior, which is influenced by their own attitude and by the society [41]. Whereas TPB was introduced as an extension of TRA for considering other constraints that affect personal behavior, such as internal or external economic position and experience for using a service / technology [6]. TPB included another determinant / construct known as Perceived Behavioral Control (PBC). Theory of Planned Behavior (TPB) predicts intentional behavior and is considered to be more general as compared to TRA because behavior can be deliberate (i.e. intentional) as well as planned [46]. The intention is determined through three constructs namely attitude towards behavior, subjective norm and perceived behavioral control [31]. Favorable attitude and subjective norm, implies greater perceived behavior control. In TPB certain behavior is defined through three kinds of beliefs behavioral, normative and control beliefs [47]. (Figure 3 for model related by Ajzen [48])

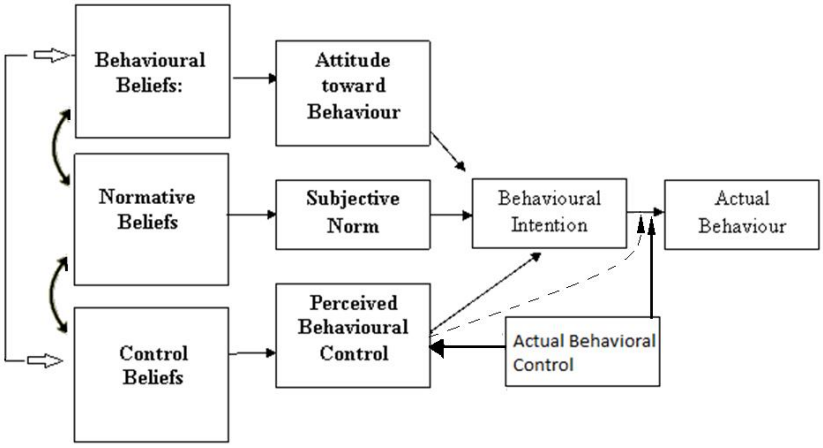

Figure 3: TPB Model

2.3.3 Decomposed Theory of Planned Behavior (DTPB):

DTPB was developed by Taylor and Todd in 1995 in a study for understanding IT usage [12]. This model further divides and explores dimensions of attitude,

subjective norm and behavioral control towards behavioral intention. Major change was the decomposition of attitude belief into Perceived Usefulness (PU), Perceived Ease of Use (PEOU) and compatibility. These factors are consistent while considering information technology and its usage.

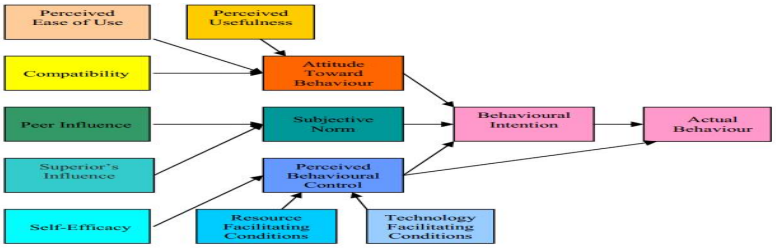

Figure 4: DTPB Model

Normative belief is divided into peer influence and superior influence due to the fact that they have different views for IT use. Perceived behavioral control was divided into three constructs called self efficacy, resource facilitating condition & technology facilitating condition. This model is more elaborative and capable for explaining behavioral use.

2.3.4 Technology Acceptance Model (TAM):

Davis in 1989 proposed the Technology Acceptance Model also known as TAM [23, 44], which is established on the theory of Reasoned Action TRA [30], as a tool for predicting the possibility that a new technology will be adopted within a group or an organization. Technology Acceptance Model was developed based on the hypothesis that the acceptance of technology and its use are well understood and can be related by analyzing individual's internal beliefs, their intentions and their attitude. Due to this it is feasible to predict future technology trend in terms of use by applying TAM when the technology is introduced.

TAM utilizes TRA based theoretical foundation for determining causal linkage between Perceived usefulness and Perceived ease of use, as essential beliefs.

Technology Acceptance Model in its original form consists of five components namely Perceived Usefulness (PU), Perceived Ease of Use (PEOU), usage Attitude, Behavioral Intention of usage, and Actual Use of system.

TAM hypothesizes and assumes that the fact for adopting a particular technology for use can be determined by two key technological factors called PU and PEOU. PU implies to the degree of belief that an individual considers a particular technology to be used for enhancing ones performance in a job or towards any given task. The term PEOU refers to the individual's belief in a particular technology who considers it to be easy to use or free of effort [23]. Here BI means the individual's future behavior to use that technology for achieving any goal or a plan. BI then relates to 'actual system use' in terms of likelihood or anticipation based on individual's intentions to use a technology in actual.

The use of BI in original TAM was used in two unique aspects that is, as an independent variable and as a dependent variable. BI acts as a dependent variable in the situation for testifying the validity of PU & PEOU, whereas BI acts as an independent variable when expressing actual usage behavior. In a follow-up research the attitude variable is shown to observe weak predictors for BI [12]. As a result in many subsequent researches using TAM the use of Attitude variable was excluded.

Technology Acceptance Model as developed by Davis (1989) articulates success of system in terms of adoption and use, can be readily measured by three factors concerning the user of the system, these factors are PU, PEOU and Attitude (ATU) towards system usage [23]. Similarly if a system is not considered as easy for use by its users then that system is perceived as not useful. The model depicts that user's perceptions determine the Behavioral Intention for using or not using a system. And testing these perceptions can be captured by considering user's perception for usefulness and ease of system use [23, 49].

In two decades TAM has transformed into a very stable, robust, effective and greedy model for prediction of user acceptance of any technological system in use. In

the first decade of TAM use for mapping acceptance of systems, a similar position was maintained by Venkatesh & Davis [22]. Technology Acceptance Model in general has been supported by various empirical studies and this has enhanced the capabilities of TAM as a model for predicting technology acceptance in numerous contexts and amongst a variety of systems in use [50, 51, 52, 53, 54]. TAM also helps analyze and explain the adoption variation in a majority of possible information systems [55, 56, 57]. Over the time TAM as a model incorporates and accumulates different findings in terms of information systems research, which enables this model to be very suitable for modeling acceptance of different technologies such as computer acceptance [44].

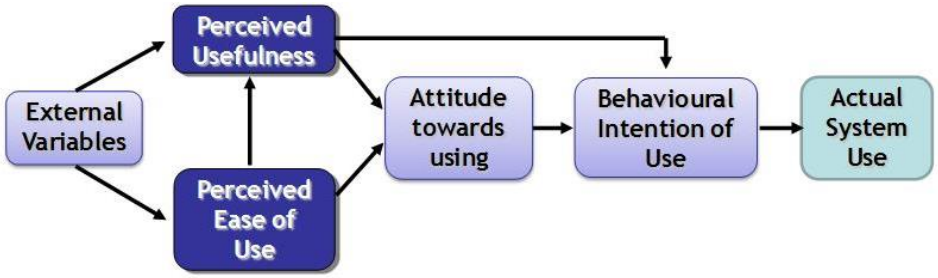

Figure 5: Technology Acceptance Model (Original)

TAM has certain assumptions; one is that the technology use is voluntary. The second assumption is that at a given time with sufficient information about a particular behavioral activity of an individual, the individual's behavioral intention implies that the behavioral use will resembles the actual usage. TAM is a widely used model in research papers for investigating acceptance of various technologies. The number of researchers and academics that are still utilizing Technology Acceptance Model proves the fact that this model as a valid tool with a wide scale of acceptance.

2.3.4.1 Limitations of TAM:

TAM has become one of the broadly utilized models particularly for information systems because of its higher degree of applicability, understandability and simplicity. However TAM has some imperfections and all TAM associations / relationships are not carried out or considered as they are in all studies, this is due to

the extensive variation in terms of predicting effects in various studies that are concerned with different types of systems and unique set of users.

2.3.5 Technology Acceptance Model 2 (TAM2):

TAM2 was developed by Davis and Venkatesh [22]. The goal of this model was to extend TAM to include additional determinants of TAM for explaining PU and usage intentions in terms of social influence and influential reasoning process. Also TAM2 was developed to understand how the effects of these determinants vary with the increasing experience of users upon target IT systems. TAM2 will help in designing changes that would increase the user acceptance and its usage of future systems.

It was noted that the illustrious usage of TAM towards information systems of professional use, but the actual use of such systems had gone low and some systems remained underutilized [22]. Venkatesh and Davis moved forward to extend the TAM model, while acknowledging its original value, which was developed by Davis and by Davis, Bagozzi and Warshaw in 1989. TAM was extended by Venkatesh and Davis as a follow-up approach referred to as TAM2, in this extended model focus was to model determinants of Perceived Usefulness for gaining better understanding of technology usage intention. Davis and Venkatesh asserted that even though perceived usefulness in previous research is an important driver towards Intentional Use some determinants are still overlooked that may cause an influence. Therefore in TAM2 social influences were incorporated as a potential factor along with focus towards PU and PEOU. In TAM2 social influence theoretically operated through Perceived Usefulness (PU). In TAM2 there are three major factors that affect individual adoption towards a system that are subjective norm, voluntariness and image. Subjective norm refers to the influence of a third person or a group that affects an individual's decision for performing a specific behavior. Here voluntariness reflects the inter-link with the first factor (Subjective norm) to represent the degree of voluntariness to influence an agreement to the subjective norm. Image is the third factor, which depicts the effect on individual's social status for using a system in a society or group.

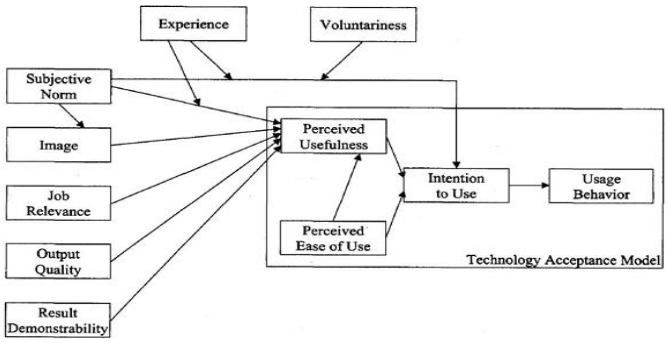

Figure 6: TAM2 Model

2.3.6 Augmented TAM / Combined TAM & TPB (CTAM-TPB):

Factors such as social or control behavior have a significant influencing on Information Technology especially in terms of behavior usage. Therefore Todd and Taylor in 1995 added namely subjective norm and perceived behavioral control to TAM [12]. This change was made to provide a complete test for essential determinants of IT use, because of predictive utility in terms of IT usage and social psychology. This model is known as (Augmented TAM) / (Combined TAM & TPB).

Augmented TAM provides a capable model for IT usage acceptance for both categories of users that are experienced or inexperienced, keeping a reasonable balance of variance in intentional behavior and actual behavior [12]. Thus augmented TAM is useful in predicting usage behavior for users that do not have any experience with a system or a technology.

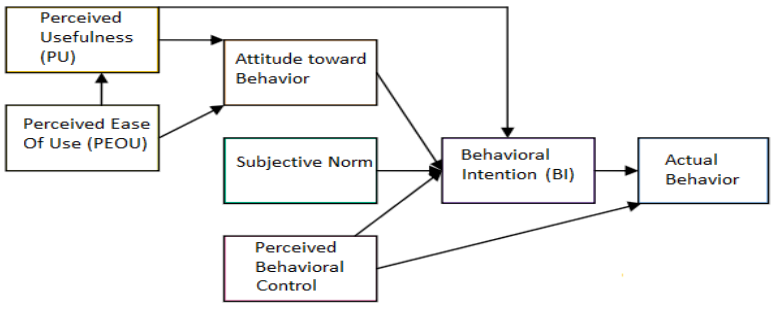

Figure 7: CTAM-TPB Model

2.3.7 Unified Theory of Acceptance and Use of Technology (UTAUT):

The Unified Theory of Acceptance & Use of Technology also called UTAUT was introduced by Venkatesh, Morris, Davis, Davis F.D and G.B [58] in 2003. This model constituted four important determinants of Usage and Intentions. Apart from four determinants the model also includes four essential moderators for the key relationships. UTAUT considers four major constructs that act as direct determinants of usage behavior and user acceptance of technology. These are Performance Expectance, Effort Expectancy, Social Influence and Facilitating Conditions. The four moderators include gender, age, voluntariness and experience. Apart from this in the model 'Attitude' for technology use, its productivity or uneasiness not considered as direct determinants of intention.

UTAUT model represents the fact that with passage of time determinants of intention as well as behavior have been refined such that the key relationships are moderated [53]. This is explained by considering the key moderators such as age, which received less emphasis in previous models but currently in this model it affects every key relationship by moderating their effects. Similarly gender is also considered as another key moderator towards influence, and this moderation affect of gender is also supported in sociology as well as social psychology.

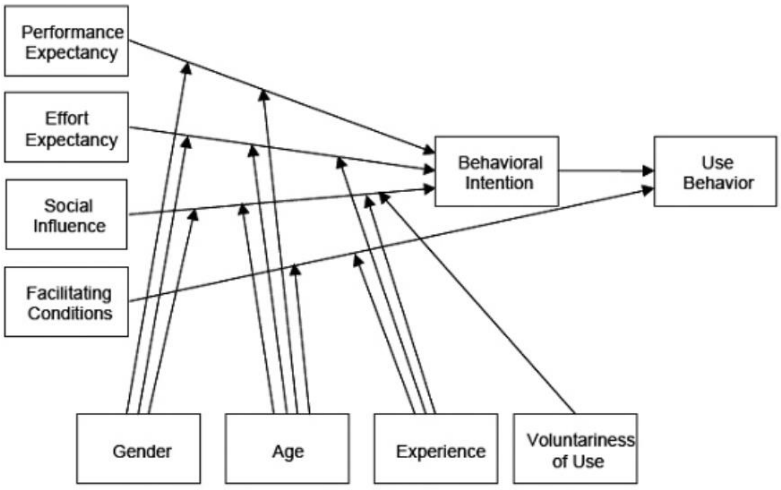

Figure 8: UTAUT Model

Chapter 3:

RESEARCH MODEL & HYPOTHESES

3.1 RESEARCH MODEL:

The formation of this research model is built on the significant aspects of the models and theories that have previously been discussed. This research is based on the adapted version of Technology Acceptance Model, which combines TAM, TAM2 and augmented TAM. Constructs of perceived usefulness and perceived ease of use are further extended by including factors such as social norms and perceived cost savings. Smartphone usage intentions are examined by either the direct or indirect determinants together with various factors along with individual characteristics. The model was developed while keeping in view the different constructs and their contextual use within different Information System studies. Smartphone has multiple technologies integrated in a single hand held device, that are rapidly evolving therefore Smartphone acceptance analysis might subsume many diverse factors. Analysis of these factors will help in measuring the overall acceptance through user perceptions and their behavioral intentions for using a Smartphone. In the research model, eight primary functional attributes were defined as independent variables and assumed that they affect Behavioral Intention of Smartphone through PU and PEOU as in figure 9.

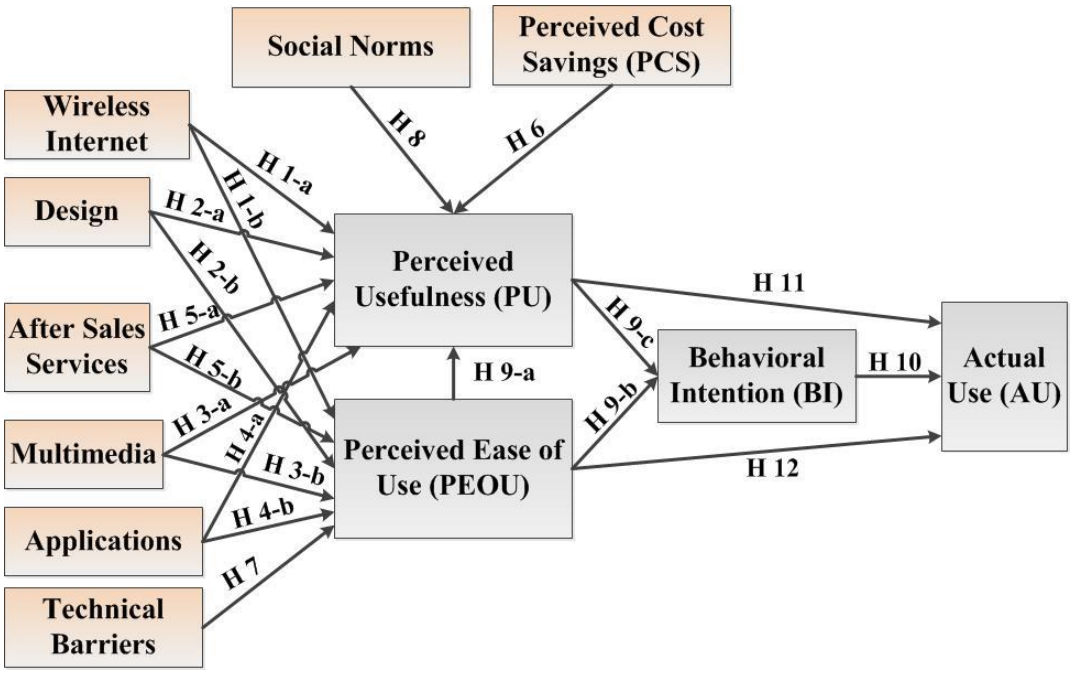

Figure 9: Research Model for Smartphone

3.2 MODEL CONSTRUCTS & HYPOTHESES DEVELOPMENT:

3.2.1 Perceived Usefulness:

Perceived Usefulness refers to the degree of user belief that using a technology has improved the performance of various tasks related to productivity or goal. Perceived Usefulness directly affects usage intentions of device, as postulated by the proposed model in literature [19, 20]. Perceived usefulness strongly determines usage intention in Technology Acceptance Model [21, 22, 23]. Previous research has shown that not only in a professional environment but also outside, Perceived Usefulness is a critical factor in user acceptance of technology [19, 24]. In this context Perceived Usefulness is taken as the extent of how well consumer(s) believe that a Smartphone can be integrated in their day-to-day activities [66]. It is the user belief that a Smartphone enables an increase of productivity, efficiency and convenience of use [66].

3.2.2 Perceived Ease of Use:

Perceived ease of use (PEOU) is recognized as another essential external determinant that may affect user intention of technology adoption [23]. PEOU is the extent to which individual belief in using a system is free from effort [23]. If a system is perceived as used easily then individuals will observe a higher intention to use that system. PEOU acts as a direct determinant towards usage intention, which has been studied in literature [20, 19], and they have also confirmed the effect on usage intention. Igbaria et al., [19] hypothesized and confirmed the effect of perceived ease of use. The research context of Igbaria et al., [19] was related to test the use of micro-computer amongst professionals including managers in North America. A micro-computer is a computer having a central microprocessor. Results implied perceived usefulness to be the main motivational factor for using a micro-computer by professionals [19]. Previous research pointed that perceived ease of use to have a positive as well as significant relationship with natural behavior for using Cellular Telephones [20]. Focus of Kwon & Chidambaram [20] was to study adoption of cellular telephone adoption as a useful technology amongst people. That is a system which is not easy to use or prohibits entertainment experience in turn affects the usage intention. Chong and Marthandan [25] proposed that whatever the perception in terms of technology usefulness is, the fact that how easy it is to use that technology in practical terms may still induce an affect towards user initial intention to adopt or continue the system. Findings of previous research have discussed inconsistency in terms of relationship between ease of use and acceptance behavior relating to different types of products / technologies [26, 28]. It has been concluded by many researchers that PEOU is an important anticipator in predicting user trend towards mobile acceptance [27, 29]. Snowden & Spafford [29] conducted a non-empirical case study on mobile technologies acceptance through TAM in operations management or project management domain of business industry. Cheong & Park [27] defined mobile technology acceptance through mobile Internet due to increasing number of subscriptions and growing revenue. Cheong & Park [27] referred mobile Internet as

M-internet and studied individual behavior for using M-internet in Korea. Mobile Internet technology considered luxury at that time, still its innovative use as a technological tool for fast and secure communication through wireless networks started to provide services such as email, banking and entertainment [27]. Cheong & Park [27] empirically showed PEOU to be an influential factor towards M-internet acceptance. Perceived Ease of Use is considered as the degree of a computing technology to be easy to use and without any difficulty [44]. Relating this concept towards Smartphone adoption, PEOU is the extent that users may easily operate Smartphone and navigate through it without much effort [66].

3.2.3 Behavioral Intention:

It is important for researchers and practitioners to understand individual's resistance for using emerging technologies such as computers [44]. For this purpose, practical methods for evaluating technology and understanding ways for improving its acceptance amongst people should be explored [44]. TAM is more specialized than TRA due to decades of Information Systems research, which is more suitable for modeling system acceptance of new technologies [44]. Davis et al., [44] research explored the ability to anticipate user acceptance of computer technology by measuring their intentions. Therefore Smartphone acceptance can also be measured by understanding user intentions, which is termed as behavioral intentions. This construct will help us in explaining user behavior as well as future behavior of individuals for using a Smartphone. Variables including perceived usefulness, perceived ease of use and social norms are measurable for justifying and explaining user intentions for using a technology [44]. In TRA behavioral intention is defined as an individual's act to follow certain behavior (i.e. performing certain actions on a system) and this behavior is caused due to his or her own intentions [44]. Behavioral intention can be considered as a measure of individual's strength to perform a task that helps in achieving an outcome [44]. In both models, behavioral intention of a user can be influenced by other factors [44]. For example social norms (in TRA) can influence behavioral intention of a user [44]. Similarly perceived usefulness and ease of use (in TAM) can

influence behavioral intention of a user [44]. In TAM, usefulness relates to behavioral intention directly, which means an individual can develop an intention for using a system such as a computer and this intention is based on that user's awareness for using the technology for improving his or her performance [44]. Performance in this context refers to the ability to perform certain tasks by using a system. Thus in both models namely TAM and TRA, Behavioral Intention is a very important determinant of usage behavior or actual behavior [44]. Davis et al., [44] emphasized that behavior is predictable from measures of behavioral intention. Davis et al., [44] further elaborated this concept that even if any other factor imposes an influence on actual use (i.e. actual behavior) of a system by users then it is influenced indirectly through Behavioral Intention. These findings were supported by their research on the collected data for the corresponding hypotheses [44]. Behavioral Intention is therefore a measurable construct and can give insight into future level of system acceptance for its users [44].

The behavior of technology use and associated factors of technology acceptance can be explained by applying information-systems model developed by Davis [23] in 1989 known as TAM. In TAM usage behavior of information systems (such as a computer) is mainly explained through behavioral intention, which is formed as an outcome of human awareness to reach a decision through some intellectual process [23]. Behavioral intention is ascertained by two factors of belief known as perceived usefulness (PU) and perceived ease of use (PEOU) [23]. The two main factors enable system developers to control user beliefs towards a system, understand their behavior intention and system actual use [23]. TAM proposes perceived usefulness (PU) and perceived ease of use (PEOU) to help detect behavioral intentions of an individual to use a system [23].

In TAM, behavioral intentions are established as a result of conscious decisions [58]. Important belief factors in context of information system acceptance and use include perceived usefulness, perceived ease of use and attitude [23, 91]. The cognitive factors are perceived usefulness and perceived ease of use [23]. Attitude is

interpreted as the degree to which a user considers and affiliates a system with his/her job [23]. The attitude to use a particular technology in this model is considered as a factor for future behavior or cause of an intention leading towards behavior [23]. Ajzen and Fishbein [91] considered attitude of technology use in terms of positive or negative feeling effect of individual user to perform a certain behavior. Venkatesh et al., [58] proposed perceived ease of use and perceived usefulness are two essential factors for explaining technology usage. Empirical studies have proved the existence of relationships between two major factors for Smartphone use in TAM that are perceived usefulness and perceived ease of use [80]. If there is an increase in perceived ease of use for users of Smartphone then perceived usefulness also increases, therefore influencing behavioral intention for Smartphone use [80].

Individual's readiness to perform a certain action known as behavior is indicated through intention [30], where intention acts as a critical factor for explaining consumer's behavior. Intentions are verified as precedent of human behaviors [32]. Intentions are found by analyzing individual's attitude towards technology use that is perceived to result in a positive outcome [11].

3.2.4 Attributes of Smartphone:

Information system products are composed of many different attributes that might facilitate technology acceptance for target users. Every user accepts different set of attributes, which are influenced due to many factors such as social influence, job relevance, usefulness, easy to use etc. Therefore attributes and factors have a considerable influence towards consumer acceptance depending upon the level of satisfaction and the usefulness of using a technology such as Smartphone. Similarly users tend to compare various product attributes from one product to another. It is important to derive various influencing attributes and factors, and relating them in a structured way to measure the overall acceptance of Smartphone technology.

3.2.5 Wireless Internet:

Smartphone supports connectivity to the Internet through Wi-Fi. The use of Wi-Fi for accessing Internet has increased greatly with the increased emergence of mobile devices [93]. This is because mobile devices are Wi-Fi enabled [93]. Furthermore as the number of hotspot increase the user acceptance also grows [93]. Recently Mobile Technologist and Mobile Operators are realizing the importance of devices to have an in-built Wi-Fi enabling technology for Internet access, because Wi-Fi plays a vital role to help avoid network mobile data traffic to clog, which results in unsatisfied customer base [93]. Furthermore new business models are being considered by service providers to gain benefit from Wi-Fi enabled devices [93].

Wireless Internet access has evolved rapidly with time, in terms of data networks the technology has reached 4th generation (4G) and the upcoming 5th generation (5G) of mobile networks [92]. Smartphoneôs primary mode for accessing Internet and mobile services is via standards that are associated with technologies from 1G to 5G. Standards have evolved through different mobile technology generations such as AMPS, GSM, GPRS, CDMA and ôSingle Unifiedô [94]. The mobile wireless technology of 5G is focused in developing user terminals for providing access to different wireless technologies, simultaneously combining different flows from other technologies as well [92]. First generation (1G) provides basic analog mobile voice service while second generation (2G) provided capacity and coverage as compared to 1G [92]. Third generation (3G) provides high-speed data services enabling an experience similar to mobile broadband [92]. Fourth generation (4G) provides ubiquitous terminal mobility, which was successfully tested first time in Tokyo (Japan) in the year 2005 [92]. NTT Do Co Mo using 4G achieved 1Gbps real time packet transmission at speed of 20km/h [92]. 4G provides access to a wide range of advanced mobile telecommunication services on mobile as well as fixed networks, including packet switching at high data transfer rates, advanced applications such as multi-user environments [92]. The upcoming fifth generation (5G) is considered more intelligent future technology aiming to interconnect different geographic locations

along with multiple devices such as laptops with mobile phone with a certain degree of automaticity [92].

Wireless connectivity in Smartphone is the service that provides accessibility to the Internet and enables digital information & content sharing to its users. Wireless Internet affects the mobile service acceptance as evident in the research [1]. As Smartphone also support wireless Internet access, this functionality was also available in 2003 in certain mobile phones. The study in 2003 showed one of the broad factors that affect mobile phone technology acceptance is network capabilities (Smartphone was not available at that time) [1]. Network capabilities such as wireless Internet access significantly contributed towards users trust in a mobile device enabled with wireless Internet connectivity [1]. The paper stated that users trust in a mobile computing device would "erode" if the network was down or less reliable or even less responsive, which connects to the Internet using wireless technology. This is because wireless technology gives the advantage of mobile communication, mobile commerce and mobile collaborative services [1]. The findings also included that mobile device usage increased in terms of data features, if the number of web services are increased which remained available through wireless Internet access consequently improving chances of technology adoption [1]. This implies that using wireless technology to access Internet will help a user complete his or her tasks efficiently. That is by using wireless technology available in Smartphone, users expect to perform tasks in a better way. Therefore wireless connectivity has an important contribution towards Smartphone acceptance and its usability. Thus we establish the hypothesis as:

> **H1-a:** Wireless Internet connectivity option increases the Perceived Usefulness of a Smartphone

Users of Smartphone share a high preference towards ubiquitous Wi-Fi connection according to Wi-Fi Alliance survey [96]. About 90% responded to continue their current Service Provider for delivering automatic ability to connect to Wi-Fi hotspots, with a considerable 72% willing to pay more for such a service and an

almost equal percentage willing to change their provider if such a service is offered by another [96]. This survey was conducted by Wakefield for Wi-Fi Alliance with the polls indicating that easy to use Wi-Fi connection can drive loyalty and induce a considerable impact on Service Provider user base [96]. According to statistics [97] the second most accepted consumer requirement for Smartphone is an in-built Wi-Fi adapter. Further analysis shows 40% Smartphone users from every age group to perceive Wi-Fi adapter to be important for using the device [97]. Thus wireless connectivity makes it easier for users to connect to Internet for effectively using a Smartphone. Perceived Ease of Use is the individual's perception to use a technology easily, and in wireless context we consider that the more options there are to connect to the Internet the more easily the Smartphone use becomes. Internet can be accessed either from a data package service or through Wi-Fi in a Smartphone. In many situations, user may find it easier to connect to Internet through Wi-Fi rather than data package. Cellular mobile network providers are considered a standard to fulfill consumer mobile device needs [153]. However a study by Cisco about Smartphone and Tablet users related consumer preference for using Wi-Fi instead of cellular network providers [153]. The reasons for users to consistently prefer Wi-Fi included speed, price, quality, coverage and security [153]. Since no one prefers a loading screen on their Smartphone screen while streaming online videos [153]. Wi-Fi is 69% faster than cellular networks for loading websites, video streaming and sending messages [153]. An average American pays about $83 monthly for cellular network service, whereas Wi-Fi is already available at many homes, workplaces, businesses, as well as public places, at almost no or little cost [153]. In terms of quality the call quality using a Wi-Fi service is clearer and the bandwidth may even increase, if there are more hotspots around [153]. Wi-Fi is available almost everywhere, which increases the coverage aspect such as coffee shops, gym, home or work places [153]. We can state that almost no network, may it be the cellular or the wireless network, is considered completely secure but a majority of Cisco survey participants in 2012 supported Wi-Fi as the better secure network as compared to cellular network [153]. This is because Wi-Fi provides more control in terms of security settings with

personalized network labels and passwords [153]. The same trend is followed in UK where there are more Smartphone users who access the Internet by logging onto a Wi-Fi network instead of a cellular network [154]. And this may be the reason why apart from fixed network operators, the mobile operators are also offering Wi-Fi service [154]. In this context, Cellular Internet network packages do not provide unlimited services as compared to Wi-Fi service that is available at almost everyoneôs home [155]. And using too much Cellular package can lead to over usage fees [155].

Nowadays service providers do not make money on voice service anymore, however real opportunity lies in data usage [156]. And using a Wi-Fi service is the last thing that major carriers want consumers to do [156]. Service providers want consumers to use data plans by using their network package services, which makes the consumers to spend more and hence increases companyôs revenue [156]. But there are instances where service providers figure out that their subscriber is using a Smartphone for voice services only, and providers may force the consumers through different polices to pay for data plans as well [156]. We establish the second wireless hypothesis as:

> **H1-b:** Wireless Internet connectivity option increases the Perceived Ease of Use of Smartphone

3.2.6 Design

While considering Smartphone design as an independent variable there are two major aspects of Smartphone design [66]. That is basic design color of Smartphone and detailed appearance including shape, keypads and touch screen [66]. Leung & Wei [4] recognized that the physical appearance of a Smartphone is the way of expression for the user. Czarnitzki & Thorwarth [77], mention the success story of Apple's product called iPod, and stated that right design can become a decisive factor for new products entering in market. The research explains that a good design gives consumers a feeling of product suitable to their needs [77]. Czarnitzki & Thorwarth [77] quote the example as a proof that recent trend of companies is to design products

as fashionable accessories. Yamamoto & Lambert [78] showed that aesthetics have an effect on customer's product preference especially where industrial products are concerned. Yamamoto & Lambert [78] discuss as well as provide evidence that it might not seem to have any effect on performance, but appearance does have an impact on an industrial product. They utilized a conjoint scaling approach and found that industrial product appearance exhibits an influence, which in some cases might even exceed product performance or price attributes. Yamamoto & Lambert [78] finally suggest that due attention should be given towards product aesthetics because it pays-off in the form of sales.

There are three main steps under consideration for Smartphone design, which consists of ôbasic styleô, ôuser interface (UI)ô, and ôstyling with color-material-finishing (CMF)ô [95]. Basic style means Smartphoneôs style suitable for specific Information Communication Technology (ICT) services and scenarios of device use [95]. Implying a user Interface which is understandable in human psychology and cognitive characteristics, that is in terms of easily operating the hardware [95]. Step 3 includes overall styling with respect to Smartphone Color, Material of Smartphone outer frame and Finishing such as sharp or smooth look [95]. The market environment for Smartphone design is oriented around customer perception of attractive design, which embodies customer values based on Smartphone usage scenario and customer preferences [95]. Respondents of another study showed the need for highly usable Smartphone hardware and its software [59]. Design features that the user considers important to be available in a Smartphone includes screen size for text visibility, memory for allowing applications function properly and battery life [59]. Hence, there are several Smartphone design features that might play a role towards the usefulness of the technology amongst users. Therefore the first hypothesis of design is:

H2-a: Design features increase the Perceived Usefulness of a Smartphone.

Smartphone design includes touch screen design, which has considerable contribution towards ease of use [95]. Touch screens of Smartphone differ by key

operations of various scenarios of device usage [95]. Fujitsu objective at Japan is to develop easy to use Smartphones for providing comfortable and enjoyable touch screen operations for Smartphone users, by understanding design requirements and using the knowledge obtained from designing ñRaku-Rakuò (easy to use) handset series [95]. Therefore the second hypothesis of design is proposed as:

H2-b: Design features increase the Perceived Ease of Use of a Smartphone.

3.2.7 Multimedia

Multimedia includes several media functions for its users [79]. It refers to as the functions such as camera, music, games, or a medium for expression and communications [66]. Nysveen [6] performed a study relating to four different mobile services namely SMS, Contact, Payment and Gaming; in which the conclusion was based on analysis of the these services. This analysis showed that user intention and the attitude towards actual use were influenced directly by the motivational influence of enjoyment. In another study by Hong relating to mobile data services, enjoyment was found to significantly predict the intended adoption of mobile data services in the scope of communication, information & entertainment [7]. Cheong & Park [8] showed the perceived playfulness helps in predicting people intention to use mobile Internet. Fang [9] studied and found playfulness to influence the adoption of mobile games. For multimedia messaging service (MMS) Thorbjornsen [10] reported a positive significant effect of behavior towards people intention to use MMS.

Main concern of Smartphone consumers is multimedia usefulness towards user productivity [98]. The term ñsmartò in Smartphone can be referred as user expectation from the device to perform complex tasks such as streaming, high quality video playback, music playlists management, support to different audio video formats, Internet browsing and office tasks such as Word documents, presentations, Excel sheets etc. [98]. Windows Mobile provides multimedia features for playing back music, messaging, web browsing, email, Bluetooth, Getting start center, video streaming, audio and video editing to increase usability for common user [98].

Smartphone serves as a multimedia device with users spending more than 30 minutes a day for multimedia activities [99]. Most of the multimedia time in Smartphone usage is spent listening to music, or watching videos, or taking snap shots, or viewing pictures, or storing and accessing files on the Smartphone [99]. A noticeable difference is observed towards time spent on multimedia across different Smartphone operating systems [99]. In India Android users spend about 11% of multimedia usage time for streaming videos and mobile TV apps while in comparison Symbian users spend 3% and BlackBerry users only 4% of multimedia time [99]. According to the study Smartphone users consume multimedia content with an engagement level activities peak time at mid-day, approximately 2-3pm and social networking activities at night (10-11pm) [99]. Smartphone is considered as a complete converged device integrating multimedia functionality such as music player, digital camera, gaming, navigation, radio and television [99]. It is estimated that handset manufacturers sell more cameras than camera manufacturers [99]. Thus multimedia opens a gateway of opportunity for content creators and advertisers reaching a larger target audience [99]. Therefore the following hypothesis is suggested for multimedia:

H3-a: Multimedia features increase the perceived usefulness of a Smartphone.

Multimedia features that are available in Smartphone tend to diminish time or spatial constraints for users and therefore supports ease of use [5]. Multimedia includes music support such as centralized iTunes store, which provides support for a wide range of Apple application as well as 3rd party applications [98]. Multimedia features like ôiTunesô or ôstoreô provides iPhone user base an easy access to any Smartphone enhancement, products or music [98]. This increases the ease to use a Smartphone device. Companies like Apple can align hardware and integrate with iPhone Operating System successfully to give new multimedia features to its device for example multi-touch applications, accelerometers, microphone, cameras technologies with sophisticated input data to Smartphone [98].

Dowling [79] defined multimedia simply as a combination of two or more media elements. Multimedia is referred as a comprehensive end product built collectively from multiple media elements [79]. The term media elements or media components are like smaller end products that can be experienced independently [79]. Multimedia experience includes several media functions of communication, entertainment and expression [106]. Technologically multimedia is an integrated set of smaller products for the purpose of transmission, storage, access and content creation [106]. The smaller products or simply media that selectively participate in the formation of multimedia may include text, images, graphics, speech, audio, video, animation and data-files [106]. Some examples of multimedia are 'newspaper' which integrates text, half tone images; similarly 'Television' is multimedia, which constitutes audio-video signals [106]. Today such multimedia features are also available online [106]. Therefore another multimedia hypothesis is:

> **H3-b:** Multimedia features increase the Perceived Ease of Use of a Smartphone.

3.2.8 Applications

Applications in Smartphone refer to the software or executable content that provides some kind of service. Behavior of users can be observed from the unique set of application & their usage. So the applications that user conveniently uses and finds them to be useful, thus contributes to the overall acceptance of Smartphone to the user. Similar important terminology, relevant in this context is known as Computer self-efficacy, which means the degree of people's belief to have the ability to perform a specific task on their computer or Smartphone [11]. Two main components of facilitating conditions include technological resources & compatibility [12, 13]. Some Smartphone applications are free and some are factory-installed applications, while many have to be bought, which may include application usage charges [59]. Users considered Smartphone useful as it incorporated apps for emails, course material, time management apps and personal organizer apps etc. [59]. In Smartphone-application context Perceived Usefulness implies to improve the user productivity and increases

their learning performance [59]. So the following hypothesis is suggested for applications:

H4-a: Availability of preferred applications increase the Perceived Usefulness of a Smartphone.

According to a study students considered Smartphone applications to be beneficial as they were easy to use, speedy in access, and available online [59]. Many platforms have different application base capability, like some can run office tool using a third party application [98]. Following table reflects supported applications in various platforms [98]. Web based applications have some similarities as well as differences when compared with Smartphone applications [107]. Web applications are larger in size and consists more number of pages while Smartphone applications are composed of fewer pages with interactive buttons [107]. Smartphone applications are abbreviated as 'apps' [108]. Smartphone apps can be sub divided into more differentiating components such as number of apps, access to apps, price for using apps, and availability through app stores [108]. These application features can contribute towards acceptance of a Smartphone as a device and can also lead to selection of a specific Smartphone brand based on user perception. We can relate 'number of apps' to have two aspects one is the number of apps providing basic features at the time of Smartphone purchase and the other is the total number of applications available to the Smartphone being purchased [108]. On the other hand 'access to apps' means the Smartphone applications that are available in a market place or their platform dependency [108]. Moving on to 'price of apps' it represents the application use cost whether to use on the go or for access to installation of application while some applications are free [108]. Finally 'availability through app store' implies the availability of applications online for installation via online application stores of different platforms, for example Apple App Store, Blackberry App World, Nokia Ovi Store, Google Play etc. So the next hypothesis is:

H4-b: Availability of preferred applications base increase the Perceived Ease of Use of a Smartphone.

Table 1: Comparison Table of applications for different Platforms

Mobile OS	ANDROID	IPHONE	SYMBIAN	WINDOWS MOBILE	PALM
Office Support	-Google Office Suite (mail, calendar, etc.) -Third-party	-3rd Party office applications	- MS Office Suite	-MS Office suite	"Documents To Go" by DataViz (support for Word, Excell, PowerPoint, and PDF)
Desktop Sync	USB synch	Proprietary with iTunes	Mobile Active Sync, USB, and over-the-air (OTA)	MS ActiveSync	HotSync
Speech-to-text	Third Party Apps	3rd Party App	VoiceMode 2.0	-MS voice command -Third-party	"SayIt" by ToySoft; "HipTalk" by Digital Dan
Media Player	-Android MediaPlayer - Third-party front-end	-ITunes media player - No third party access to library	-Differs based on the device using Symbian.	-WMP	-Pocket Tunes by NormSoft -Palm Media -MMPlayer
Web Browser	-Based on WebKit Library	-Safari	-Browser differs based on the device.	-IE6	-Blazer
VoIP Support	-None	-Yes	-Yes	-P2P	-None
Video Codec Support	H.263, H.264, MPEG-4, WMV	H.264, MPEG-4	Audio and video codec interfaces compliant with OpenMax IL 1.0	ASF, AVI, MPEG-4, MS RLE, WMV	AVI, WMV, MPEG, MPG, ASF, MPEG-1, 3G2, 3GP, MOV, QT, OGG
Audio Codec Support	3gp, mp4, m4a, aac, mp3, midi, ogg, .wav, .wma	MP3, M4A, AAC	Audio and video codec interfaces compliant with OpenMax IL 1.0	ASF, AIFF, AU, AVI, G.711, GSM 6.10, MIDI, SND, Wave, MP3, WMA	MP3, MIDI, MP2, WAV, WMA, ACC, ACC+, AMR
Image Codec Support	JPEG, GIF, PNG, BMP	GIF, JPG, PNG, BMP, TIF, WMF, EMF	BMP, DIB, FPX, PNG, RLE, TGA, WBMP, GIF , JPEG, JPG, JPE, JIFF , PCD, PCX, PDS, PSF, TIF, TIFF, EMF, WMF	JPG, PNG 1.1, TIFF, GIF, BMP, EXIF, ICO,	BMP, DIB, FPX, PNG, RLE, TGA, WBMP, GIF , JPEG, JPG, JPE, JIFF , PCD, PCX, PDS, PSF, TIF, TIFF, EMF, WMF

3.2.9 After Sales Service

After Sales Service refers to the service provided to improve the overall product experience or support such as user claims, user support and user help services [66]. Smartphone is a complex device and tends to possess several operational problems requiring resources for resolution [102]. After sales services for Smartphone such as repairs cannot be resolved by automated solutions, as they require issue's root cause diagnosis [102]. This is usually performed by a highly skilled technician for example a fast battery drainage issue [102]. When the device is analyzed by a technician he/she may conclude that the battery is faulty or the issue is due to

malfunctioning keys or any other device aspect issue [102]. Device issues are difficult to be diagnosed through phone or remote assistance, which means after sales support for servicing is necessary [102]. Since Smartphone is an essential part of customer's lives, a quick resolution is in high demand and this may include access to Smartphone through loan [102]. Companies such as Dell, Apple and Nokia have attained success in today's competitive market by providing customers with technical support in stores and nearby service centers [102]. Buying decisions of consumers towards technology products is considerably affected by the level of after sales services provided by the device manufacturing companies [109]. According to consumer reports, Apple as a laptop manufacturer is a top ranked after sales service provider in America and has earned a reputation of the best selling computer technology support vendor [109]. Apple in 2013 scored 86% in satisfying customer problems through extended after sales services [109]. Apple remains ahead in terms of after sales support from other computer manufacturers by offering a consistent after sales support, with problem solving capability through phone support and online support [110]. Thus after sales supports reflects the strength of a company such as Apple to fix issues that are faced by its users after purchasing its product [110]. This signifies the level of control on a technological device by its manufacturers in terms of device support for its Hardware and Software [110]. These types of services enable convenience amongst the users for improving experience, and hence may contribute towards the usefulness as well as the ease of use of a Smartphone.

H5-a: After Sales Service increases the perceived usefulness of a Smartphone.

H5-b: After Sales Service increases the perceived ease of use of a Smartphone.

3.2.10 Perceived Cost Savings:

Cost of a Smartphone technology is a primary consideration for its adaption [2]. Costs include more than just monetary factors for example time and emotional effort [2]. Here emotional effort is referred to the effort involved in learning and using a mobile technology. The decreasing cost (i.e. device purchase or service use) and

increasing capability of a Smartphone through useful applications saves time, and gives a relative advantage. Smartphone has the capability to enable users and business professionals to reap benefits from Smartphone IT services including automation, fast processing, access to content, logistics, and ubiquity in applications functionality. High price of a device can severely impair the adoption possibilities of an innovative technology [103]. Even though some Smartphone are costly but those understanding its usefulness still purchase Smartphones like iPhone [103]. Some handsets of iPhone are costly, but this made the users to purchase such Smartphones through low price tying deals (i.e. purchase discount offers for company employees) or by leasing contracts (i.e. rent) for speeding up technology adoption [103]. Therefore it seems important to examine how individuals perceive cost when deciding to adapt Smartphone. So the hypothesis of perceived cost savings with perceived usefulness is:

H6: Perceived cost savings increase the perceived usefulness of a Smartphone.

3.2.11 Technical Barriers:

Behavior intention can be ascertained as an actual behavior if the intended behavior can be performed, which can be under some volitional control (i.e. deliberate influence) [31]. Generally behavior is experienced through the performance of certain tasks usually depends to some extent on non-motivational factors [31]. Non-motivational factors referred as opportunities and resources such as time, money, skill, cooperation with others etc [31]. Collectively such factors result in making certain opportunities and resources available to users to successfully perform the intended behavior [31].

Smartphone technicality and the mobile services can be expressed in terms of time and effort required for learning or using a system [18], while it may have a negative contribution towards perceived ease of use. Technological barriers that refer to lack of technicality (i.e. opportunities & resources) may tend to reduce intended outcome for Smartphone users. This concept can be understood with an example as discussed by Ajzen [31]. It can be considered as if there were more technical barriers

for using a Smartphone the individual's perception to easily use it will be low (i.e. then there will be a lesser degree of individual freedom to use a Smartphone). There are two main technological components namely compatibility and resources [12, 13]. Compatibility is referred as the degree of innovative technology to fit potential adopters existing values, their experiences and needs [12]. Resource implies factors such as time and money [12].

Technical barriers are closely connected to all kinds of access related issues of the Smartphone such as technological infrastructure, price, device design, usability, availability of the service etc. [71]. Technical barriers act as a sacrifice component of mobile service perceived value that tends to reduce the intended adoption of a device. There are certain limitations of mobile multimedia services specially related to ease of use and navigation such as bandwidth, hardware, cost, software functionality & privacy [34]. Similarly Vrechoupoulos [17], describes certain inconveniences related to devices along with lack of personalization including complicated use, lack of security, high price for mobile access & poor quality. These barriers are predominantly related to technology in use. Kim et al., [18] studied technological services as the degree of mobile services specifically mobile Internet as being perceived to be technologically excellent. They referred technicality to be determined by individual's ease of use, which includes learning, system reliability (i.e. error free), availability, security, connectivity and efficiency (i.e. response time). Meso et al., [35] considers technological barriers as lack of reliable or accessible mobile technology that includes any shortcomings, which obstructs the use of a mobile technology. Barriers may include lack of facilitating conditions (for example technical support), financial or technical resources, and access to system components (that is network, software or hardware). Stability of infrastructure and device compatibility problems all these relate towards Service providers [24]. Barriers including lack of technical support or training for using a mobile system have a negative impact towards adoption of advanced mobile services / technologies [36]. These barriers may affect the ease in

Smartphone use by individuals reducing their perception of comfort. Therefore we propose the following hypothesis.

H7: Technical barriers decrease the perceived ease of use of a Smartphone.

3.2.12 Social Norms:

Social norms are the perceptions of a user to follow a certain behavior based on the social pressure exerted in a social setup [31]. Ajzen termed social norms as subjective norm meaning the perceived social pressure on a user to perform tasks, which forms the behavior of technology use [31]. This pressure may be exerted from the individualôs social circle such as friends & relatives. Social pressure ties into another aspect called the social status. Individual's motivation that leads to believe that using a system will help to obtain a higher social status or an important position in a society, which may be the only main reason for the individual to adapt that system [20]. Literature includes similar factors in extended TAM and confirms that people tend to respond to social pressure to maintain a favorable position within a society (such as social groups, family, and friends) [22]. Social norms are considered as a factor having a direct influence on usefulness [100, 101]. Social norms are assumed to have a direct influence on perceived usefulness [71]. The term subjective norm refers to the social influence with and amongst others in the theory of reason action [30]. Findings by Hyojoo et al., [104] revealed that social influence (i.e. social norm) is an important determinant of perceived usefulness of mobile computing device. Results showed a positive influence of social influence towards perceived usefulness [104]. Verkasalo [71] concluded role of social norms should be part of future research for Smartphone users. For Smartphones social norms implies the individual experiencing pressure from society for buying and using a Smartphone. Therefore the proposed hypothesis is:

H8: Social norms increase the Perceived Usefulness of a Smartphone.

Earlier discussion in light of literature support has been made in detail. Perceived Usefulness is taken as the extent of how well consumer(s) believe that a

Smartphone can be integrated in their day to day activities [66]. It is the user belief that a Smartphone enables an increase of productivity, efficiency and convenience of use [66]. PEOU acts as a direct determinant towards usage intention, which has been studied in literature [20, 19], and they have also confirmed the effect on usage intention. Literature revealed perceived ease of use to have a positive as well as significant relationship with natural behavior for using Cellular Telephones [20]. Behavioral intention can be considered as a measure of individual's strength to perform a task that helps in achieving an outcome [44]. Behavioral intention is ascertained by two factors of belief known as perceived usefulness (PU) and perceived ease of use (PEOU) [23]. The two main factors enable system developers to control user beliefs towards a system and understand their behavior intention and system actual use [23]. If a system is perceived to be used easily then individuals will observe a higher intention to use that system. Igbaria et al., [19] confirmed the effect of perceived ease of use on perceived usefulness. Igbaria et al., [19] research context was testing the use of micro-computer amongst professionals including managers in North America. Results indicated perceived usefulness to be the main motivational factor for using a micro-computer by professionals, amongst the three factors namely social pressure, enjoyment and usefulness [19]. Findings also revealed perceived ease of use (also referred to as Complexity) as the key influencing variable towards the three motivational factors [19]. One of the preceding variable called skills of perceived ease of use caused a direct affect on the micro-computer usage through perceived usefulness [19]. Therefore a system which is not easy to use or prohibits its usefulness in turn affects the usage intention. This leads us to the following hypothesis:

> **H9-a:** Perceived Ease of Use of a Smartphone increases its Perceived Usefulness.

In TAM, usage behavior for information systems is mainly explained through behavioral intentions, which are formed as an outcome of a conscious decision making process [23]. TAM proposes perceived usefulness (PU) and perceived ease of use (PEOU) to help understand behavioral intentions of an individual to use a system [23].

Perceived usefulness and Perceived ease of use has a direct influence towards behavioral intention [75]. Both constructs impose individual influence towards behavioral intention for system use [72]. Dulcic et al., [72] focuses on work performance improvement for employees and considers perceived usefulness of a system to play a critical role for users in evaluating the advantages of system use. Literature implied that users perceive a system useable if the system itself is easier to use [73]. If a system is complicated to use then the performance benefits will be considered low as compared to the difficulty in using a system [73]. PU and PEOU both have their importance in depicting behavior intention to use a system [72]. Relating to Smartphone adoption, PEOU refers to the extent that users may easily operate Smartphone and navigate through it without much effort [66]. Kwon & Chidambaram [20] results pointed perceived ease of use to have a positive as well as significant relationship with natural behavior for using Cellular Telephones. Chong and Marthandan [25] proposed that whatever the perception in terms of technology usefulness is the fact that how easy it is to use that technology in practical terms may still induce an affect towards user initial intention to adopt or continue the system. Cheong & Park [27] referred mobile Internet as M-internet and studied individual behavior for using M-internet in Korea. Mobile Internet technology considered luxury at that time, still its innovative use as a technological tool for fast and secure communication through wireless networks started to provide services such as email, banking and entertainment [27]. Cheong & Park [27] empirically showed PEOU to be an influential factor towards M-internet acceptance. PEOU might have a positive effect on intention to use Smartphone. Similarly, Igbaria et al., [19] showed perceived usefulness to be the main motivational factor for using a micro-computer by professionals and so the perceived usefulness might positively influence the intention to use a Smartphone. Therefore in the light of the studies we conceptualize following hypotheses for PU and PEOU:

> **H9-b:** Perceived Ease of Use positively influences Intention to use a Smartphone.

H9-c: Perceived Usefulness positively influences Intention to use a Smartphone.

Chapter 4:

METHODOLOGY

4.1 RESEARCH METHODOLOGY:

The research methodology was developed after a comprehensive literature review. Determination of research model required a quantitative approach for measuring the concepts and different factors associated to the acceptance of Smartphone technology. In this regards literature was studied in detail to understand similar research that were carried out in various contexts and unique demographics around the world.

4.1.1 Questionnaire:

We adopted a survey approach for collecting data. The most important part in this process is the development of the questionnaire. Information about the usage of Smartphone, its functions and market trends was first observed, especially the increasing sales figures in Pakistan along with its increased use in our daily life. Also, with the introduction of new wireless networking service in Pakistan for data transmission, namely 3G and 4G have recently contributed in the Smartphone increased usage. In order to follow a survey/questionnaire approach for data collection, it needs to be understood that the primary source for data extraction consists of human subjects in a particular demographic. That is why prior literature review about different technologies, their acceptance, survey designs and analysis strategies were closely and comprehensively studied. After this in context of Smartphone technology its use and capabilities were understood and questionnaire was designed.

The focus during questionnaire design was on the wording of the questions, keeping them easy to read and understandable to the relevant context. Then the focus shifted to categorize the overall look and arrangement of sections in the survey. Ways to make it easy for the respondents to give valuable information. A very important step

was to develop data translation sheets to convert the information from survey paper into machine-readable form for conducting statistical based structural analyses. Survey design requires planning on issues such as categories of data, scaled items, personal measures and the appearance of the survey. A major challenge was to keep the number of questions a minimum even though we required information on so many critical factors associated with Smartphone technology and its acceptance including social as well as technical aspects. The survey design phase took us about two months; starting from December 15th, 2013 to February 20th, 2014. This much time was invested in the survey development because we believed it will play a pivotal role in information gathering phase and required keeping in mind some careful aspects of population preference, device characteristics, as well as the main objectives of the study. The questionnaire that we designed for data collection is given in appendix B. The questions key is given in appendix C, which relates them with the underlying constructs respectively. The constructs statements table is given in appendix E that gives an insight into the questions, which were derived after studying different questions found in literature that are used in similar contexts.

4.1.2 Target Sample:

The questionnaire was organized to keep primary questions first in the sequence and then the control questions such as age, gender, etc. The unit of analysis for the research is individuals. This implies to the level of aggregation of data collected. Meaning each response is taken as an individual data source. The survey was conducted on the target population composed of undergraduate, postgraduate students and academic faculty members from School of Electrical Engineering and Computer Science (SEECS), National University of Sciences and Technology (NUST), Islamabad, Pakistan. We conducted a pilot survey from February 24th, 2014 to February 28th, 2014. The actual survey activity started from March 12th, 2014 up to May 7th, 2014.

4.1.3 Pilot Testing:

Before the final survey, the pilot survey was conducted. It consisted of about 21 survey forms from individual from each of the above mentioned target groups. These individuals were not included in the audience for the final survey. The purpose of the pilot survey was to detect any problems in questionnaire that might be missed during design phase. Pilot survey included information and fields for respondents to give comments on the question items, which they find difficult, either inappropriate or ambiguous, and to give any suggestions, which would be essential in the context of this research. Also the number of question and amount of time on average taken by respondents was noted to optimize the structure and wordings of the final survey to meet the task for extracting accurate, relevant and reliable data within a small amount of time. The pilot survey helped in the following ways: translating raw data into machine readable form, maintaining translation sheets, improve wording for some items, reviewing the question sequence, improve the overall layout, gaining familiarity amongst the target population, checking response rate and making a strategy for improving it. After the follow-up activities and lessons learnt from pilot the actual survey was finalized and made ready for launching the data collection campaign.

4.1.4 Mode of Actual Survey

It is critical to articulate questions that give relevant information that might be useful, easily translated, effectively processed and would be in line to the research. The questionnaire incorporated a cover letter describing the purpose of the study, the team of researchers involved, along with definition of Smartphone device with brief on capability, and what makes it different from other similar devices. A very important task was to filter those individuals from the study who were either using a Smartphone, or had experienced using it before and were aware of its potential. The focus was on the Smartphone users who were using, or had used it before, or had a very clear view of the device functionality and were intending to use or purchase the device in future. This challenge was tackled by adopting two approaches first by including a control question that asked from individuals who did not meet the criteria

to exit the survey immediately. The response to such questions further facilitated in removal of similar incorrect data form analysis for example the ones who responded to the survey, even though they were not the intended audience. Second part of the strategy involved conducting a paper based survey in form of small batches in a controlled environment. The questionnaire used a 7-point Likert scale for recording item response, which is considered most relevant for measuring behavioral intentions and attitudes of target audience in similar research. The scale ranges from 1 to 7 with assigned numeric values of: 1 = Strongly Disagree, 2 = Disagree, 3 = Slightly Disagree, 4 = Neutral, 5 = Slightly agree, 6 = Agree, and 7 = Strongly agree. As a motivation a small prize was also included in the survey where each respondent can voluntarily participate and can win free tickets to cinema through a lucky draw.

4.1.5 Distribution & Sampling of Actual Survey

The data collection activity started on March 12th, 2014 up to May 7th, 2014. The total numbers of survey distributed and collected were 473. Out of which 7 were rejected due to multiple reasons such as the ones that responded to control question as non Smartphone users and showed never to have experienced it, but they did not exit the survey and filled it completely (such surveys were not part of the study or any analysis. Such cases were removed from analysis because they were explicitly directed to discontinue the survey in the first question if they were not part of the intended audience). Similarly, rejected surveyôs also included the ones which had only first page filled but the remaining empty. Apart from rejected there was another category that was not included in analysis and they had a total of 29 in number. These 29 surveys were from those people who responded to the control question appropriately and exited the survey immediately and did not proceed with the survey.

4.1.6 Response Rate of Actual Survey

The control question was our first question that informed about the target audience to be Smartphone users or the ones who had experienced it and were aware of its functionality. The remaining 437 responded correctly to the control question and

opted to be part of the target audience and filled the survey completely. That is total number of valid surveys, which are considered complete, were included in the analysis and they totaled up to 437 surveys. Therefore our dataset consisted of 437 rows (i.e. total useable survey responses). The response rate was 100% because 473 surveys were distributed and we were able to collect each and every survey back successfully. The usable data was about 92.38% = 437 / 473 * 100. The estimated average time to complete the entire survey by an individual was from 10 to 15 minutes.

The data entry phase involved labeling each survey with a unique row or observation ID along with information of class or location that reflected the batch to which the survey belonged for record keeping and referencing purpose. Out of 437 useable dataset 32 had one or two missing cells, thus 405 responses were complete surveys. The dataset used in analysis included the 405 complete responses (i.e. rows) with no missing values.

Chapter 5:

HYPOTHESES TESTING AND DATA ANALYSIS

5.1 DATA ANALYSIS:

After the data collection phase the usable sample size that we selected for our data analysis was a complete 405 dataset, which had no missing values. We adopted the Structural Equation Modeling (SEM) approach for performing the data analysis. It is a modeling approach for establishing relationships amongst variables. SEM belongs to the second generation of multivariate data analysis technique that is often used in marketing research [118]. The method involves use of observed measurement items to represent a number of Latent constructs or factors. Since latent variables or constructs cannot be measured or estimated directly they are usually inferred from measured variables and the associated relationships. Structural Equation Modeling is an extension of multiple linear regression analysis consisting of multiple equations for which simultaneous calculations are performed. SEM includes five key stages namely, Model Specification, Model Identification, Model Estimation, Model Testing, and Model Modification. Specification is the causal modeling of measurement as well as structural model. Identification refers to the consideration of over-identified models. The estimation is the stage for using a particular method for performing analysis, which can have assumptions. Testing is to analyze the model along with the data for extracting results. The final stage known as modification is aimed to restructure the model to achieve overall success for meeting standardized acceptance levels.

The SEM modeling process consists of two major phases called the Validation of measurement model using Confirmatory Factor Analysis and then the Model fitness testing of the structural model using path analysis. We applied the Partial Least Square Structural Equation Modeling (PLS-SEM) approach, which is a distinct approach to SEM for performing the analysis on the data and the research model. Usually in research an over-identified model is used, which is the model that has number of observed variances greater than the number of parameters to be estimated. That is with

a degree of freedom df > 0. In this context, the designed Smartphone research model is also an over-identified model. PLS-SEM is an appropriate as well as the preferred method for research that includes the objectives of prediction and theory development [115]. PLS-SEM is like multiple regression analysis [115]. PLS-SEM has a main objective to maximize explained variance for endogenous variables and to evaluate the data quality on the basis of measurement model [115]. PLS-SEM minimizes the residual variance of endogenous latent variables [115]. The use of PLS-SEM is increasing applied in disciplines of marketing and business research, with more than 100 studies published based on PLS-SEM in the top 20 marketing journals [115]. PLS-SEM has the ability to work on a wide range of sample sizes, with less restrictive data assumptions, and can be applied on models having high complexity [115]. PLS-SEM can address a wider range of problems as compared to Covariance based SEM (CB-SEM) [115].

Basic PLS-SEM algorithm adapts a two stage processing approach [115, 152]. First stage composed of four steps for calculating latent constructs scores and in the second stage final estimates are calculated, which includes outer weights, loadings and structural path coefficients for the model [115]. In the final stage the relationships, loadings and weights are calculated by applying ordinary least square method for each of the partial regression values in the PLS-SEM path model [115]. The efficiency observed in terms of increased parametric estimation PLS-SEM reveals a greater statistical power than that of CB-SEM [115]. PLS-SEM easily overcomes the problem related to estimation of stable factor scores also known as indeterminacy problem [115]. PLS-SEM develops precise factor scores by calculating latent variables in exact linear combination of observed indicator variables [115]. PLS-SEM can be considered as close proxy of the CB-SEM results [115]. PLS-SEM uses a two step process for estimating separately the measurement and structural model [115]. First step involves measurement of reliability and validity according to certain criteria that is associated with formative and reflective measurement model specification, after meeting the criterion then the structural relationships are examined through path analysis [115].

PLS-SEM bootstrap results provide the standard error of each path coefficient in the model [115]. After this a studentôs t-Test is applied to measure the significance of modelôs path relationships [115].

PLS-SEM avoids the identification issue and has more potential as compared to CB-SEM because fewer indicators can be used for conducting analysis [128]. PLS-SEM path modeling by using SmartPLS is proved to be well suited to carry out confirmatory factor analysis, which is more reliable and valid, and its proof is based on calculations and modeling that were performed in SmartPLS [128]. Based on analytics performed in a research the factor loadings, outer loadings, and average variance extracted given by PLS-SEM were improved as compared to CB-SEM for the same data [128]. PLS-SEM also maximizes explained variance of latent constructs thus proving the effectiveness of PLS-SEM for researchers to conduct their research [128].

5.2 RESULTS:

The data analysis is performed by following a step wise approach. A brief description of the major steps involved in the analytical process using Structural Equation Modeling is presented as follows:

1. Measurement Model Analysis:
    - Internal Consistency reliability: A measure using correlations of different items on the same test scale. It checks whether several items that are suppose to measure same construct produce similar scores.
    - Indicator reliability: The proportion of indicatorôs variance contribution, which is explained by respective construct. Reliability in general denotes the overall consistency of a measure and a measure is considered highly reliable if it produces similar outcomes under consistent conditions.

- Convergent validity: Degree to which for example two measures of a construct that should be related to each other theoretically are in fact related.
- Discriminant validity: Tests whether for example two measures or concepts which are supposed to be unrelated are actually unrelated. Generally, convergent validity and discriminant validity are subtypes of construct validity.

2. Structural Model Analysis:
    - t-value extraction: Tests the significance of structural path by using t-statistics of different relations.
    - P-value: The probability value is used to finally test hypothesized relationships for rejection or acceptance.
    - R^2 Explained Variance (Model Fit): The amount of variance of a construct that is being explained by other predecessor variables or constructs.
    - Path Coefficients: explains the effect strength of one variable or construct on another construct or variable.

5.2.1 PCA with SmartPLS :

SmartPLS deals with indeterminacy problems that are related to difficulty in estimating stable factor scores by effectively computing exact linear combinations of observed indicator variables [151, 115]. In SmartPLS we can perform Discriminant validity, which is based on Fornell-Larcker Criterion, which implies that a variable should explain the variance of its own indicators better as compared to other variables. And the discriminant validity is found by using square root of average variance extracted (AVE) and the construct cross correlation matrix. From a research the values of factor loadings, outer loadings and AVE is better in case of PLS-SEM (algorithm of SmartPLS) as compared to CB-SEM technique [126]. Measurement items are expected to co-vary to be correlated. For reflective measurement models, indicators (items) should be correlated similar to Principal Component Analysis (PCA). The

indicator reliability represents the proportion of each indicatorôs variance that is explained by their respective constructs. The indicator reliability is estimated by using empirical variance of the latent variable and error variance of its indicator(s). That is indicator reliability indicates the variance contribution of an indicator, which is explained through the latent variable. At least one half Loadings should be higher than 0.7 (or at least one half of the Squared Item Loadings should be greater than 0.4), which gives as a consequence the variance of construct and its indicator, and this implies that the value is greater than the variance of the measurement error. Thus indicator reliability is the degree to which the item (indicator) accurately and completely identifies the occurrences from all cases for being the indicator occurrences.

The acceptance of factor validity can be portrayed as two statements: (1) Each measurement item (indicator) correlates strongly, that is converges with the one construct it actually relates to. (2) Each measurement item correlates weakly, that is it discriminates with all other constructs. Discriminant validity tests the question whether the concepts or measurements are supposed to be unrelated and are in fact unrelated. Factor analysis yields appropriate pattern of loadings of items to their respective constructs in SmartPLS discriminant validity analysis. AVE measures the extent of variance captured by a construct in relation to the variance due to random error. In this context indicator reliability and discriminant validity for the research model is presented later in this chapter.

The dataset (405 responses with no missing values) is first loaded in SmartPLS in which we can render the path model and perform the data analysis. The research model was drawn in SmartPLS, it is to be noted that before performing any analysis the software is capable to automatically handle missing values (if the 437 dataset was used, which had some missing values). SmartPLS uses its in built procedure of mean replacement for missing value analysis. It automatically traces empty or missing labels and adjusts them during run time automatically without altering the original dataset. For analysis the 405 dataset was used, which had no missing values. First the Internal

Consistency Reliability is checked by calculating the composite reliability for every latent construct and verified against the acceptable ranges. Then using SmartPLS we check the indicator reliability for each construct. Afterwards Confirmatory Factor Analysis (CFA) is performed for testing the convergent validity and discriminant validity of the model and data. Average Variance Extracted (AVE) is an essential value for each variable, which is used for checking validity. The research model when tested in SmartPLS displayed a good degree of reliability and validity output. After this step, path and structural analysis was performed. We have used our dataset with 405 rows (no missing values) for obtaining true outcomes for different analyses, because any type of automatic imputation or adjustment would cause some degree of uncertainty.

5.2.2 Measurement Model Analysis (Reliability & Confirmatory Factor Analysis):

For assessing the Structural Equation Model (SEM) output the following steps are required [118]:

- Internal consistency reliability
- Indicator reliability
- Convergent validity
- Discriminant validity

5.2.2.1 Internal consistency reliability:

The use of SmartPLS software for applying PLS-SEM path modeling is suitable [126]. While using SmartPLS it is recommended to carry out Confirmatory Factor Analysis and the software is considered more reliable as well as valid [126]. Reliability is referred to the degree by which a measurement tool produces stable as well as consistent results [112]. Ticehurst and Veal [113] explained reliability as the extent of findings from a research to be same, if that research is repeated at a later date or with a different sample population. This suggests that reliability of a measure expresses the extent of the measure to be free of bias or free from error. Thus enables the assessment tool to give consistent measurements across time and different

instrument items [113]. Reliability assists in determining the goodness of measure and demonstrates accuracy in measurement [114].

Assessment of reflective measurement models should be made through their reliability and validity [115]. Construct reliability is measured on the basis of composite reliability, which gives an estimate of internal consistency for various constructs [115]. Cronbachôs alpha has an assumption for considering every indicator to be equally reliable, whereas Composite reliability does not assume that all variables are equally reliable [115]. Thus, making Composite reliability more appropriate for Partial Least Square Structural Equation Modeling (PLS-SEM), which prioritizes and computes indicators based on their reliability during model estimation [115].

According to Henseler et al., [116] Cronbachôs alpha Ŭassumes all indicators to be equally reliable, however PLS algorithm prioritizes indicators with respect to their reliabilities resulting to produce a more reliable composite. Cronbachôs alpha provides a severe underestimation of internal consistency reliability of Latent Variables with respect to PLS path models and it is best suitable to apply a different measure namely the composite reliability ρ_c [117]. Composite reliability considers indicators to have different loadings and can be explained in the same way as Cronbachôs alpha [116].

Traditionally the Cronbachôs alpha provides a conservative measurement of internal consistency in PLS-SEM for social science research [118]. Previous research literature has recommended using Composite Reliability as a replacement of Cronbachôs Ŭ[119]. For exploratory research Composite reliability value ranges from 0.6 to 0.7 and in more advanced stages of research 0.7 or higher are considered as acceptable, where as values below 0.6 show a lack of reliability [120, 115]. Bagozzi and Yi [119] discussed composite reliability to be 0.6 or higher as acceptable if the research is an exploratory research otherwise it should be 0.7 or higher.

Indicator Reliability identifies the portion of an indicatorôs variance that can be explained by the underlying Latent Variable [121]. The threshold criteria imply that

an indicatorôs variance should be explained more than 50% by the latent construct [121]. This means for loadings referred as ɔ of the latent constructs on an indicator variable for example x or y, should have a value larger than 0.7 to be considered as acceptable [121]. This threshold implies the variance that is shared between a latent construct and its indicator is greater than the variance of measurement error [121]. In empirical research weak loadings are frequently observed especially when newly developed scales are used [121]. When outer loadings are squared to find the indicator reliability 0.7 or higher is preferred and for exploratory research 0.4 or higher is acceptable [122]. Sometimes weak indicators are retained because of their contribution to satisfy validity [115]. The indicators that show very low loadings below 0.4 are always removed from reflective scales [115].

Table 2: Reliability Outcomes and Convergent validity

Latent Variables/Constructs	AVE	Composite Reliability ρ_c	Cronbach's Alpha α
After Sales Service	0.7948	0.8855	0.7498
Applications	0.4815	0.7879	0.6442
Design	0.7502	0.8573	0.6672
Multimedia	0.5527	0.7865	0.5959
Perceived Cost Savings (PCS)	0.7346	0.847	0.6387
Perceived Ease of Use (PEOU)	0.6412	0.78	0.4507
Perceived Usefulness (PU)	0.674	0.8608	0.7567
Social Norm (SN)	0.653	0.7819	0.5545
Technical Barriers (TB)	0.7565	0.8611	0.6849
Wireless Internet	0.6051	0.7478	0.3795

Composite reliability referred as internal consistency reliability. The composite reliabilities are given in Table 2. The model was rendered in SmartPLS and PLS algorithm was executed on the survey data of 405 respondents. If the PLS algorithm does not converges the data in less than 300 iterations then the data can be considered abnormal [118], that is its sample size might be too small or there might be existing outliers or too many identical indicator values [118]. Since the PLS algorithm when executed on our data converged successfully in only 6 iterations for the Smartphone

research model, which is less than 300 this implies that the data has none of the abnormality issues as mentioned above. According to literature the values of composite reliability values of 0.7 or higher and 0.6 or higher for exploratory research are considered acceptable.

Table 2 shows the values of variables for the research model, After Sales Service (ASS; ρ_c = 0.8855; Ŭ = 0.7498), Applications (A; ρ_c = 0.7879; Ŭ = 0.6442), Design (D; ρ_c = 0.8573; Ŭ = 0.6672), Multimedia (MM; ρ_c = 0.7865; Ŭ = 0.5959), Perceived Cost Savings (PCS; ρ_c = 0.847; Ŭ = 0.6387), Technical Barriers (TB; ρ_c = 0.8611; Ŭ = 0.6849), Perceived Ease of Use (PEOU; ρ_c = 0.78; Ŭ = 0.4507), Wireless Internet (WI; ρ_c = 0.7478; Ŭ = 0.3795), Social Norm (SN; ρ_c = 0.7819; Ŭ = 0.5545) and Perceived Usefulness (PU; ρ_c = 0.8608; Ŭ = 0.7567) all lie within the higher acceptance range (greater than 0.7). The values of Actual Use is (AU; ρ_c = 1; Ŭ = 1) and Behavioral Intention (BI; ρ_c = 1; Ŭ = 1) are considered as constants because they have only one measurement item. For Cronbachôs alpha there are only two boarder cases namely Multimedia and Social Norm, but they can also meet the criteria if we rounded off their values to 0.6 as they have values of 0.5959 and 0.5545 respectively. For Perceived Ease of Use and Wireless Internet the alpha values do not meet, but their composite reliabilities are above the higher acceptance range of 0.7 (therefore they are reliable) and composite reliability as discussed before can be considered as a good replacement of alpha value. Most of the variables fulfill the Cronbachôs Alpha acceptance range (greater than 0.6). *Each and every variable in the model is above the higher acceptance range (greater than 0.7) of Composite Reliability. Therefore, the research model completely fulfills the internal consistency reliability criterion.*

5.2.2.2 Indicator reliability

Table 3 displays the results of Confirmatory Factor Analysis (CFA) for the research model with the total sample size of 405 (No missing values). The table is composed of Item Loadings and the Squared Multiple Correlations (SMC) these outcomes will help explain the indicator reliability. According to literature we have two rules of thumb, first one states that at least one half of Item Loadings should be

greater than 0.7. The second rule states that at least one half of the Squared Item Loadings should be greater than 0.4. Thus one half of each indicatorôs variance should be explained by the associated Latent variable.

Table 3: Results of Confirmatory Factor Analysis (CFA) (n = 405)

Items	Standardized Factor Loadings													
	Applications	After Sales Service	Actual Use (AU)	Behavioral Intention (BI)	Design	Multimedia	Perceived Cost Savings (PCS)	Perceived Ease of Use (PEOU)	Perceived Usefulness (PU)	Social Norm (SN)	Technical Barriers (TB)	Wireless Internet	SMC	AVE
A1- I consider a Smartphone to be more useful that has many applications available for use.	0.6952	0	0	0	0	0	0	0	0	0	0	0	0.48	0.4815
A2- I believe that a Smartphone is useful that has applications relevant to my day to day tasks.	0.7007	0	0	0	0	0	0	0	0	0	0	0	0.49	
A3- I consider a Smartphone easier to use that includes a variety of applications.	0.6927	0	0	0	0	0	0	0	0	0	0	0	0.47	
A5- I find Smartphone apps easy to use.	0.6869	0	0	0	0	0	0	0	0	0	0	0	0.47	
AS2- If I have technical difficulties in using a Smartphone, the technical support personnel at a service center will help to resolve the issue.	0	0.9317	0	0	0	0	0	0	0	0	0	0	0.86	0.7948
AS3- If I have technical difficulties in using a Smartphone, the technical support personnel at a service center will be easy to reach at any time.	0	0.8495	0	0	0	0	0	0	0	0	0	0	0.72	
AU- I use Smartphone routinely and regularly.	0	0	1	0	0	0	0	0	0	0	0	0	1	1
BI2- I intend to buy a Smartphone in the next 2 months	0	0	0	1	0	0	0	0	0	0	0	0	1	1
D2- I prefer a Smartphone that has a longer battery life.	0	0	0	0	0.87	0	0	0	0	0	0	0	0.76	0.7502
D3- I prefer a durable Smartphone. (i.e. it can tolerate external damages/environment such as small impacts and water-proof casing)	0	0	0	0	0.86	0	0	0	0	0	0	0	0.73	
MM1- I would consider a Smartphone more useful that has high media support such as RAM, camera resolution, sound quality, picture quality, interactivity etc.	0	0	0	0	0	0.6566	0	0	0	0	0	0	0.43	0.5527
MM2- I feel that Smartphone with various media support is easier to use.	0	0	0	0	0	0.7729	0	0	0	0	0	0	0.59	
MM3- I am comfortable with the Smartphone which offers a variety of interactive media capabilities. (such as GPS, smart gesture recognition, Smart answering, quad core processing capability, cloud services, mobile TV, teleconferencing etc)	0	0	0	0	0	0.7936	0	0	0	0	0	0	0.629	

Items	Standardized Factor Loadings													
	Applications	After Sales Service	Actual Use (AU)	Behavioral Intention (BI)	Design	Multimedia	Perceived Cost Savings (PCS)	Perceived Ease of Use (PEOU)	Perceived Usefulness (PU)	Social Norm (SN)	Technical Barriers (TB)	Wireless Internet	SMC	AVE
PCS1- A Smartphone supports many essential services that I need when I am travelling and saves me cost for carrying multiple devices.	0	0	0	0	0	0	0.8601	0	0	0	0	0	0.73	0.7346
PCS2- I can perform different activities on a Smartphone without much effort.	0	0	0	0	0	0	0.854	0	0	0	0	0	0.72	
PEOU1- I find Smartphone easy to use.	0	0	0	0	0	0	0	0.8696	0	0	0	0	0.75	0.6412
PEOU3- I can easily increase my skills of using various features of Smartphone.	0	0	0	0	0	0	0	0.7253	0	0	0	0	0.52	
PU1- I find Smartphone useful in quickly accomplishing my daily tasks.	0	0	0	0	0	0	0	0	0.8496	0	0	0	0.72	0.674
PU2- I believe that using a Smartphone improves the quality of my daily tasks.	0	0	0	0	0	0	0	0	0.8569	0	0	0	0.73	
PU3- I find Smartphone as a helpful mobile educational tool for improving learning experience.	0	0	0	0	0	0	0	0	0.7524	0	0	0	0.566	
SN2- I believe that Smartphone characteristics including hardware capability and software quality reflects one's personality to others.	0	0	0	0	0	0	0	0	0	0.9651	0	0	0.93	0.653
SN3- I find people who own a Smartphone to have a good social status.	0	0	0	0	0	0	0	0	0	0.612	0	0	0.37	
TB1- I find it difficult to install applications on Smartphone.	0	0	0	0	0	0	0	0	0	0	0.9109	0	0.82	0.7565
TB2- I face difficulty in altering network configurations on Smartphone.	0	0	0	0	0	0	0	0	0	0	0.8266	0	0.6832	
WI1- I believe that having Wi-Fi connectivity in a Smartphone makes it useful.	0	0	0	0	0	0	0	0	0	0	0	0.9054	0.81	0.6051
WI2- I believe that having Wi-Fi connectivity in a Smartphone makes it easier to use.	0	0	0	0	0	0	0	0	0	0	0	0.6248	0.39	

* Note: SMC = Squared Multiple Correlations (Outer Loadings Squared Report of SmartPLS), AVE = Average Variance Extracted, 1-7 Likert Scale = 1 (Strongly Disagree) é 7 (Strongly Agree)

From the Table 3, we note that every variable fulfills the acceptance criterion of Item Loadings, such as Actual Use (1), Multimedia (0.6566, 0.7729, 0.7936),

Perceived Cost Savings (0.8601, 0.854), Perceived Ease of Use (0.8696, 0.7253), Perceived Usefulness (0.8496, 0.8569, 0.7524), Technical Barriers (0.9109, 0.8266), After Sales Service (0.9317, 0.8495), Behavioral Intention (1), Design (0.8725, 0.8598), Social Norms (0.9651, 0.612) and Wireless Internet (0.9054, 0.6248), all having at least half values (underlined) greater than 0.7. Only one variable is a boundary condition with almost all four variables approximately equal to 0.7 (we still consider it acceptable because the SMC meets the criteria for all four items) for Item Loadings and that variable is Applications (0.6952, 0.7007, 0.6927, 0.6869).

From the Table 3 results we note that all the variables fulfill the acceptance criterion of Squared Item Loadings (Squared Multiple Correlations), such as Actual Use (1), Multimedia (0.43, 0.59, 0.629), Perceived Cost Savings (0.73, 0.72), Perceived Ease of Use (0.75, 0.52), Perceived Usefulness (0.72, 0.73, 0.566), Technical Barriers (0.82, 0.6832), Applications (0.48, 0.49, 0.47, 0.47), After Sales Service (0.86, 0.72), Behavioral Intention (1), Design (0.76, 0.73), Social Norms (0.93, 0.37) and Wireless Internet (0.81, 0.39), all having at least half values greater than 0.4. *The research model completely fulfills the criteria for indicator reliability. The research model completely conforms to the acceptance criterion for both types of reliabilities, namely Internal Consistency reliability and Indicator reliability. Hence, the Smartphone research model is concluded to be reliable.*

5.2.2.3 Limitations of Cronbach's alpha α:

Cronbachôs Alpha (by Cronbach in 1951) is a conventional criterion for internal consistency, which provides an approximate calculation for reliability based on indicator inter-correlations [116]. The dependency and trust on Cronbachôs alpha as an exclusive reliability index is no longer sufficiently warranted [123]. This is because the development of Cronbachôs Ŭhas certain assumptions behind the estimator and its predecessors [124]. Measurement items considered usually were dichotomous and required manual calculations [124]. Therefore, the dominant requirement for an estimator of reliability was simplicity [124]. It has the following two primary assumptions [124]:

1) The Correlations are equal
2) The Standard Deviations are equal

It is prominent in the definition of reliability that strict assumptions of equal variances of the measurement errors and the equal variances of items are not required [124]; they are just the properties of parallel model [124]. This implies the values that are obtained using such a criterion would result in underestimation, if these strict assumptions of equal correlations and standard deviations are not met [124]. There have been many evident problems that are produced by strict assumptions inherited from its predecessors [124]. When Cronbachôs alpha is practically put to use violations of these assumptions is inevitable and this leads to the underestimation of outcomes for reliability [124]. Nowadays empirical research problems are multidimensional and it is difficult to design items that measure only one dimension [124]. Surely the most evident problem of Cronbachôs alpha is its built-in assumption of one dimensionality [124]. Therefore coefficient alpha may observe high simplicity, utility and power, it tends to create problems for applied researchers as they seek to search, develop and validate new assessment tools using the domain sampling model of classical measurement theory [125].

5.2.2.4 Convergent Validity:

Validity describes the extent to which the data gathered truly reflects the phenomenon being explored. For reflective measurement models, validity is determined by computing convergent validity and discriminant validity [115]. Determining convergent validity requires analyzing the Average Variance Extracted (AVE) for each latent variable in the research model [118]. Sufficient condition for assessing convergent validity requires AVE value of *0.50 or higher*, which implies the latent variable should explain more than half of its indicatorôs variance [115]. Similarly, Bagozzi and Yi [119] explained that convergent validity should be 0.5 or higher. Literature considers 0.5 and higher values to represent a sufficient degree of convergent validity [127, 126]. This means latent variable or constructs explain more

than half of its indicatorôs variances. In addition to this it is also postulated that latent constructs share more variance with the assigned indicators as compared to another latent variable in the structural model [126, 127].

All variables (see Table 2 AVE column) of the research fall in the acceptable criteria for convergent validity (greater than 0.5) include Actual Use (1), After Sales Service (0.7948), Multimedia (0.5527), Perceived Cost Savings (0.7346), Perceived Usefulness (0.674), Applications (0.4815), Behavioral Intention (1), Design (0.7502), Perceived Ease of Use (0.6412), Social Norms (0.653), Technical Barriers (0.7565) and Wireless Internet (0.6051). óApplicationsô is the only boundary case but it is also approximately equal to 0.5. *All other constructs fulfill the convergent validity criteria successfully. Therefore, the Smartphone research model completely fulfills the criterion for convergent validity.*

5.2.2.5 Discriminant validity:

It is recommended that square root of AVE of each latent variable can be utilized to establish the discriminant validity [127, 118]. The square root of AVE for a latent variable should be larger than the correlations of other latent variables [118]. This can be achieved by constructing a table having square root of AVE (manually calculated from AVE values) and writing them in the diagonal with bold format [118]. The correlations between variables (latent variables) are then copied from the SmartPLS report ñLatent Variable Correlationò section of the default report and then placing these correlations in the lower left triangle of the constructed table [118].

In statistical terminology AVE of each variable (latent construct) should be greater than the constructôs highest squared correlation with any other latent construct [127]. That is we have two measures for discriminant validity one is the square root of AVE and the other are the correlations of latent constructs [126]. The correlations for each latent construct should be lower than square root of AVE for obtaining the validity of the measurement model [128]. The diagonal values in bold are the square

roots of AVE while other values are the correlations between the constructs respectively [126].

Table 4 shows the diagonal matrix for evaluating discriminant validity for the research. All the latent variables of the research successfully fulfill the requirements for discriminent validity. Square root of AVE for each and every latent construct was found greater than correlations in their respective row and column. The square root AVE values for variables are Actual Use (1), After Sales Service (0.8915), Applications (0.6939), Behavioral Intentions (1), Design (0.8661), Multimedia (0.7434), Perceived Cost Savings (0.857), Perceived Ease of Use (0.8007), Perceived Usefulness (0.8209), Social Norms (0.808), Technical Barriers (0.8697), and Wireless Internet (0.7778). *Thus, the discriminant validity criteria are fulfilled successfully. The Smartphone research model fulfills the convergent and discriminant validity criteria, therefore the research model has proved to meet the validity criteria completely.*

Table 4: Discriminant validity of Smartphone Research Model

Latent Variables	Actual Use (AU)	After Sales Service	Applications	Behavioral Intention (BI)	Design	Multimedia	Perceived Cost Savings (PCS)	Perceived Ease of Use (PEOU)	Perceived Usefulness (PU)	Social Norm (SN)	Technical Barriers (TB)	Wireless Internet
Actual Use (AU)	**1**	0	0	0	0	0	0	0	0	0	0	0
After Sales Service	-0.0394	**0.8915**	0	0	0	0	0	0	0	0	0	0
Applications	0.2649	0.1123	**0.6939**	0	0	0	0	0	0	0	0	0
Behavioral Intention (BI)	-0.0686	0.0903	0.0983	**1**	0	0	0	0	0	0	0	0
Design	0.1012	0.0978	0.3353	-0.0474	**0.8661**	0	0	0	0	0	0	0
Multimedia	0.1738	0.1046	0.5548	0.0881	0.3418	**0.7434**	0	0	0	0	0	0
Perceived Cost Savings (PCS)	0.2646	0.0887	0.4472	0.0529	0.2594	0.3283	**0.857**	0	0	0	0	0
Perceived Ease of Use (PEOU)	0.2228	0.0995	0.4118	0.0375	0.042	0.342	0.3607	**0.8007**	0	0	0	0
Perceived Usefulness (PU)	0.258	0.1103	0.3834	0.1161	0.2149	0.2505	0.3852	0.4143	**0.8209**	0	0	0
Social Norm (SN)	0.0848	0.1848	0.0984	0.1559	-1E-04	0.1271	0.0877	0.0727	0.2245	**0.808**	0	0
Technical Barriers (TB)	-0.2467	0.1131	-0.2705	0.1615	0.0041	-0.2062	-0.2068	-0.3435	-0.1096	0.1553	**0.8697**	0
Wireless Internet	0.1668	-0.0226	0.3694	-0.034	0.2941	0.3347	0.2507	0.2233	0.2596	0.0629	-0.1482	**0.7778**

5.2.3 Bootstrapping Analysis (t-values):

The significance of structural path is tested using t-Statistics, which can be performed by using SmartPLS Bootstrap procedure [118]. Bootstrap procedure of SmartPLS generates t-Statistics for inner and outer model for significance testing [118]. The procedure works by considering a large number of subsamples (5000 recommended) from the original sample with replacement for returning bootstrap standard errors, which produce approximate t-values for significance testing of structural path [118]. We configured 405 as cases in the setting, since this quantity is the valid number of observations for our dataset. The value of samples was set to 5000 as per recommendations and finally we executed bootstrapping on three different types of sign changes options namely, ôNo Sign Changesô, ôIndividual Sign Changesô and ôConstruct Level Changesô. The Construct level Changes option was tested because it accommodates the sign changes moderately between the other two extreme sign changes settings [118]. Bootstrapping estimates path coefficientôs significance with the minimum number of bootstrap samples of 5000, and the number of cases should be equal to the observations in the sample [115]. Two-tailed test have critical t values of 1.65 for significance level of 10 percent, 1.96 for significance level of 5 percent and 2.58 for significance level of 1 percent [115, 118]. The condition for two tailed t-test with a significance level of 5%, the path coefficient will be significant if the t-statistics value is larger than 1.96 [118]. The path coefficients t-Statistics for inner model of the research with maximum and minimum types of sign changes setting is shown in table 5.

Table 5: t values and P values (Two-tailed) for Research Model Hypotheses

HYPOTHESES #	Hypothesis	T Statistics	P-Values Two Tailed	Hypothesis Outcome
H 1-a	Wireless Internet connectivity option increases the Perceived Usefulness of a Smartphone	1.2981	0.195	Rejected
H 1-b	Wireless Internet connectivity option increases the Perceived Ease of Use of Smartphone	1.3115	0.1905	Rejected
H 2-a	Design features increase the Perceived Usefulness of a Smartphone.	1.766	0.078	Failed to reject
H 2-b	Design features increase the Perceived Ease of Use of a Smartphone.	2.1265	0.034	Failed to reject
H 3-a	Multimedia features increase the perceived usefulness of a Smartphone.	1.2414	0.215	Rejected
H 3-b	Multimedia features increase the Perceived Ease of Use of a Smartphone.	2.3043	0.02178	Failed to reject
H 4-a	Availability of preferred applications increase the Perceived Usefulness of a Smartphone.	2.2439	0.025	Failed to reject
H 4-b	Availability of preferred applications base increase the Perceived Ease of Use of a Smartphone.	4.6729	< 0.001	Failed to reject
H 5-a	After Sales Service increases the perceived usefulness of a Smartphone.	0.3815	0.703	Rejected
H 5-b	After Sales Service increases the perceived ease of use of a Smartphone.	2.2461	0.025	Failed to reject
H 6	Perceived cost savings increase the perceived usefulness of a Smartphone.	2.7118	0.007	Failed to reject
H 7	Technical barriers decrease the perceived ease of use of a Smartphone.	4.436	< 0.001	Failed to reject
H 8	Social norms increase the Perceived Usefulness of a Smartphone.	4.2023	< 0.001	Failed to reject
H 9-a	Perceived Ease of Use of a Smartphone increases its Perceived Usefulness.	4.0048	< 0.001	Failed to reject
H 9-b	Perceived Ease of Use positively influences Intention to use a Smartphone.	0.2432	0.8079	Rejected
H 9-c	Perceived Usefulness positively influences Intention to use a Smartphone.	2.2221	0.0269	Failed to reject
H 10	Behavioral Intention directly affects the Actual Usage of Smartphone.	1.9995	0.046	Failed to reject
H 11	Perceived Usefulness directly affects the Actual Usage of Smartphone.	3.2121	< 0.01	Failed to reject
H 12	Perceived Ease of Use directly affects the Actual Usage of Smartphone.	2.1785	0.03	Failed to reject

The results for the two extreme types of sign changes in the research model reflected similar outcomes. The results were consistent for any type of bootstrapping sign change setting. The green highlighted t-values for path coefficients in table 5 meet the significance criteria, that is the values are greater than 1.96 (5% significance Level Two tailed t-test). The green highlighted results are therefore significant at 95% probability level and show that our data is good enough to support the conclusion with a 95% confidence. The t-value for H 2-a hypothesis is however found to be significant at 90% confidence level (10% Two tailed t-test).

5.2.4 P Values:

The use of pre-calculated tables such as t-tables helps in converting t-values to P-values for statisticians [131]. The t-values should be greater than or equal to t = 1.960 (df = 353) for producing a p-value less than 0.05 (Two tailed p) [130, 131]. The p-values are calculated automatically using excel function TDIST [146], it provides probability values used for hypothesis testing. The function requires inputs of degree of freedom, the t value and the option for selecting the type of tailed test in our case it is two tailed test [146]. Table 5 shows the p values for the Smartphone research model and the green highlighted meet the chosen significance criterion of $p < 0.05$ (Two Tailed). The degree of freedom is calculated by df = N ï x = Sample ï (Number of items + Number of constructs) = 405 ï (40 + 12) = 405 ï 52 = 353.

From table 5 fourteen paths fulfill the criteria. The green highlighted t-values of table 5 meet the significance criteria and these hypotheses cannot be rejected, therefore they are accepted. For the Smartphone research model only one endogenous variable p values is lower than the acceptable threshold and that path is Perceived Ease of Use (PEOU) -> Behavioral Intention (BI) (see Table 5). For exogenous variables both paths of wireless Internet are rejected based on the defined criteria. One path of Design, Multimedia and After Sales Service did not meet the criteria (see Table 5). In total only five paths were rejected namely, After Sales Service -> Perceived Usefulness (PU), Design -> Perceived Usefulness (PU), Multimedia -> Perceived Usefulness (PU), Perceived Ease of Use (PEOU) -> Behavioral Intention (BI), Wireless Internet -> Perceived Ease of Use (PEOU) and Wireless Internet -> Perceived Usefulness (PU).

5.2.5 R^2 Explained Variance (Model Fit):

The numbers that appear inside circles of the model after the PLS algorithm in SmartPLS is executed refers to R^2 and is called explained variance [118]. This means that the amount of variance of the latent variable that is being explained by other latent variables [118]. Primary evaluation criteria of Structural Equation Modeling consists of significance of path coefficients and the R^2 measures (explained variance) [115].

The objective of prediction oriented PLS-SEM methodology is to explain the variance of endogenous latent variables (dependent variables) [115]. The judgment for the R^2 level depends upon the discipline of research and the value of $R^2 = 0.2$ is considered high in disciplines such as consumer behavior [115]. The values of R^2 in PLS path models of 0.19, 0.33 and 0.67 are considered as weak, moderate and substantial [116, 129]. Table 6 shows the values for R^2 explained variance for various variables in the research model. Figure 10 shows the output from SmartPLS with the R^2 values residing within circular objects called latent variable constructs. Only the endogenous variables have the R^2 values because they are linked with predecessor variables called the exogenous variables that have an effect on the explained variance for such latent constructs. The exogenous variables (independent variables) therefore get a value of 0 representing their exogenous nature.

The structural model evaluation criteria primarily include R^2 measures and the significance level of path coefficients [115]. The coefficient of determination referred as R^2 explains how much the constructs variance has been explained by its predecessor latent variables. The R^2 value is 0.3067 for Perceived Usefulness (PU) latent construct. This shows that eight latent variables namely Social Norm, Perceived Cost Savings, Wireless Internet, Design, After Sales Service, Multimedia, Applications and Perceived Ease of Use (PEOU) together explain 30.67% of variance in Perceived Usefulness (PU) which is considered high in consumer behavior research (above 0.2). Similarly, R^2 value is 0.266 for Perceived Ease of Use (PEOU) latent construct. This implies that six latent variables namely Wireless Internet, Design, After Sales Service, Multimedia, Applications and Technical Barriers together explain 26.6% of variance

in Perceived Ease of Use (PEOU) which is also considered high in consumer behavior research (above 0.2). The R^2 value is 0.014 for Behavioral Intention (BI) and 0.0923 for Actual Use (AU). Here we see that only two latent variables namely Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) together explain 1.4% variance in Behavioral Intention (BI). However we still see a moderate direct association from PEOU, BI and PU towards Actual Use (Use). This implies that three latent variables namely Perceived Ease of Use (PEOU), Behavioral Intention (BI) and Perceived Usefulness (PU) together explain 9.23% variance in Actual Use (AU), which is moderate in terms of consumer behavior research since it is explaining almost 10% of variance in AU. The Model is a good fit in terms of explaining variance of major constructs including PU, PEOU and AU. The structural model is a good fit also because the significance levels of the path coefficients (as presented in next section) are in line with the expected hypothesized paths. The path coefficients analysis statistically supported almost each relationship in the same manner as the hypotheses were tested through bootstrapping analysis (in terms of directional association).

Table 6: R^2-Explained Variance (Model Fit)

Latent Variables / Constructs	R Square
Actual Use (AU)	0.0923
Behavioral Intention (BI)	0.0136
Perceived Ease of Use (PEOU)	0.2656
Perceived Usefulness (PU)	0.3067

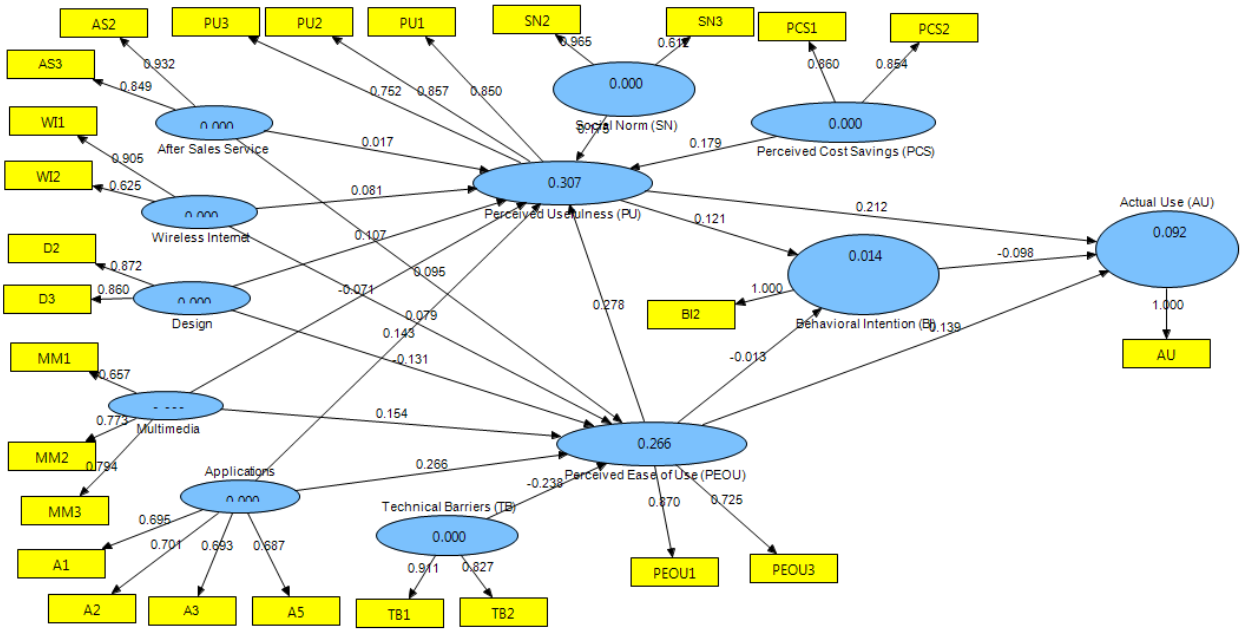

Figure 10: SmartPLS output with R^2 values and path coefficients

5.2.6 Path Coefficients:

The values on the arrow heads after the PLS algorithm is executed in SmartPLS are the path coefficients [118]. Path coefficient explains how strong is the effect of one latent variable on another latent variable [118]. Statistical importance is ranked on the basis of path coefficients weights [118]. Generally, for a dataset having 1000 sample observations the standardized path coefficient should be greater than 0.2 to be significant [118]. Individual path coefficients in the PLS structural model are also called the standardized Beta coefficients (b) of Ordinary Least Squares regression [115]. It should be noted that a variables relative statistical importance is not the same as its operational or strategic importance [118]. The path coefficients sizes and significance can be noted for the inner model as shown in the figure 10 (arrows from latent constructs to other constructs) [118]. Path coefficients help to estimate the significance of hypothesized path relationship [118]. For a sample of 400 the standardized path coefficients should be greater than 0.1, and path a coefficient signifies whether one variable can predict the other variable directly [118]. We can

check the path coefficients also from the SmartPLS Outer Loading reports, after PLS algorithm is executed [118]. Table 7 also shows the model path coefficients.

Table 7: Path Coefficients Smartphone Research Model

Latent Variables / Constructs	Actual Use (AU)	Behavioral Intention (BI)	Perceived Ease of Use (PEOU)	Perceived Usefulness (PU)
Actual Use (AU)	0	0	0	0
After Sales Service	0	0	0.0951	0.0171
Applications	0	0	0.2662	0.1428
Behavioral Intention (BI)	-0.0984	0	0	0
Design	0	0	-0.1313	0.1074
Multimedia	0	0	0.1536	-0.0706
Perceived Cost Savings (PCS)	0	0	0	0.1792
Perceived Ease of Use (PEOU)	0.1386	-0.0128	0	0.2779
Perceived Usefulness (PU)	0.2119	0.1214	0	0
Social Norm (SN)	0	0	0	0.1752
Technical Barriers (TB)	0	0	-0.2384	0
Wireless Internet (WI)	0	0	0.0789	0.0813

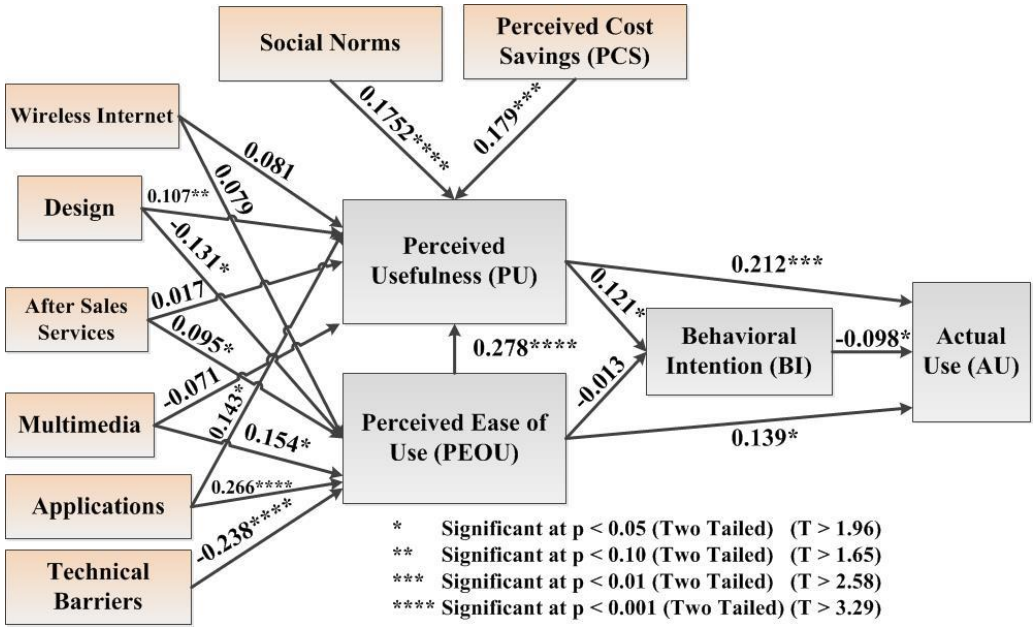

Figure 11: Summary of Path Coefficients and Significance

The green highlighted standardized path coefficients in table 7 (Research Model figure 10) are greater than 0.1, this implies that the path coefficients are

significant. These values reflect the strength of one variables effect on the other and helps rank their statistical importance. The path coefficient of 0 represents no direct effect or linkage of relationship, but the path coefficients can be considered to have direct positive or negative relationship by following a defined significance level of 0.1. The model output suggests that PEOU has the strongest effect on PU with the path coefficient of 0.2779, followed by PCS (0.1792), SN (0.1752), Applications (0.1428), Design (0.1074), WI (0.0813), and After Sales Service (0.0171). The impact of Multimedia on PU is however negative, which shows an inversely proportional relationship (decreasing effect) with the value of -0.0706. The relationships from PEOU, PCS, SN, Applications, and Design are statistically significant because their path coefficients are above 0.1; therefore they are strong as well as direct predictors of PU. Whereas the relationship from WI, After Sales Service and Multimedia towards PU are statistically insignificant, since their path coefficients have lower than 0.1 value. Similarly, Applications (0.2662) have the strongest effect on PEOU followed by Multimedia (0.1536), and they are significant because their path coefficient value is above 0.1. As expected from hypothesized relationship Technical Barriers has the strongest negative path coefficient of -0.2384 which defines an inversely proportional relationship. Thus Applications, Multimedia and Technical Barriers are direct predictors of PEOU. However After Sales Service (0.0951) is almost 0.1 if we round of the value thus After Sales Service can be considered as a direct predicator of PEOU. WI (0.0789) has path coefficient approaching 0.1 but considered lower than 0.1 which makes WI statistically insignificant. Therefore WI (0.0789) and Design (-0.1313) do not predict PEOU directly.

The model also suggests that PU (0.1214) has the strongest effect on BI and is considered as a significant direct predicator of BI, because its path coefficient has a value above 0.1. On the other side PEOU (-0.0128) has a path coefficient lower than 0.1, which shows that PEOU does not predict BI directly. We see from table 7 that PU (0.2119) strongly effects AU followed by PEOU (0.1386). PU and PEOU both are statistically significant as they have path coefficients above 0.1, which shows that they

are direct predictors of AU. However BI (-0.0984) is statistically insignificant with path coefficient less than 0.1 and it does not predicts AU directly.

5.3 DEMOGRAPHIC DATA:

In this section data extracted with respect to our demographics in context of Smartphone acceptance research will be discussed. The demographic data associated to respondents for discussion consists of Age, Gender, Family Income, extent of Smartphone features used, Education level of respondents, Home Town of respondents, Number of respondents family members using Smartphone, Name of Smartphone Brand in use by respondents, Primary mode for Internet Access, Activities for which the Smartphone is used by respondent, and Smartphone brand preference of respondents. The information was extracted by performing frequency analysis using SPSS 21, on the data extracted from the questionnaireôs personal details sections, which were located at the end of the survey. The response to these personal details questions was voluntary and the results are reported for those who willingly shared the data. The responses are completely anonymous, therefore identities of the respondents are hidden and the privacy is maintained.

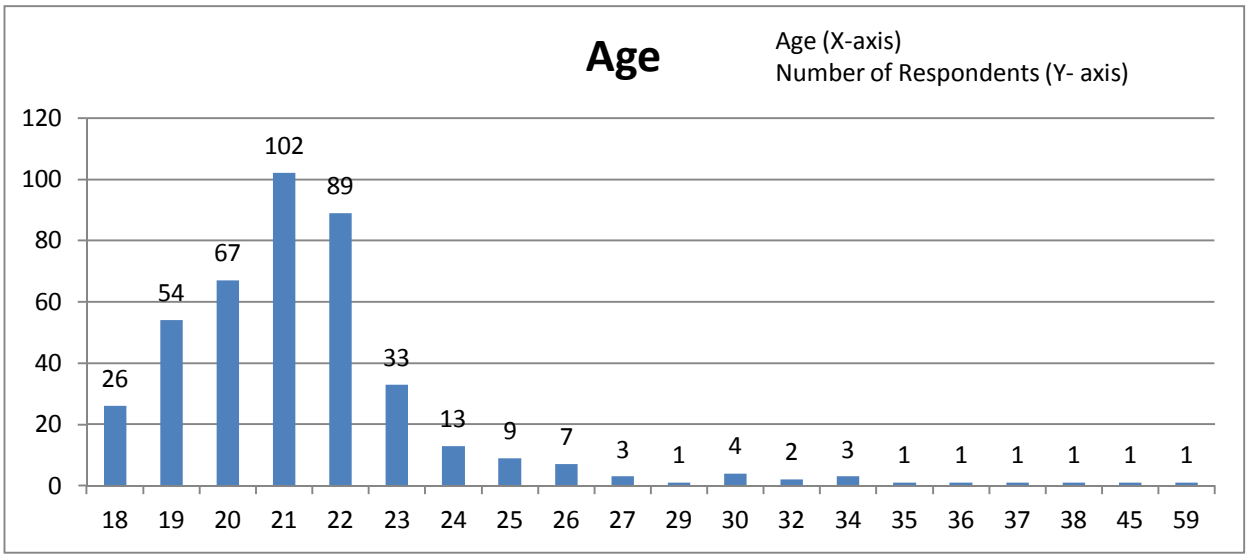

Figure 12: Survey Respondents Age Groups

Figure 12 shows the age for respondents of survey with a minimum age from 18 to a maximum age of 59. We see, that a large number of respondents who are using a Smartphone belong to the age group from 18 to 27. Figure 12 shows that about 102 (peak value) respondents of the questionnaire were from individuals of age 21.

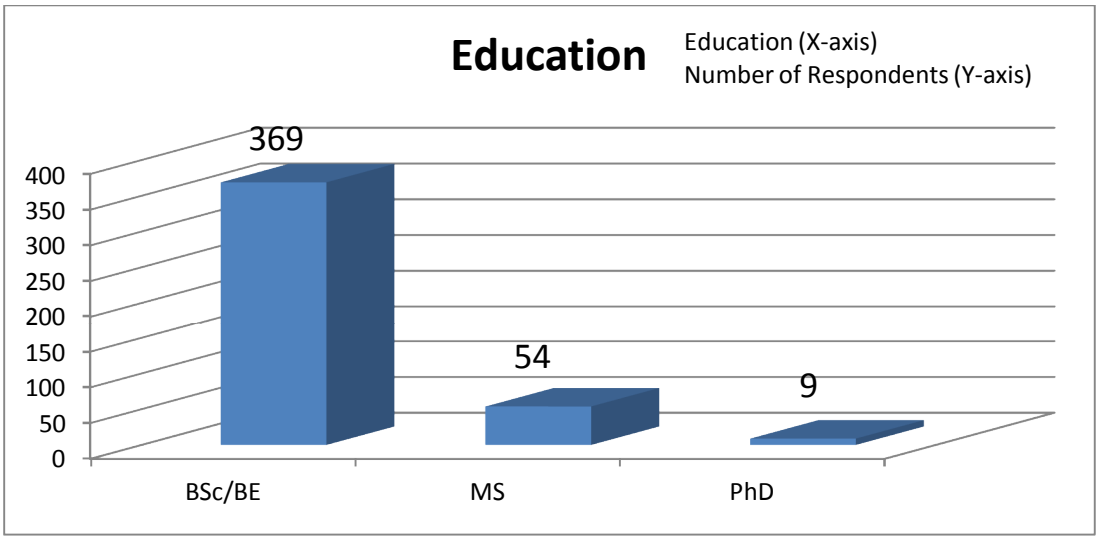

Figure 13: Education Level of Respondents

Figure 13 reflects the education level of individuals that participated by responding to the survey questionnaire. They are students belonging to BS, MS and PhD university programs. The faculty members who participated in the survey are included in PhD.

Figure 14, shows that there were 162 female and 273 male survey respondents.

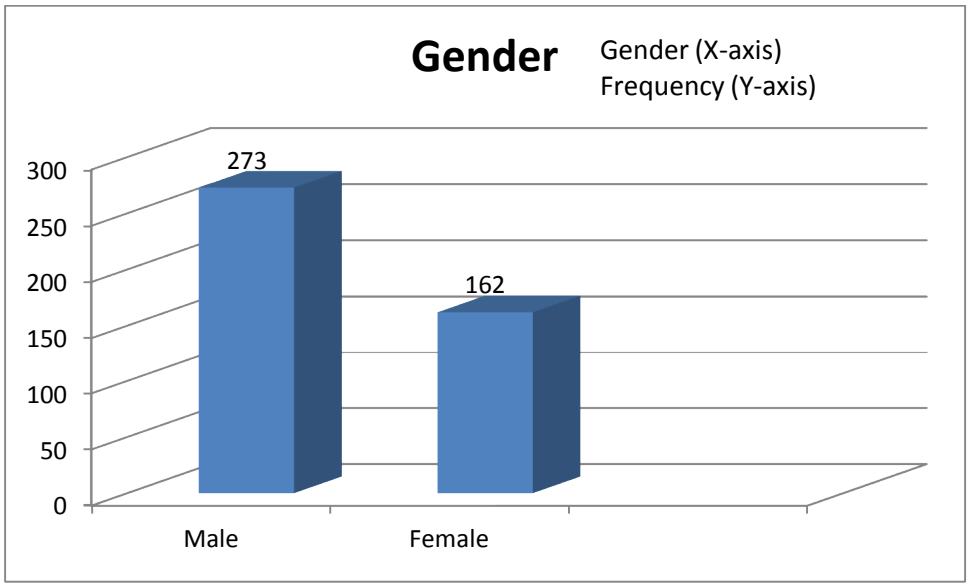

Figure 14: Gender Frequency

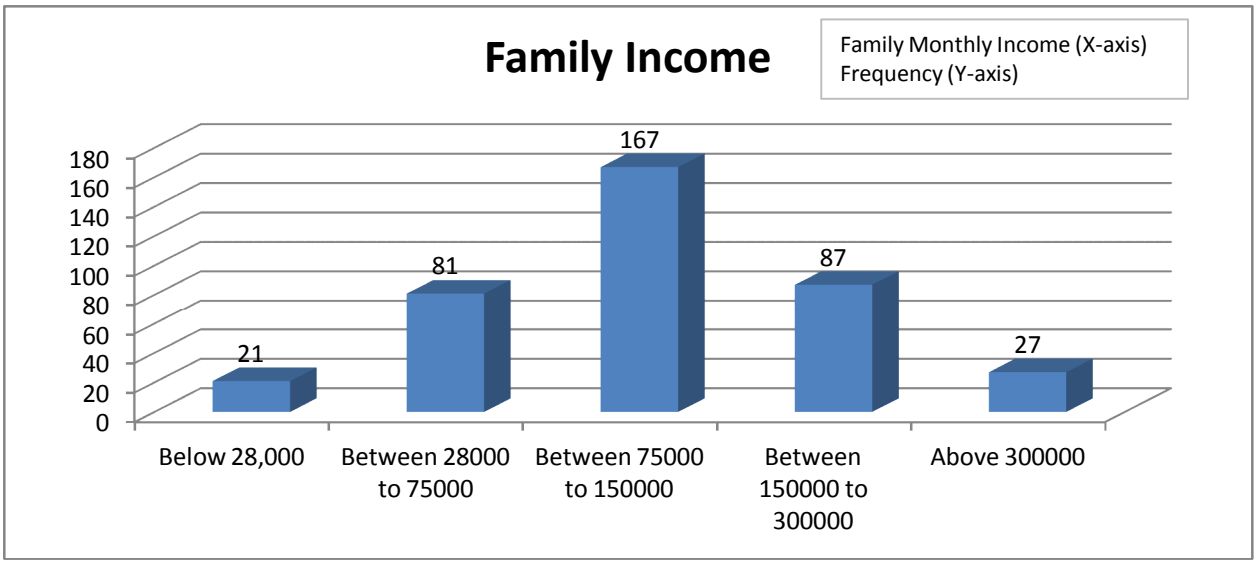

Figure 15: Family Monthly Income of respondents

Figure 15, shows the respondentôs family monthly income and the pattern is similar to a normal curve. About 167 respondents monthly family income is between 75000 to 150000 rupees and at the higher end of family income only 27 families earn above 300000 rupees per month.

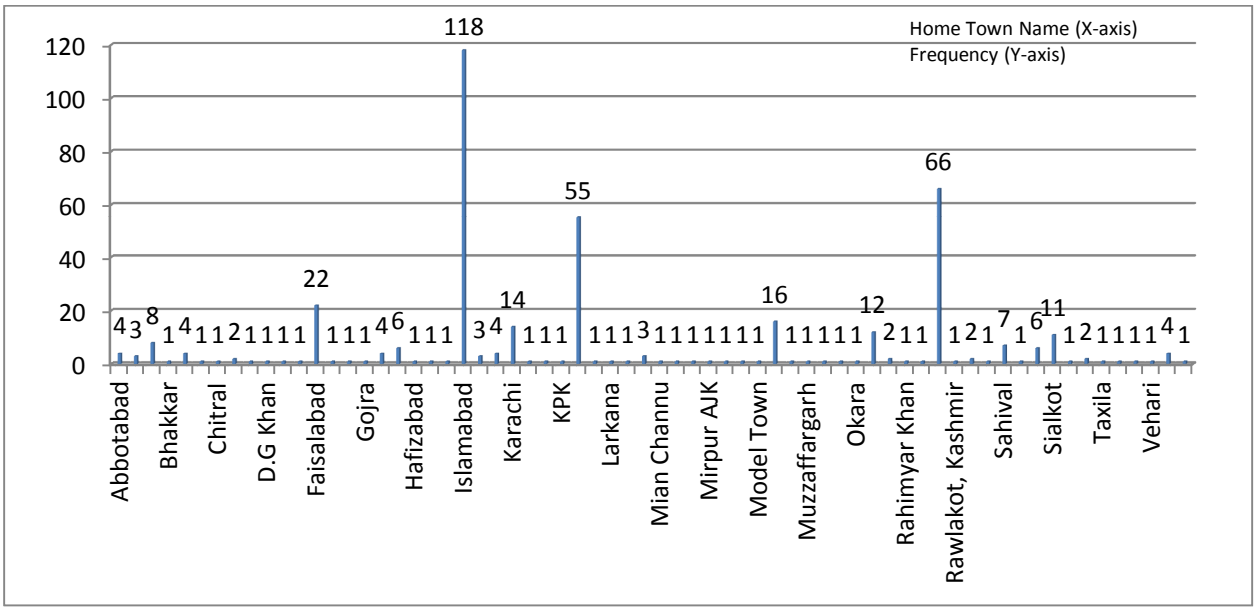

Figure 16: Respondent's Home Town

Figure 16 shows the home town to which the respondents belong to. At first place in terms of maximum number of respondents there are 118 individuals, which belong to Islamabad. This shows the extent of spread in the population studying at NUST Pakistan that belongs to different regions, who participated in filling out the survey for this research. The extent of people representing different regions of the country is more clearly visible in table 8.

Table 8: Respondent's Home Town (Region)

HomeTown	
City Name	**Frequency**
Abbotabad	4
Attock	3
Bahawalpur	8
Bhakkar	1
Chakwal	4
Charsadda	1
Chitral	1
D G Khan	2
D I Khan	1
D.G Khan	1
Dina	1
Dubai	1
Faisalabad	22
Fort Abbas	1
Gilgit	1
Gojra	1
Gujranwala	4
Gujrat	6
Hafizabad	1
Haripur	1
Haripur KPK	1
Islamabad	118
Jhang	3

City Name	Frequency
Jhelum	4
Karachi	14
Khanewal	1
Kohat	1
KPK	1
Lahore	55
Lakki Marwat	1
Larkana	1
Mansehra	1
Mardan	3
Mian Channu	1
Mianwali	1
Mirpur	1
Mirpur AJK	1
Mirpur, Sindh	1
Mirpurkhar, Sindh	1
Model Town	1
Multan	16
Muridke	1
Muzzaffargarh	1
Nawabshah	1
New York	1
Okara	1
Peshawar	12

City Name	Frequency
Quetta	2
Rahimyar Khan	1
Rajanpur	1
Rawalpindi	66
Rawlakot, Kashmir	1
Riyadh,Saudia Arabia	2
Sadiqabad	1
Sahival	7
Sangra	1
Sargodha	6
Sialkot	11
Skardu	1
Swabi	2
Taxila	1
Toba Tek Singh	1
Umerko Sindh	1
Vehari	1
Wah Cantt	4
Wazirabad	1

People have different personal preferences in terms of Smartphone features that they use. These features are listed along with their respective labels as shown in table 9. The extent of use for these features was measured from each individual in the form of five categories namely: Never, Rarely, Sometimes, Often, Always. The figure 17 is representing the response from individuals in terms of using features. Figure 17 therefore reflects the actual preference of personal features that they use in a Smartphone.

Table 9: Smartphone features with labels used by individuals

Label	Features
F1	Calls
F2	Text Messaging (SMS)
F3	Internet (e.g. Web Browsing)
F4	E-mail client
F5	Social Media Connectivity (e.g. Facebook)
F6	Camera Function
F7	Data Synchronization (e.g. backups, addresses, outlook)
F8	Instant Messaging Client (e.g. Whatsapp, 'Ping', MSN, Yahoo, Skype)
F9	Personal information management (e.g. contacts, calendar, agenda)
F10	GPS navigation (e.g. location identification, traffic route)
F11	Office tasks (e.g. Presentation, documentation, excel sheet)
F12	Video Conferencing (e.g. Skype)
F13	Online TV Channels
F14	Games
F15	Online shopping
F16	Reading e-books
F17	Learning & education
F18	Web based application Services (e.g. Dropbox)
F19	Downloading / Listening Music
F20	Video playback
F21	News / Weather, Traffic, other information services
F22	Exploring & Experimentation with applications
F23	Importing and exporting personal data
F24	As a Business Tool (using it with applications relating to a job such as logistics management app)
F25	Synching other devices (Name them _____)

The synching device mostly listed by individuals that are used for synchronization of their Smartphone includes: Application Servers, Audio System, Online documents, Car Bluetooth, Car Music System, other mobile phones, Computer, Laptop, Digital Living Network Alliance (DLNA) enabled Television, Online mail accounts (Gmail), I-pad, Mac-book, Online stores (like itunes), Xbox, other Smartphones, Television, Tablet, and USB devices.

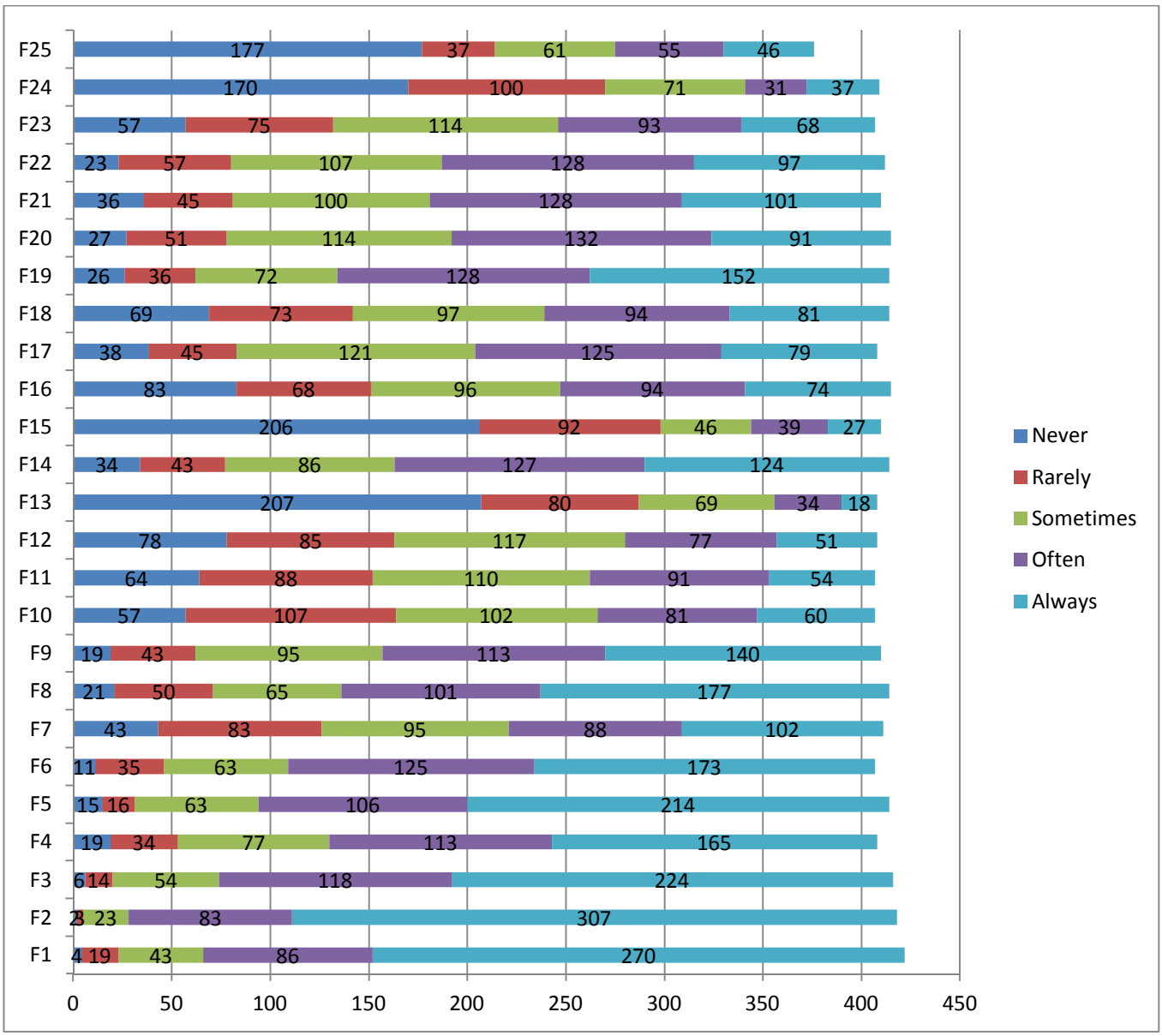

Figure 17: Personal Preference of Smartphone features and extent of usage

From the information extracted using the survey question pertaining to the number of family members and how many of them are currently using a Smartphone, we get the picture of Smartphone usage within our society. Figure 18 presents the Smartphone use with respect to family size. The X-axis corresponds to the family size while the Y-axis reflects the average number of Smartphone users in a family.

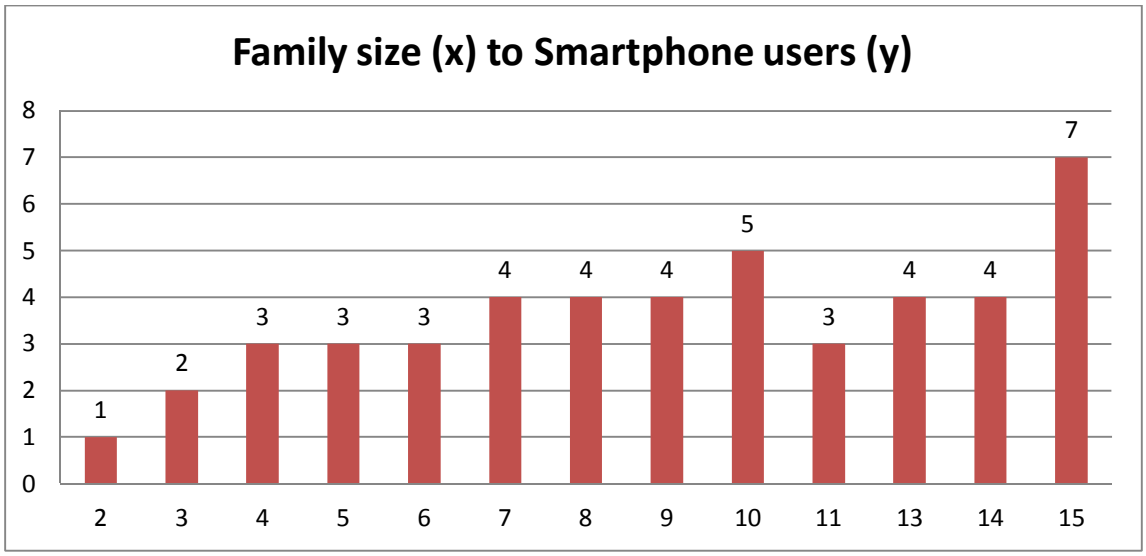

Figure 18: On average Smartphone users with respect to family size

Figure 19 gives a glimpse of Smartphone ownership by respondents of the survey. This shows which brands are currently leading the market in terms of ownership in our demographics. The top five brands in the data extracted from the users of the target demographic includes: Samsung, HTC, Apple, Nokia, and Sony.

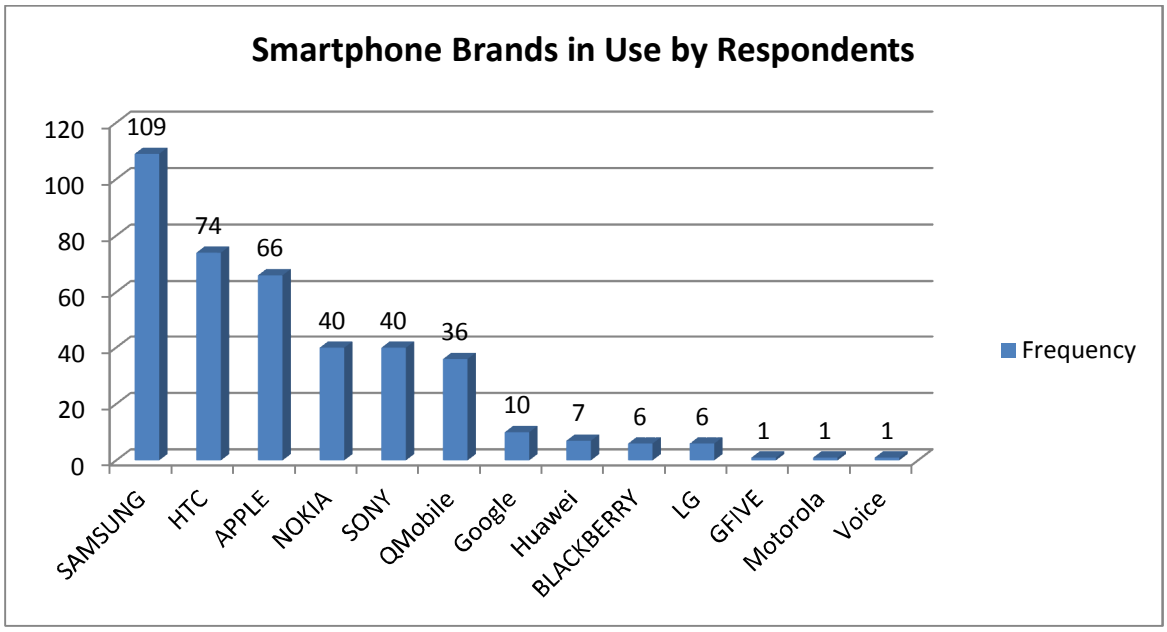

Figure 19: Smartphone Brands in use by survey respondents

Figure 20 shows that the primary mode adopted in our demographics for connecting the Smartphone with Internet is by using Wi-Fi (403 votes). Data package service from service provides only received 22 votes. This can point towards a market which has not being targeted effectively by service providers, may be due to service quality level, cost per MB in mobile Internet usage etc. People still prefer Wi-Fi as compared to data package service. Service providers can launch better campaigns and give various rebates to push the users to use data package more easily and comfortably. There can be other external reasons which may be causing this effect, which can be explored in this context as a future research.

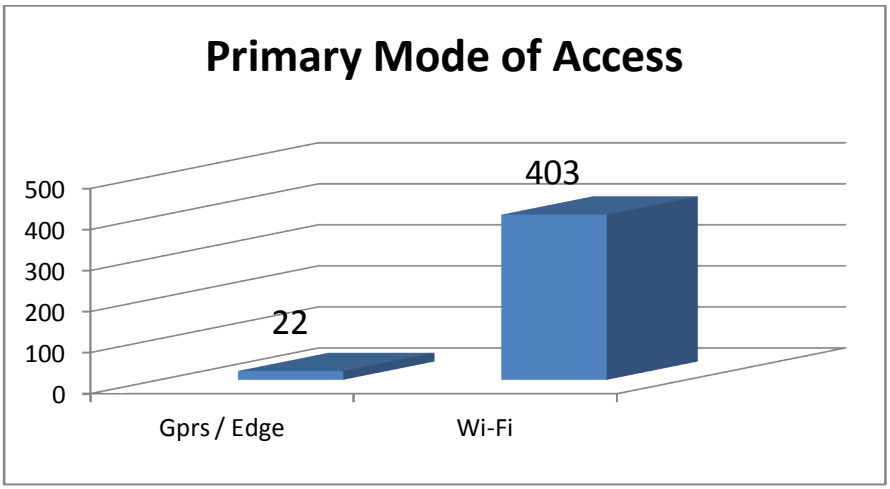

Figure 20: Smartphone primary mode for Internet Connectivity

In addition to this data showed the purpose for which respondents use their Smartphone. They can select multiple answers. Results show that 135 respondents selected work related tasks, 302 selected studies related tasks and 376 checked personal tasks. In the survey, respondents were asked to rank top 3 brands which they would prefer. The brand which got most votes at number one position was Apple, and then was Samsung and finally HTC.

5.4 DESCRIPTIVE STATISTICS:

Mean ratings of the measurement items were calculated by applying frequency analysis on the original dataset using IBM SPSS 21. The mean rating is actually the mean value for all the responses captured for a particular question in a survey that is under consideration for measurement, based on some defined scale. In the Smartphone research, we adopted a 7 Likert-Scale questionnaire items for recording individual response to different questions from each participant. The average value for a 7 Likert-Scale is equal to 4, which represent a neutral response to a question. Over here 4 is the center value for the Likert Scale of 7 and also the average value for comparison derived by taking the average. That is, by taking a sum from 1 to 7 integers which represent various response categories and then dividing the sum by 7 (therefore we get the center or average value of 4). The mean rating values that are tending towards the

higher limit 7 and greater than 4 reflect population response agreeing to a particular measurement question. Whereas the mean values that are lower than 4 and tending towards the lower limit of 1 reflect the population response disagreeing to a particular measurement question. The following table shows the Mean Ratings for different measurement items of the survey from a total of 405 individuals. Table 10 lists the item, the number of responses received, number of missing cells, the mean value and their respective standard deviation.

Table 10: Descriptive Statistics n = 405

Items	N	Missing	Mean	Std. Deviation
A1 - I consider a Smartphone to be more useful that has many applications available for use.	405	0	6.06	0.936
A2 - I believe that a Smartphone is useful that has applications relevant to my day to day tasks.	405	0	5.97	1.048
A3 - I consider a Smartphone easier to use that includes a variety of applications.	405	0	5.78	1.148
A5 - I find Smartphone apps easy to use.	405	0	5.92	0.950
AS2 - If I have technical difficulties in using a Smartphone, the technical support personnel at a service center will help to resolve the issue.	405	0	4.16	1.525
AS3 - I consider a Smartphone easier to use that includes a variety of applications.	405	0	3.75	1.528
AU - I use Smartphone routinely and regularly.	405	0	5.79	1.607
BI2 - I intend to buy a Smartphone in the next 2 months.	405	0	4.21	1.924
D2 - I prefer a Smartphone that has a longer battery life.	405	0	6.54	0.921
D3 - I prefer a durable Smartphone. (i.e. it can tolerate external damages/environment such as small impacts and water-proof casing)	405	0	6.41	1.003
MM1 - I would consider a Smartphone more useful that has high media support such as RAM, camera resolution, sound quality, picture quality, interactivity etc.	405	0	6.29	0.934
MM2 - I feel that Smartphone with various media support is easier to use.	405	0	5.74	1.094
MM3 - I am comfortable with the Smartphone which offers a variety of interactive media capabilities. (such as GPS, smart gesture recognition, Smart answering, quad core processing capability, cloud services, mobile TV, teleconferencing etc)	405	0	5.84	1.221
PCS1 - A Smartphone supports many essential services that I need when I am travelling and saves me cost for carrying multiple devices.	405	0	5.9	1.281
PCS2 - I can perform different activities on a Smartphone without much effort.	405	0	6.03	0.960
PEOU1 - I find Smartphone easy to use.	405	0	6.03	1.099
PEOU3 - I can easily increase my skills of using various features of Smartphone.	405	0	5.96	1.066
PU1 - I find Smartphone useful in quickly accomplishing my daily tasks.	405	0	5.72	1.261

Items	N	Missing	Mean	Std. Deviation
PU2 - I believe that using a Smartphone improves the quality of my daily tasks.	405	0	5.53	1.228
PU3 - I find Smartphone as a helpful mobile educational tool for improving learning experience.	405	0	5.63	1.251
SN2 - I believe that Smartphone characteristics including hardware capability and software quality reflects one's personality to others.	405	0	3.47	1.748
SN3 - I find people who own a Smartphone to have a good social status.	405	0	3.63	1.748
TB1 - I find it difficult to install applications on Smartphone.	405	0	2.39	1.467
TB2 - I face difficulty in altering network configurations on Smartphone.	405	0	3.35	1.766
WI1 - I believe that having Wi-Fi connectivity in a Smartphone makes it useful.	405	0	6.68	0.653
WI2 - I believe that having Wi-Fi connectivity in a Smartphone makes it easier to use.	405	0	5.85	1.361

Chapter 6:

DISCUSSION AND CONCLUSION

The main reason for this chapter is to summarize and consolidate the results of this research. This chapter will include the discussion on Smartphone Acceptance Model along with the implications associated with theoretical, practical and methodological context. The limitations of the study, suggestions and implications for future research are also discussed in this chapter.

In accordance to the research objectives the study is formulated as follows:

- A literature review was made to understand the theories and associated models. These models are discussed in detail in chapter 2, such as: Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), Decomposed Theory of Planned Behavior (DTPB), Technology Acceptance Model (TAM), Technology Acceptance Model 2 (TAM2), Augmented TAM or Combined TAM & TPB (C-TAM-TPB) and Unified Theory of Acceptance and Use of Technology (UTAUT).

- Previous literature was reviewed in relation to Smartphone acceptance, its adoption and usage. This review is presented in chapter 2, which discusses in contexts of Smartphone technology, individual use, as a common consumer, organizational setup, for university learning and in the cultural contexts.

- Research was further extended to formulate a model of technology acceptance for Smartphone usage and the critical factors involved. Its details and the proposed research model are rendered in chapter 3.

- The discussion on the methodology used, the data collection approach, the data cleaning process is rendered in chapter 4.

- We have generated as well as validated a research model that best describes Smartphone usage within Pakistan.

- Data analysis and hypotheses testing was performed and the outcomes are discussed in detail in chapter 5. The results, acceptance ranges, software tools and algorithms used along with output graphics and tabulated outcomes are given in this chapter. In this the demographic information is also presented.

- Finally in this chapter (i.e. chapter 6), we present a discussion along with conclusion on the findings.

- Appendix shows the designed questionnaire for conducting the survey. Coding sheets used for data collection phase is also a part of appendix. Also, enlists the origins of different survey questions that were used and considered from literature in the survey development phase.

6.1 DISCUSSION OF HYPOTHESES TESTING:

6.1.1 Wireless Options:

As seen from table 5, the calculated t-value t= 1.2981 (p=0.195) from wireless Internet to Perceived Usefulness indicate a weak intrinsic consequence of wireless Internet towards Perceived Usefulness. This shows that wireless Internet does not contribute towards Perceived Usefulness of a Smartphone. Hence, we can state that wireless options for Internet connectivity do not increase the Perceived Usefulness of a Smartphone. This indicates that there is no direct contribution of this factor towards the usefulness a user perceives from using a Smartphone. *Hence H1-a is rejected.*

The calculated t-value t=1.3115 (p = 0.1905) from wireless Internet to Perceived ease of use indicate an insignificant relationship of wireless Internet towards Perceived ease of use. We can therefore state that, wireless options for the Internet

connectivity do not increase the Perceived ease of use of a Smartphone. *Hence H1-b is rejected*.

Many people use Wi-Fi as a primary option to connect to Internet via Smartphones, instead of data package. Both the options are becoming low cost and with increased coverage. Since hotspots are easily available in homes, market places, shopping centers, theaters, colleges and universities so Wi-Fi is almost taken for granted. Also, the launch of 3G services in Pakistan with attractive prices might have made the users perceive Internet connectivity as not an exclusive characteristic contributing towards Smartphone usefulness or easy to use. There are about five mobile Internet service providers in Pakistan. Apart from this Pakistan has a very well established wireless infrastructure this is because 3G and 4G services are now available, offering high speed Internet. This is because now individuals can use their Smartphones through high speed 3G data package service, which is available in most of the regions across the country. That is to say Wi-Fi is essential but not necessary. Another reason might be that the two options for Internet access are not clogging in terms of Internet traffic nor do they face any issues such as connectivity or failure of data transfer. Therefore, the consumers do not feel the necessity for acquiring some other option for Internet connectivity on a Smartphone, which would give them better speed or quality online services.

6.1.2 Design Features:

As seen from table 5, the calculated t-value t=1.766 (p = 0.078) from design to Perceived usefulness indicates a direct significant relationship from design features towards Perceived usefulness. We can therefore state that, design features increase the Perceived usefulness of a Smartphone. Path coefficient value (β) from SmartPLS for this relationship (see table 7) is equal to 0.107. *This hypothesis is supported at a 10% significance level, hence H2-a is accepted*.

This result can be explained, while considering design as an essential aspect of a Smartphone that should conform to the consumer preferences. In Pakistani market

consumers prefer a Smartphone with good design. Users tend to be intrigued by the different features such as size, shape and external look of a Smartphone. And this is the reason why there are so many Smartphone brands in Pakistan offering a large variety of Smartphone with different designs. The aim is to increase the variety for customers to choose from. This shows that consumers are conscious about style and the design of a Smartphone. This shows that the consumers of this region are design conscious. In addition to this, the market is full of low cost stylish phone covers, frames, which further promote the focus for having a Smartphone fitting the design preferences of the consumers. This impacts the purchase decision of a Smartphone to a considerable and significant extent. Thus, general consumers in our region do observe an esthetic sense and consider design as an important detail for a Smartphone to be useful.

As seen from table 5, the calculated t-value t = 2.1265 (p = 0.034) from design to Perceived ease of use indicates a direct significant relationship from design features towards Perceived ease of use of a Smartphone. We can therefore state that, design features increase the Perceived ease of use of a Smartphone. However, the path coefficient (β) value is -0.131 (see table 7). This implies that design features have a direct negative predicting effect on Perceived ease of use of a Smartphone. The path coefficient is therefore contradicting with the significant p value for this relationship. According to path coefficient value, design features decrease the effect of perceived ease of use of a Smartphone. *Therefore this contradiction leads us to reject the hypothesis H2-b*.

There is a touch-screen interface in almost every Smartphone having keys arrangement as QWERTY keys standard format, similar to the ones in most laptops. Most of the operations in a Smartphone can be easily operated. For example games can easily be played through inbuilt motion sensors or available keys, which offers different easy to understand use of controls. Almost all Smartphones are designed keeping in view the comfort of users and making their experience enjoyable. Such features are already available in a Smartphone including interfaces in different

languages. This implies that design features do not affect the ease in using a Smartphone. It turns out that the effect of design towards Perceived ease of use of a Smartphone is quiet mute.

6.1.3 Multimedia Features:

As seen from table 5, the calculated t-value t= 1.2414 (p = 0.215) from multimedia to Perceived usefulness indicates an insignificant relationship. We can therefore state that, multimedia features do not increase the Perceived usefulness of a Smartphone. *Hence H3-a is rejected.*

An explanation in this regards can be made by considering features that are common in Smartphones as well as featured phones. For example they have camera, Wi-Fi and applications etc. Due to the similar features, it seems that the population gives little importance towards multimedia capabilities found in Smartphone, because some of the multimedia features with limited capability are also present in featured phones. Although a Smartphones have higher resolution cameraôs as compared to featured phones, with linked application base for editing, sharing and capturing events. Smartphone provides access to almost every type of data usage just like a personal computer. Smartphone allows the execution of third party applications, but there are a few featured phones having some similar services making them alike to but not equivalent to a Smartphone. This grayness in functionality might have caused consumers to overlook the Smartphone multimedia capabilities. Similarly, A Smartphone is like small computing device having its own processor like Quad core processor, which enables it to deliver advanced functionality along with the capability to evolve and integrate cutting edge technologies on the go. However the featured phones do not have any such technological capabilities. Smartphones also have different sensors for example motion sensing modules for improving userôs operational experience, which are not available in featured phones. Smartphone even though higher in terms of multimedia capability, somehow the respondents are not aware of the fact or do not perceive multimedia important anymore.

Another possible reason could be that most of the consumers in the demographic are composed of students who are more focused on studies and rarely get time for using various advanced multimedia features of Smartphone on a regular basis, and this has resulted in a lack of interest for utilizing Smartphone multimedia functionality. There are many useful applications of extending Smartphone media capability. For example in medicine Smartphone enables professionals to scan retina, make an automated inspections and via online link doctors can delivered prescriptions to the patient. Across the world multimedia features of Smartphone are being extended. However, consumers in the demographics are probably not aware of the true potential or perhaps they cannot realize it. This might have resulted in hiding the true potential of the multimedia and its usefulness amongst common consumers for Smartphone. There are so many cutting edge features being integrated in the hardware as well as software of a Smartphone that are probably available across the globe but have not yet been introduced in this market.

As seen from table 5, the calculated t-value t=2.3043 (p = 0.02178) from multimedia to Perceived ease of use indicates a direct significant relationship. We can therefore state that, multimedia features increase the Perceived ease of use of a Smartphone. Path coefficient value (ϐ) from SmartPLS for this relationship (see table 7) is equal to 0.1536. *Hence H3-b is accepted*.

There are many advanced multimedia utilities of Smartphone including GPS-location based services. For example 3D map services which gather information across the globe and helps locate different resorts, monuments etc. All these services integrated with Smartphone camera and other cloud based services. The remote sensing capability can assist in identification of location, vehicle or even a person. Apart from this multimedia also includes other integrated feature such as smart recognition (gesture, voice, face etc.), auto response and data processing, the processing capability, cloud based communication, mobile TV, video conferencing, etc.. A Smartphone provides easy as well as effective technology use in many different situations on the go for users and enhances the way we interact with each other. The

media capability such as voice control, tasks, Skype services etc make it easy for the user to use a Smartphone as a tool not only for staying connected but to perform tasks easily and effectively through multimedia features. Individuals therefore perceive that the more in number are the multimedia features in a Smartphone the easier it will be to use it for executing their tasks. It is to be noted that the target population belong to different engineering and technology departments, therefore they are aware of the multimedia utilities and they feel it easy to adopt a Smartphone that offers more multimedia features.

6.1.4 Preferred Applications:

As seen from table 5, the calculated t-value t= 2.2439 (p = 0.025) from applications to Perceived usefulness indicates a direct significant relationship. We can therefore state that, preferred applications increase the Perceived usefulness of a Smartphone. Path coefficient value (β) from SmartPLS for this relationship (see table 7) is equal to 0.1428. *Hence H4-a is accepted*.

As seen from table 5, the calculated t-value t=4.672 (p = 0.00000423) from applications to Perceived ease of use indicates a direct significant relationship. We can therefore state that, preferred applications increase the Perceived ease of use of a Smartphone. Path coefficient value (β) from SmartPLS for this relationship (see table 7) is equal to 0.2662. *Hence H4-b is accepted*.

This is obvious because many people prefer a Smartphone having a large number of applications. Some applications that are already installed, while other applications that are accessible and can be downloaded using a online application stores, for example Google play, Apple app store, Samsung Apps store, Nokia OVI store, Android market, BlackBerry App world etc. Each set of applications have their own preference amongst consumers based on their needs. Smartphone applications that support daily official tasks and are compatible with standard formats such as word, power-point, excel etc. are also considered useful. As per the survey response where we see that the consumers prefer a variety of applications, they also prefer the

relevance of applications towards their personal needs in context to their daily tasks. Applications should be easily accessible and easy to download. Applications also facilitate in increasing knowledge with the Internet access, for example provide news, applications related to provide access to different e-books, magazines, articles, blogs etc.. Social media applications (such as facebook, twitter etc.) help people socialize through Smartphones, this also signifies the usefulness of the Smartphone in terms of networking.

Preference of applications amongst consumers is also based in terms of ease for using a Smartphone for completing tasks that suits in their respective contexts. For some it is a necessity in terms of job performance. For some it acts as a personal digital assistant. Applications give an ease for the consumers to use a Smartphone that makes them feel comfortable or perhaps helps him achieve a goal efficiently. If users feel easy to perform tasks by using a particular set of applications then they will definitely prefer to use the Smartphone offering those applications. For example as a word processor application most of the users will prefer Microsoft word application on a Smartphone because the consumers have experience of using it on their personal computers. Similarly, applications that are compatible with other systems enable users to share different content amongst various compatible platforms. This makes content to be easily accessed, reviewed as well as shared. In this context there are many applications that increase the perceived ease of use of a Smartphone, especially those applications that already have high consumer preference. Similarly, applications may include music store apps such as itunes or file sharing such as dropbox, which are famous as well as convenient for the users. Similarly, there can be learning applications that provide tutorials, ebooks and user guides for using the Smartphone device for specific purpose, which will guide the users to follow certain steps to achieve a goal using a specific application. Some examples include a photo editing tool, a logistics management application, or perhaps games that first train through a practice guide for using various for achieving various task by using Smartphone

interface. The easier it is for the consumers to use a Smartphone the more quickly and effectively they can fulfill their tasks and achieve certain goals.

6.1.5 After Sales Service:

As seen from table 5, the calculated t-value t=0.3815 (p = 0.703) from After Sales Service to Perceived usefulness indicates an insignificant relationship. We can therefore state that, After Sales Service does not increase the Perceived usefulness of a Smartphone. *Hence H5-a is rejected.*

The possible explanation is that consumers are unaware of such services or they seldom avail it. There are some Smartphone companies that have no service centers in this region for example official Apple support for iPhone called the Service Answer Center is not available in Pakistan although it is available in many other countries across the globe. Therefore people have not experienced the true after sales services support that an international company offers to its customers, for example the services of Apples iPhone Answer Center includes screen repair, warranty, battery and power issues, or other customer reported issues. In the region there may be lack of warranty, replacement schemes or insurance. Another issue is the availability of second hand phones and low cost featured phones that make consumers consider the option of replacement with a new phone. One more reason is that in Pakistan there are many unauthorized service shops or even local mobile repair electronic stores, which provide the support as an independent business, (although they are not comparable to the companyôs support service) that is why the population does not consider After Sales Service to be useful. For the companies that have service centers there is another issue that they may be residing in one city say Karachi but if a person needs to visit a service center in Islamabad probably he will consider other options. That is the reach ability issue of a service center is important. Consumers also have bad experience in terms of local after sales service, which compels them to think of purchasing a new rather than repairing the original Smartphone.

As seen from table 5, the calculated t-value t=2.241 (p = 0.025) from After Sales Service to Perceived ease of use indicates a direct significant relationship. We can therefore state that, After Sales Service increases the Perceived ease of use of a Smartphone. Path coefficient value (β) from SmartPLS for this relationship (see table 7) is equal to 0.0951. *Hence H5-b is accepted*.

In Pakistani market there are technical people who have the skills and ability to fix as well as guide people in purchasing a Smartphone even, if the original support centers are not located in the region. These local technicians facilitate consumers in using a Smartphone device and help resolve issues. There are Smartphone companies such as Apple whose service center are not available in Pakistan; however they are readily being used by many people. It may be because of the number of people using these devices along with local technical support that is pushing the acceptance of Smartphone amongst consumers. That is to say the sales services for those Smartphones that are available along with the ones not available still have local technical personals and local service centers that provide services to customers. This enables the consumers to perceive that after sales service does in fact increase the perceived ease of use of a Smartphone. Coming towards reach-ability to service centers there are many local companies in almost every city in Pakistan, which can be easily approached for support. These include mobile shops, private electronic device and repair companies etc. Apart from this companies like Qmobile have their customer care centers all over Pakistan and perhaps this is the reason why their products sales are increasing in Pakistani market especially Smartphones. This spread of customer support has made the Smartphone consumers to believe that after sales services increase the perceived ease of use of a Smartphone. As service centers facilitates its customers on various issues and helps troubleshoot any issue that the customer might be facing. Since there are other companies including Qmobile whose services can be available, this immediate support and assistance strategy is gaining the interest as well as loyalty from the Smartphone consumers. This is all because of quick resolution and easy access of support services.

6.1.6 Perceived Cost Savings:

As seen from table 5, the calculated t-value t=2.7118 (p = 0.007) from Perceived cost savings to Perceived usefulness indicates a direct significant relationship. We can therefore state that, Perceived cost savings increase the Perceived usefulness of a Smartphone. Path coefficient value (ϐ) from SmartPLS for this relationship (see table 7) is equal to 0.1792. *Hence H6 is accepted*.

By understanding various dimensions of cost that relate to Smartphone usefulness we can explain this trend. The respondents from the demographic perceive that a Smartphone can save time for performing tasks and achieving goals through its advanced automated services, for example accessing maps on the go and reaching places before time. In addition to this Smartphone helps save effort cost for example an automated logistics management application capable to mark sales as well as check latest reports, which is connected to backend databases and servers, this helps avoid manual hectic process of record keeping and brings into the play the power of mobile computing. As a personal device consumers do not need to carry their laptops around, Smartphone enables them to stay connected access emails, review documents, and perform specialized tasks. Smartphone provide ubiquitous services giving the common consumer the power to use their professional resources efficiently and achieve high productivity in daily life tasks. The Smartphone is the preferred device for professionals belonging to business, finance, medicine and many other jobs based on the relevance of services of a Smartphone and the userôs ultimate goals.

6.1.7 Technical Barriers:

As seen from table 5, the calculated t-value t=4.436 (p = 0.000012) from Technical Barriers to Perceived ease of use indicates a direct significant relationship. We can therefore state that, Technical Barriers decrease the Perceived ease of use of a Smartphone. Path coefficient value (ϐ) from SmartPLS for this relationship (see table 7) is equal to -0.2384. *Hence H7 is accepted*.

The relation from Technical Barriers towards Perceived Ease of Use as hypothesized has a negative relationship. That is, if Technical Barriers increase the Perceived Ease of Use decreases. For instance if there are infrastructure related issues for example wireless network connectivity problems, then the perceived ease of use of a Smartphone would be low. This is because most of the services are linked through the Internet and if the network is unavailable then it would be difficult for the consumer to use a Smartphone. The ease in using a device depends upon many technical factors including, network, legal, power and many similar issues. For example if an application of a Smartphone requires sort of configurations to function properly, then this will also be considered as a barrier. Similarly if someone is not acquainted in using mobile devices such as Smartphone, then that user would need to learn using it by following some training guide or interface guiding stepwise animations. Such features are available in some handsets for example in Samsung Galaxy Series. In this case even lack of experience or understanding to use a Smartphone is also considered as a Technical Barrier. Similarly, there can be regulatory issues, for example if the authorities pass a new policy that each person can use only one Subscriber Identity Module (SIM) card, so this is a barrier because this policy is limiting Smartphone users to be restricted in using only using one SIM. Another category of technical barrier can be related to the unavailability of services as well for example in case of a Smartphone application. For instance if an online shopping application goes down due to a Denial of Service attack then that application cannot provide its services anymore. Therefore Technical Barriers impede and obstruct the ease in using a Smartphone.

6.1.8 Social Norms:

As seen from table 5, the calculated t-value t=4.2023 (p = 0.00003351) from Social Norms to Perceived usefulness indicates a direct significant relationship. We can therefore state that, Social Norms increase the Perceived usefulness of a Smartphone. Path coefficient value (β) from SmartPLS for this relationship (see table 7) is equal to 0.1752. *Hence H8 is accepted*.

There is a saying ñBirds of features flock togetherò, similarly if a group that is close to someone considers a Smartphone to be useful then that person will also want to use a Smartphone based on the social effect. This is also called network effect or group effect in terms of business economics. In a society if some close friend or a role model prefers to use Smartphone for many different tasks then that individual will also perceive it useful and would tend to adopt. In many cases the adoption by consumers is solely based on peer reviews and opinions, in this case individuals often ignore the technical aspects and follow the trend. Friends provoke friends and share information about usage with each other; this in turn increases the feeling to adopt the same technology. Therefore social norms have a direct significant impact towards perceived usefulness of a Smartphone. In Pakistan mostly family opinion plays the decisive role and many try to adopt a Smartphone that is used by someone in the family, may be because of the level of trust or due to the Pakistani social system. Some Smartphones are really costly and have become a status symbol in the eyes of many consumers. So many people also tend to adopt pricy Smartphones just because of maintaining a status level and give less focus on functional features. In addition to this the activities that people perform on the Smartphone motivates the trend followers to use the Smartphone in the same way for performing similar activities.

6.1.9 Perceived Ease of Use:

As seen from table 5, the calculated t-value t=4.0048 (p = 0.0000757) from Perceived ease of use to Perceived usefulness indicates a direct significant relationship. We can therefore state that, Perceived ease of use features increases the Perceived usefulness of a Smartphone. Path coefficient value (ϐ) from SmartPLS for this relationship (see table 7) is equal to 0.2779. *Hence H9-a is accepted*.

The explained variance value from SmartPLS is given by R^2 values as shown in table 6. The R^2 value for Perceived Usefulness is 0.3067 and for Perceived Ease of Use the R^2 value is 0.2656, both of these values are greater than 0.2, which is considered high for consumer behavior research. So SmartPLS R^2 is explaining the two variables with respect to their predicators.

As seen from table 5, the calculated t-value t=2.1785 (p = 0.03) from Perceived ease of use to actual use indicates a direct significant relationship. We can therefore state that, Perceived ease of use directly affects the actual usage of a Smartphone. Path coefficient value (ϐ) from SmartPLS for this relationship (see table 7) is equal to 0.1386. *Hence H12 is accepted.*

The predicators for Perceived Usefulness are seven independent variables and one endogenous variable namely: Wireless Internet, Design, Multimedia, Applications, After Sales Service, Social Norms, Perceived Cost Savings and Perceived Ease of Use, respectively. Similarly the six independent variables for Perceived Ease of Use are: Wireless Internet, Design, Multimedia, After Sales Services, Technical Barriers and Applications. Hypothesis H9-a is completely supported and accepted from SmartPLS results. Individuals perceive that the easier it is to use a Smartphone the more will it be useful for performing daily tasks. This is because the easier it is to use an advanced mobile device the clearer and understandable will be its use in the eyes of the common consumer. The easier it is to perform ubiquitous tasks the more is the Smartphone preferred, which is an advanced mobile computing device.

As displayed from the analysis the relation from Perceived Ease of Use towards Actual Use of Smartphone is significant. That is to say the more it is easy for the common consumer to use a Smartphone the more easily and effectively it can be used for performing different tasks. People usually adopt a system on which they can rely, for example Smartphone offers ubiquitous computing ability along advanced communication services besides this it is a handy device and consumers can rely on this one device instead of carrying laptops or using other systems on the go. This makes a Smartphone not only reliable but also comfortable for performing multiple tasks with a higher degree of convenience and trust. In a Smartphone one can interact using social apps, makes calls, perform computation etc making it an easy to use personal assistant offering functionality related to a mobile phone, personal assistant,

as a computer and offers networking for faster access to the Internet and the software applications that make it an effective usable tool.

As seen from table 5, the calculated t-value t=0.2432 (p = 0.8079) from Perceived ease of use to Behavioral intention indicates an insignificant relationship. We can therefore state that, Perceived ease of use do not increase the Behavioral intention of a Smartphone. *Hence H9-b is rejected*.

This means that there is no direct effect from Perceived Ease of Use towards Behavioral Intention. However we note that hypothesis H9-c and H9-a are accepted therefore there exists a mediation effect through Perceived Usefulness towards Behavioral Intention. This shows that there is a significant indirect effect from Perceived Ease of Use through Perceived Usefulness to Behavioral Intention (also known as mediation effect). Use of Smartphone does not require specialized skills as a common consumer device its use no matter whatever the brand should be easy, clear and useful. We see that the direct link from Perceived Ease of Use to Behavioral Intention is insignificant and this can be explained if we shed some light on the target population. The data collected from this demographic consists of individuals mostly youth that are student and seems that they are using computing devices for some time, therefore they already feel it very easy to use a Smartphone so there focus might be towards usefulness rather than ease of use. The population is using Smartphones and there are so many companies offering similar services therefore the survey shows that the focus of the sample is towards the factors that make the Smartphone beneficial in terms of usefulness but at the same time relate that ease of use is important but having an effect through perceived usefulness of a Smartphone.

6.1.10 Perceived Usefulness:

As seen from table 5, the calculated t-value t=2.2221 (p = 0.0269) from Perceived Usefulness to Behavioral intention indicates a direct significant relationship. We can therefore state that, Perceived usefulness positively influences the Behavioral

intentions to use a Smartphone. Path coefficient value (β) from SmartPLS for this relationship (see table 7) is equal to 0.1214. *Hence H9-c is accepted*.

As seen from table 5, the calculated t-value t=3.2121 (p = 0.0014) from Perceived usefulness to actual usage indicates a direct significant relationship. We can therefore state that, Perceived usefulness increases the actual use of a Smartphone. Path coefficient value (β) from SmartPLS for this relationship (see table 7) is equal to 0.2119. *Hence H11 is accepted*.

The survey shows that perceived usefulness of a Smartphone positively influences the intentions to use a Smartphone. It is essential to note people consider it important because Smartphones are used to perform numerous tasks of our daily life. Smartphone is a modern marvel with evolving technological capabilities having numerous utilities in many different daily tasks including medicine, engineering and in the context of various jobs. The analysis shows that respondents perceive Smartphone to bring improvement in their different tasks and leads to achievement of various goals, thus making Smartphone a useful device, which amplifies the intentions for using it. Since respondents perceive it helpful in terms of achieving goals so the intentions to use a Smartphone also increase.

The H11 relationship proves that the perceived usefulness of a Smartphone has a direct contribution towards Actual Use. The more individuals perceive a Smartphone useful for performing different activities the more they feel encouraged to use a Smartphone. This is because Smartphone has the ability to perform many activities swiftly and conveniently for example checking/sending emails, surfing the web, access many applications, perform various application based computing, review documents etc. If the people in a demographic perceive it useful then they believe by using a Smartphone they can increase their efficiency by using it in their day to day tasks. Similarly using a Smartphone can save individuals time for performing their tasks, for example quickly accessing and getting update services say stock exchange rates etc. Many can use a Smartphone and its services to improve the quality of their

tasks in terms of different contexts for instance performing job related tasks, improve learning experience, managing business schedules, or staying in touch with up to date information, using multimedia features like high resolution camera to record different moments and sharing with friends and family members.

6.1.11 Behavioral Intention:

As seen from table 5, the calculated t-value t=1.9995 (p = 0.046) from Behavioral intention to Actual use indicates a direct significant relationship. We can therefore state that, Behavioral intention increase the actual usage of a Smartphone. However, Path coefficient value (ϐ) from SmartPLS for this relationship (see table 7) is equal to -0.0984. The relationship between BI and AU has a negative path coefficient showing that the variables vary inversely with respect to each other. The path coefficient is reporting an opposite outcome for this relationship (it should have been positive) as compared to p-value. Negative path coefficient implies that if the intention to use a Smartphone increases the actual use of a Smartphone decreases, this outcome is contradicting with the hypothesis. *Therefore hypothesis H10 is rejected*.

The explained variance for Behavioral Intention (BI) is given by R Squared (R^2), which is equal to 0.0136 (see table 6). The predicators are imposing a direct effect on BI including two endogenous variables namely Perceived Ease of Use (R^2 = 0.2656), and Perceived Usefulness (R^2 = 0.3067). Perceived Usefulness (PU) has an even higher R^2 of 0.3067 with a ϐ of 0.121 (for the path PU to BI). Perceived Usefulness (PU) has R^2 = 0.3067 therefore imposes the strongest (positive) effect on BI, the next effect is casted by Perceived Ease of Use (PEOU) (R^2 = 0.2656), which is a negative (as ϐ = -0.013 from PEOU to BI), but the relationship from PEOU to BI does not hold as per 5% p-value significance criteria. The explained variance R^2 for Actual Use is 0.0923 (See table 6). The predicators that are imposing direct effect on Actual Use include Behavior Intention (R^2 0.0136), Perceived Usefulness (R^2 0.3067) and Perceived Ease of Use (R^2 0.2656). Actual Use experiences direct as well as indirect effects from Perceived Usefulness, and Perceived Ease of Use. The strongest direct and indirect effect on Actual Use is received from Perceived Usefulness (R^2 =

0.3067), and then Perceived Ease of Use (R^2 = 0.2656). Similarly the path coefficient from PU to AU is 0.212, which is signifying a positive direct relationship from PU to AU. Furthermore from PEOU to AU as per path coefficient is given by 0.139. Therefore SmartPLS rejects the hypothesis H10 due to the negative path coefficient value for this relationship.

From the output values from SmartPLS we see that there is no direct relationship from Behavioral Intention to Actual Use of a Smartphone. The effect is inversely proportional which contradicts the hypothesis statement H10. That is for every unit change of +0.098 for Behavioral Intention there will be a negative unit change of -0.098 for Actual Use of a Smartphone. The effect can be explored in future by using more indicators for Behavioral Intention. That is more dimensions should be measures in terms of Intentional use for example user intends to use a Smartphone for purpose a, b and c activities. That is there could be other intentions as well other than intending to buy and using a Smartphone. Similarly for actual use some more items like actually using it for a, b and c etc activities. The only point here is to make that the more items and different proceeding factors might explain the variance better. In literature also the intentions and actual use for many systems are measured by questions like ñI intend to buy a Smartphone in the next 2 monthsò for BI and ñI use Smartphone routinely and regularlyò for AU. That is to say we adopted question for all variables from literature keeping in view the Smartphone context but some questions like that of BI and AU are unanimously traditional, with most of the questions focusing towards future use for example using a device in 2 months or in future. From the results we see there is a direct relationship from Perceived Usefulness towards Behavioral Intention but no direct relationship from PEOU to BI and from BI to AU. We see that there exists a direct effect from Perceived Usefulness to Actual Use also there exists a direct effect from Perceived Ease of Use to Actual Use, but the mediation effect from Behavioral Intention towards Actual Use does not exist.

Table 11: Summary Table of Hypotheses Testing

HYPOTHESES NUMBER	HYPOTHESES STATEMENT	Hypotheses Outcome
H 1-a	Wireless Internet connectivity option increases the Perceived Usefulness of a Smartphone	Rejected
H 1-b	Wireless Internet connectivity option increases the Perceived Ease of Use of Smartphone	Rejected
H 2-a	Design features increase the Perceived Usefulness of a Smartphone.	Failed to Reject
H 2-b	Design features increase the Perceived Ease of Use of a Smartphone.	Rejected
H 3-a	Multimedia features increase the perceived usefulness of a Smartphone.	Rejected
H 3-b	Multimedia features increase the Perceived Ease of Use of a Smartphone.	Failed to Reject
H 4-a	Availability of preferred applications increase the Perceived Usefulness of a Smartphone.	Failed to Reject
H 4-b	Availability of preferred applications base increase the Perceived Ease of Use of a Smartphone.	Failed to Reject
H 5-a	After Sales Service increases the perceived usefulness of a Smartphone.	Rejected
H 5-b	After Sales Service increases the perceived ease of use of a Smartphone.	Failed to Reject
H 6	Perceived cost savings increase the perceived usefulness of a Smartphone.	Failed to Reject
H 7	Technical barriers decrease the perceived ease of use of a Smartphone.	Failed to Reject
H 8	Social norms increase the Perceived Usefulness of a Smartphone.	Failed to Reject
H 9-a	Perceived Ease of Use of a Smartphone increases its Perceived Usefulness.	Failed to Reject
H 9-b	Perceived Ease of Use positively influences Intention to use a Smartphone.	Rejected
H 9-c	Perceived Usefulness positively influences Intention to use a Smartphone.	Failed to Reject
H 10	Behavioral Intention directly affects the Actual Usage of Smartphone.	Rejected
H 11	Perceived Usefulness directly affects the Actual Usage of Smartphone.	Failed to Reject
H 12	Perceived Ease of Use directly affects the Actual Usage of Smartphone.	Failed to Reject

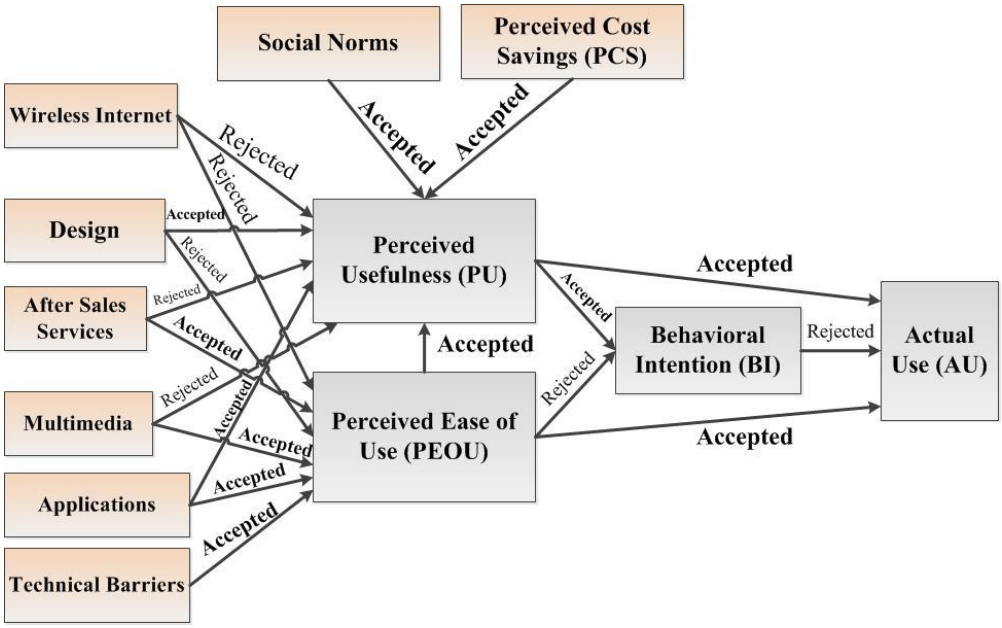

Figure 21: Hypotheses Outcome

6.2 CONCLUSION:

There are several critical inferences that are made in this study. One major finding of this research is that it confirms a constructive use of Smartphone within Pakistani consumers and shows a positive trend towards the acceptance of Smartphone in our society. Moreover the proposed research model which is made by extending Technology Acceptance Model in context of Smartphone usage, proved to be a relevant and an effective model for studying Smartphone acceptance within common consumers. The research model and its construct measures were verified for internal consistency as well as validity. The research model proved to be reliable and valid. Although not all but most of the hypotheses in the research model were accepted. Research proved and revealed many factors that affect the acceptance of a Smartphone amongst Pakistani consumers. This research model can be useful for examining the acceptance of Smartphone in different demographics and can also be utilized for other emerging technologies that share similar characteristics.

There are twelve hypotheses that were significantly accepted from the Smartphone acceptance research model. Other than these seven hypotheses were rejected from a total of nineteen hypotheses. We also conclude that there are some important factors that have a positive as well as significant effect on Smartphone acceptance within individuals. The factors that exist include: After Sales Service, Applications, Design, Multimedia, Perceived Cost Savings, Social Norms and Technical Barriers. Factors such as After Sales Service, Applications and Multimedia, significantly increases the Perceived Ease of Use (PEOU) of a Smartphone. Technical Barriers plays a significant negative role towards Perceived Ease of Use (PEOU). (The lesser the technical barriers the more easy it will be for the users to adopt a Smartphone and use it for various activities). Factors such as Applications, Perceived Cost Savings, Design, Perceived Ease of Use, and Social Norms, significantly increase the Perceived Usefulness (PU) of a Smartphone. Therefore, Smartphone manufacturers can significantly increase Smartphone sales by increasing their awareness and increasing multimedia capabilities and introducing a competitive

application base. Similarly, Social Norm plays a significant role for adopting a Smartphone amongst individuals. Technical Barriers and Perceived Ease of Use has an inverse effect on each other, and if one decreases the other increases. The research proved that Perceived Ease of Use, Perceived Usefulness significantly affects the Actual Use of a Smartphone. In addition to this Perceived Ease of Use significantly affects Perceived Usefulness directly.

6.3 RESEARCH IMPLICATIONS:

This research on Smartphone acceptance has revealed several implications that include:

1. **Theoretical Implications:** The theoretical implications associated with Smartphone acceptance research is that it contributes towards the understanding of different relationships of determinants and constructs. The methodology adopted for conducting this research provides guidelines to facilitate further research in the area of study.

   The contribution in the literature would be of analyzing and understanding Smartphone adoption. The study would also focus on social influences, technological change and any relating factors such as behavior or costs that affect the individual's decision for choosing such technologies for their benefit. Intentional use is extended in prospect of Smartphone adoption. The research will result into a framework for exploration of Smartphone acceptance and adaptation with respect to the demographic.

   Wide scale variability is observed in the case of technology as a result of fast evolution and different possible circumstances under which groups adopt particular technology for use [84]. Consumers vary with respect to their skills for using technology; similarly their attitudes are directed to meet different objectives. Consumer attitudes are dependent and based on analytical assessment of risk and benefits along with communication of analysis [87]. Consumer acceptance or rejection of technology and its products have

determinants such as ethical / moral consideration, effects of use, uncertainties, trust, regulatory system [87].

2. **Practical Implications:** Numerous practical implications are associated with this research including the idea of promoting academics to utilize Smartphone in their daily tasks. For example using Wireless Internet connectivity in Smartphone to improved professional practice, student development, increase accessibility and improve quality of work. This will help individuals in a university setup to improve and achieve their educational goals. The research provides mechanisms and a systematic process for conducting surveys on individual professionals in higher education along with the method of data analysis.

   The study not only contributes to literature of Smartphone adoption but also incorporates social influences on device acceptance as a determinant of behavioral intention. The research broadens the scope of Smartphone adoption research beyond professional environment towards consumer acceptance.

   The ubiquitous feature of Smartphone can be utilized effectively to produce and exploit numerous useful functionalities associated with its acceptance. Information retrieval and the use of advanced Smartphone features can empower individuals to search content quickly, do shopping and perform tasks on the go more efficiently. The findings of this study revealed many crucial effects caused by new technology on human intentions, behaviors, personal preferences, social influence, and most importantly its usage.

   As in Pakistan no data relating to Smartphone is available therefore we will be collecting data by adopting a survey-questionnaire approach. Target population will be the students of SEECS and data collection objectives include Smartphone user interaction, application usage etc.

   Main goal is to understand and analyze Smartphone acceptance in a specific demographic group. We have designed a modified version of TAM for

this research and the model along with its hypotheses will include empirical analysis and testing for discovering possible factors of Smartphone usage.

Furthermore the study has attempted to unravel user expectations and requirements regarding the Smartphone and the possible relations between factors affecting user intentions.

6.4 LIMITATIONS:

Although university students from undergraduate and postgraduate programs, along with faculty members are considered as the major users of Smartphone there is a possibility that their perception might be different with respect to other Smartphone Users.

Since this research is carried out in Pakistan, it may not be completely generalized for other countries because they can have different level of Smartphone penetration. That is to say the intentions of Smartphone users residing in western countries can be different as compared to ours. This implies that the acceptance may change dramatically with respect to different cultural backgrounds.

Another limitation is that there are some constructs which were measured using only few items and can have certain risks.

6.5 FUTURE WORK:

The understanding gained from this research contributes to the literature on the acceptance of Smartphone in general and provides a framework for further exploration into Smartphone acceptance and adoption.

The results may prove helpful in terms of research on other similar new devices and its adoption. For example tablet, or mobile computers that are smaller than most laptops but larger than a Smartphone or a combination of both devices with operational similarities to that of a Smartphone. The present research carried on Smartphone acceptance can be extended for such research.

This research can prove beneficial for marketing communications and strategies that are considered by Smartphone manufacturers and retailers.

REFERENCES

[1] S. Sarker and J. Wells (2003), Understanding Mobile Handheld Device Use and Adoption, Communications of the ACM, 46(12), 35-40.

[2] Sang Hyun Kim, Moderating effects of Job Relevance and Experience on mobile wireless technology acceptance: Adoption of a smartphone by individuals, Information & Management 2008, South Korea, ELSEVIER.

[3] Lu, J., Yao, J., Yu, C., 2005. Personal innovativeness social influences and adoption of wireless Internet Services via mobile technology, Journal of Strategic Information Systems 14, 245-268.

[4] L. Leung and R. Wei, More Than Just Talk on the Move: Uses and Gratifications of the Cellular phone, Journalism & Mass Communication Quarterly, 77(2), Page 308-320, 2000.

[5] Y. F. Chang, C.S. Chen, H. Zhou, Smartphone for mobile commerce, Computer Standards & Interfaces, 2009, page 740-747.

[6] Nysveen, H., Pedersen, P., Thorbjornsen, H., 2005. Intentions to use mobile services: Antecedents and cross-service comparisons, Journal of the Academy of Marketing Science, 3330-346.

[7] Hong, S.H., Tam, K., Understanding the adoption of multipurpose information appliances: The case of mobile data services, Information Systems Research, 162-179, 2006.

[8] Cheong, J.H., Park, M.C., Mobile Internet acceptance in Korea, Internet Research, 2005, 125-140.

[9] Fang, X., Chan, S., Brzezinski, J., Xu, S., Moderating effects of task type on wireless technology acceptance, Journal of Management Information Systems, 123-157, 2006.

[10] Thorbjornsen, H., Pedersen, P.E., Nysveen, H., "This is who i am": Identity expressiveness and the theory of planned behavior, Psychology & Marketing, 763-785, 2007.

[11] Compeau, D.R., Higgins, C.A., Computer Self-efficacy: development of a measure and initial test, MIS Quarterly, 189-211, 1995.

[12] Taylor, S., Todd, P.A., Understanding information technology usage: A test of competing models, Inf. Syst. Res., 144-176, 1995.

[13] Bhattacherjee, A., Acceptance of E-Commerce Services: The Case of Electronic Brokerages, IEEE Transactions on Systems, Man and Cybernetics, 411-420, 2000.

[14] Venkatesh, V., Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. Information Systems Research, 342-365, 2000.

[15] Teo, T., Pok,S., Adoption of WAP-enabled mobile phones among Internet users. Omega, 483-498, 2003.

[16] Mark Turner, Barbara Kitchenham, Pearl Brereton, Stuart Charters, David Budgen, "Does the technology acceptance model predict actual use? A systematic literature review", Information and Software Technology, 463-479, ELSEVIER, 2010.

[17] Vrechoupoulos, A., Constantiou, I., Sideris, I., Doukidis, G., Mylonopoulos, N., The critical role of consumer behaviour research in mobile commerce, International Journal of Mobile Communications, 329-340, 2003.

[18] Kim, H., Chuan, H., Gupta, S., Value based adoption of mobile internet: An empirical investigation, Decision Support Systems, 111-126 ,2007.

[19] Igbaria, M., Parasuraman, S., & Baroudi, J., A motivational model of microcomputer usage, Journal of Management Information Systems, 127-143, 1996.

[20] H. Kwon, L. Chidambaram, A test of the Technology Acceptance Model-the case of cellular telephone adoption, in: Proceedings of 33rd Annual Hawaii International Conference on System Sciences (HICSS), IEEE Computer Society, Press Los Alamitos, 2000.

[21] Cho, H., Theoretical intersections among social influences, beliefs, and intentions in the context of 3G mobile services in Singapore: Decomposing perceived critical mass and subjective norms, Journal of Communication, 283-306, doi 10.1111/j.1460-2466.2010.01532.x, 2011.

[22] Venkatesh, V., Davis, F. D., A theoretical extension of the technology acceptance model: Four longitudinal field studies, Management Science, 186-204, 2000.

[23] Davis, F.D., Perceived usefulness, perceived ease of use and user acceptance of information technology, MIS Quarterly, 319-340, 1989.

[24] Pedersen, P., Adoption of mobile internet services: An exploratory study of mobile commerce early adopters, Journal of Organizational Computing and Electronic Commerce, 203-222, 2005.

[25] Chong, Y.L. & Marthandan, G., "What drives Malaysian m-commerce adoption? An empirical analysis", Industrial Management & Data Systems, Vol 109, no. 3, pp 370-388, 2008.

[26] Dishaw, M.T. & Strong., D.M., "Extending the technology Acceptance Model with Task-Technology Fit Constructs", Information and Management, Vol. 36, no.1, pp 9-21, 1999.

[27] Cheong, J.H., Park, M.C., "Mobile Internet acceptance in Korea", Internet Research, Vol 15, no 2, pp 125-140, 2005.

[28] Kulviwat, S.T., Bruner, G.C. & Kumar, A., Toward a unified theory of consumer acceptance technology, Psychology and Marketing, Vol 24, no 12, pp 1059-1084, 2007.

[29] Snowden, S. & Spafford, J., Technology acceptance and m-commerce in an operational environment, Journal of Enterprise Information Management, Vol 19, no. 5,pp 525-539, 2006.

[30] M. Fishbein, I. Ajzen, Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research, Addison-Wesley, MA,USA, 1975.

[31] Ajzen, I., The theory of planned behavior, Organizational Behavior and Human Decision Processes, pp 179-211, 1991.

[32] Bhattacherjee, A., Understanding information systems continuance: An expectation-confirmation model, MIS Quarterly, Vol 25, no.3, pp 351-70, 2001.

[33] Ajzen, I., From intentions to actions: a theory of planned behaviour, Action Control: From Cognition to Behaviour, pp 11-39, 1985.

[34] Pagani, M., Determinants of adoption of third generation mobile multimedia services, Journal of Interactive Marketing, pp 46-59, 2004.

[35] Meso, P., Musa, P., Mbarika, V., Towards a model of consumer use of mobile information and communication technology in LDCs: The case of sub-Saharan Africa, Information Systems Journal, pp 119-146, 2005.

[36] Wu , J., Wang, S., Lin, L., Mobile Computing acceptance factors in the healthcare industry: A structural equation model, International Journal of Medical Informatics, pp 66-77, 2007.

[37] Childers, T., & Rao, A., The influence of familial and peer-based reference groups on consumer decisions, Journal of Consumer Research, pp 198-211, 1992.

[38] A. Bhattacherjee, C. Sanford, Influence strategies for information technology usage: an elaboration-likelihood model, MIS Quarterly, pp 805-825, December 2006.

[39] D. Goodhue, Understanding the linkage between user evaluations of systems and the underlying systems, Management Science, pp 1827-1844, 1995.

[40] D. Leonard-Barton, I. Deschamps, Managerial influence in the implementation of new technology, Management Science, pp 1252-1265, 1988.

[41] Ajzen, I & Fishbein, M, Understanding attitudes and predicting social behavior, Prentice Hall, 1980.

[42] Magee, A, Attitude-behaviour relationship, 2002.

[43] Han, S, Individual adoption of information systems in organizations: a literature review of technology acceptance model, TUCS Technical Report, 2003.

[44] F.D. Davis, R.P. Bagozzi, P.R. Warshaw, User Acceptance of computer technology: a comparison of two theoretical models, Management Science, 982-1003, 1989.

[45] Igbaria, M., User Acceptance of Microcomputer Technology: An Empirical Test, Omega International Journal of Management Science, 1993.

[46] Chau, PYK & Hu, PJH, Examining a model of information technology acceptance by individual professionals: An exploratory study, Journal of Management Information Systems, Vol 18, 2002.

[47] Ajzen, I, Behaviour intention based on the theory of Planned Behaviour, 2002.

[48] Ajzen, I, Theory of Planned Behaviour, 2006.

[49] Nov, O. & Ye, C., Users personality and perceived ease of use of digital libraries: The case for resistance to change, Journal of the American Society for Information Science & Technology, 2008.

[50] Gao, Y., Applying the Technology Acceptance Model (TAM) to educational hypermedia: a field study, Journal of Educational Multimedia and Hypermedia, 2005.

[51] McKinnon, K. & Igonor, A., Explaining eLearning perceptions using the Technology Acceptance Model and the Theory of Planned Behavior, Proceedings of

World Conference on E-Learning in Corporate, Government, Healthcare and Higher Education , 2008.

[52] Park, N., User acceptance of e-learning in higher education: An application of Technology Acceptance Model, Annual Meeting of the International Communication Association, New York, 2009.

[53] Sugar, W., Crawley, F. & Fine, B., Examining teacher's decisions to adopt new technology, Educational Technology and Society, 2004.

[54] Teo, T., Modeling Technology Acceptance in education: A study of pre-service teachers, Computers & Education, 2009.

[55] Gardber, C. and Amoroso, D.L., Development of an instrument to measure the Acceptance of Internet Technology by consumers, Proceedings of the 37th Hawaii International Conference on System Sciences, 2004.

[56] Khalifa, M. and Lui,V., Determinants of Satisfaction at Different Adoption Stages of Internet Based Services, Journal of Information Systems, 2003.

[57] Bhattacherjee, A. and Premkumar, G., Understanding changes in Belief and Attitude Toward Information Technology Use: A Theoretical Model and Longitudinal Test, MIS Quarterly, 2004.

[58] Venkatesh, V, Morris, MG, Davis, GB & Davis, FD, User acceptance of Information Technology: toward a unified view, MIS Quarterly, Vol 27, 2003.

[59] Ben Woodcock, Andrew Middleton and Anne Nortcliffe, "Case Study : Considering the Smartphone Learner : an investigation into student interest in the use of personal technology to enhance their learning," Student Engagement and Experience Journal, Volume 1, Issue 1 ISSN (Online) 2047-9476, DOI 10.7190/seej.vlil.38, 2012.

[60] Ran Duan, Mingsong Bi, Chris Gniady, "Exploring memory energy optimizations in smartphones," International Green Computing Conference and Workshops (IGCC), Digital Object Identifier: 10.1109/IGCC.2011.6008591, IEEE, 2011.

[61] Bo Han, Aravind Srinivasan, "eDiscovery: Energy Efficient Device Discovery for Mobile Opportunistic Communications," 20th IEEE International Conference on Network Protocols (ICNP), 2012.

[62] Dixit, S., Ojampera, T., Nee, R. and Prasad, R., "Introduction to globalization of mobile and wireless communications: today and in 2020," Globalization of Mobile and Wireless Communications Signals and Communication Technology, Springer Science and Business Media, pp 1-8, 2011.

[63] P. Yangil, J.V. Chen, "Acceptance and adoption of the innovative use of smartphone," Industrial Management and Data System, pp 1349-1365, 2007.

[64] Steve Litchfield, "Defining the Smartphone," July 2010, Available: http://www.allaboutsymbian.com/features/item/Defining_the_Smartphone.php

[65] Mobile / Smart Phone use in Higher Education , Fuxin (Andrew) Yu, University of Central Arkansas, 201 Donaghey Ave, AR Conway - Proceedings of the 2012 Southwest Decision, 2012.

[66] Young Mo Kang, Chanwoo Cho and Sungjoo Lee, "Analysis of Factors Affecting the adoption of Smartphones," Ajou University, Suwon, South Korea, IEEE Int'l Technology Management Conference, 2011.

[67] Ting-Peng Liang and Chih-Ping Wei, "Introduction to the Special Issue: Mobile Commerce Applications," International Journal of Electronic Commerce / Spring, M.E. Sharpe, Vol. 8, No. 3, pp. 7ï 17, 2004.

[68] Varshney, U., Vetter, R.J., Kalakota, R., "Mobile commerce: a new frontier," IEEE Journals & Magazines, IEEE Computer Society, Computer Volume: 33 , Issue: 10, 2000.

[69] H Lacohée, N Wakeford and I Pearson, " A social history of the mobile telephone with a view of its future," BT Technology Journal, Vol 21 No 3 , July 2003.

[70] Hossein .F, Ratul .M, Srikanth .K, Dimitrios .L, Ramesh .G, Deborah .E, "Diversity in Smartphone Usage," at Mobisys ACM, San Francisco, California, USA, June 2010.

[71] Hannu Verkasalo, Carolina Lopez-Nicolas, Francisco J. Molina-Castillo, Harry Bouwman, "Analysis of users and non-users of Smartphone applications," Telematics & Informatics, ELSEVIER, 2010.

[72] Zelimir Dulcic, Dino Pavlic, Ivana Silic, "Evaluating the intended use of Decision Support System (DSS) by applying Technology Acceptance Model (TAM) in business organizations in Croatia," SciVerse ScienceDirect, Procedia-Social and Behavioral Sciences, 8th International Strategic Management Conference, ELSEVIER, 2012.

[73] Money, W. Turner, A., "Application of the technology acceptance model to a knowledge management system," Proceedings of the 37th Annual Hawaii International Conference on System Sciences, IEEE Conference Publications, 2004.

[74] George Rigopoulos, Dimitrios Askounis, " A TAM Framework to Evaluate Usersô Perception towards Online Electronic Payments," Journal of Internet Banking and Commerce, vol. 12, no.3, 2007.

[75] Chuttur M.Y., "Overview of the Technology Acceptance Model: Origins, Developments and Future Directions," Indiana University, USA . Sprouts: Working Papers on Information Systems, 2009, 9(37). http://sprouts.aisnet.org/9-37

[76] Marvine Hammer, Raza-ur-Rehman Qazi, "Expanding the Technology Acceptance Model to examine Personal Computing Technology Utilization in government agencies in developing countries," George Washington University School of Engineering and Applied Science, Washington DC, Government Information Quaterly, 2009, ELSEVIER.

[77] Dirk Czarnitzki and Susanne Thorwarth, The Design Paradox: The Contribution of In-house and External Design Activities on Product Market Performance , September 2009, Dis cus si on Paper No. 09-068, Available: ftp://ftp.zew.de/pub/zew-docs/dp/dp09068.pdf

[78] Mel Yamamoto, David R. Lambert, ñThe impact of product aesthetics on the evaluation of industrial products,ò Journal of Product Innovation Management, Volume 11, Issue 4, September 1994, Pages 309ï 324, ELSEVIER.

[79] Jennifer Coleman Dowling, ñMultimedia DeMYSTiFieD,ò McGraw Hill Computing, ISBN 0071770658 / 9780071770651, 2011.

[80] Dan Pan, Na Chen, Pei-Luen Patrick Rau, ñThe Acceptance and Adoption of Smartphone Use among Chinese College Students,ò Cross-Cultural Design. Methods, Practice, and Case Studies, HCI International 2013, 5th International Conference CCD, Springer, Las Vegas, NV, U.S.A., July 2013.

[81] Aaron Smith (Senior Research), ñSmartphone Ownership 2013 Update,ò Pew Research Center, June 5th 2013. Available: http://pewinternet.org/Reports/2013/Smartphone-Ownership-2013.aspx

[82] Usman Masood Noor (Value Added Services Group Head-Warid Telecom), ñSmart generation picking pace in global markets,ò Daily Times, May 2013. Available: http://www.dailytimes.com.pk/default.asp?page=2013%5C05%5C03%5Cstory_3-5-2013_pg5_15

[83] Web Desk, ñ30m internet users in Pakistan, half on mobile: Report,ò The Express TRIBUNE with International New York Times, June 2013. Available: http://tribune.com.pk/story/567649/30m-internet-users-in-pakistan-half-on-mobile-report/

[84] (What is Technology Adoption), Bridges to Technology Corp, http://www.bridges-to-technology.com/page21.html

[85] http://www.chasminstitute.com/METHODOLOGY/TechnologyAdoptionLifeCycle/tabid/89/Default.aspx

[86] Brett Lunceford, "Reconsidering technology adoption and resistance observations of a semi-Luddite," , Hampton Press Inc. and MEA, 2009, http://www.academia.edu/510375/Reconsidering_Technology_Adoption_and_Resistance_Observations_of_a_Semi-Luddite

[87] Frewer, L. , "Societal issues and public attitudes towards genetically modified foods.," Trends in Food Science & Technology, pp 319-332, 2003.

[88] Las Vegas Sun, Fairfax to buy BlackBerry for $4.7 billion, Sept. 25, 2013, http://www.lasvegassun.com/news/2013/sep/25/ap-cn-tec-blackberry-sale/

[89] Jung Kun Park, Su Jin Yang, Xinran Lehto, "Adoption of mobile Technologies for Chinese consumers," Journal of Electronic Commerce Research, Vol. 8, No. 3, 2007.

[90] Yan, X., "Mobile data communications in China," Communications of ACM, Vol 46, No 12, 2003.

[91] Ajzen, I., Fishbein, M., ñAttitudes and the attitude-behavior relation: Reasoned and automatic processes,ò In W. Stroebe & M. Hewstone (Eds), European review of social psychology, John Wiley & Sons, 2000.

[92] Pankaj Sharma, ñEvolution of Mobile Wireless Communication Networks-1G to 5G as well as Future Prospective of Next Generation Communication Network,ò International Journal of Computer Science and Mobile Computing, IJCSMC, Vol 2, Issue 8, pg 47-53, , August 2013.

[93] Stuart Taylor, Andy Young, Andy Noronha, ñWhat do Consumers Want from Wi-Fi? Insights from Cisco IBSG Consumer Research,ò Cisco Internet Business Solutions Group (IBSG), May 2012.

[94] Shakil Akhtar, ñ2G-5G Networks: Evolution of Technologies, Standards and deploymentò, Clayton State University, USA, 2009. Available: http://123seminarsonly.com/Seminar-Reports/012/64344596-2G-5G-Networks-Encyclopedia-Paper.pdf

[95] Mitsuhiko Kawami, ñSmartphone Design at Fujitsu,ò FUJITSU Sci. Tech. J., Vol 49, pp 220-226, April 2013. Available: www.fujitsu.com/downloads/MAG/vol49-2/paper13.pdf

[96] Karl Stetson, ñEasy-to-Use Wi-Fi® an Essential Offering for Service Providers,ò Austin, TX, May 2012. Available: http://www.wi-fi.org/media/press-releases/easy-use-wi-fi®-essential-offering-service-providers

[97] Mohd Azam Osman, Abdullah Zawawi Talib, Zainal Abidin Sanusi, Tan Shiang-Yen, Abdullah Sani Alwi, ñA Study of the Trend of Smartphone and its Usage Behavior in Malaysia,ò International Journal on New Computer Architectures and Their Applications (IJNCAA), The Society of Digital Information and Wireless Communications, 2012.

[98] Michael Wei, Abhinav Chandran, Hsin Ping Chang, Jui Hung Chang, Corey Nichols, Comprehensive Analysis of SmartPhone OS Capabilities and Performance, 2009. Available: http://www-scf.usc.edu/~juihungc/project_page/doc/ee532_FinalReport.pdf

[99] Nielsen Informate Mobile Insights, ñSmartphone- A Multimedia Center,ò July 2012. Available: www.nielsen.com/content/dam/corporate/india/reports/2012/Smartphone%20-%20A%20Multimedia%20Center.pdf

[100] Lopez-Nicolas, C., Molina-Castillo, F.J., Bouwman, H., ñAn assessment of advanced mobile services acceptance: Contributions from tam and diffusion theory models,ò Information &Management, pp 359-364, 2008.

[101] Venkatesh, V., Bala, H., ñTechnology acceptance model 3 and a research agenda on interventions,ò Decision Sciences, pp 273-315, 2008.

[102] Terry Steger and Praveen Shankar, ñSmartphone Post-Sales Service A New Strategy to Win the Battle for Customers,ò Accenture-High Performance Delivered, 2012. Available: http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-Smartphone-Post-Sales-Service.pdf

[103] Eero Ekebom, ñAdoption of Smartphone: iPhone. Research of adopting a mobile phone innovation from private consumer's viewpoint,ò Department of Information and Service Economy, Aalto University School of Economics, 2012.

[104] Hyojoo Son, Yoora Park, Changwan Kim, Jui-Sheng Chou, ñToward an understanding of construction professionalôs acceptance of mobile computing devices in South Korea: An extension of the technology acceptance model,ò Automation in Construction, 82ï 90, 2012, ELSEVIER.

[105] Ali Tarhini, Kate Hone, Xiaohui Liu, ñUser Acceptance Towards Web-based Learning Systems: Investigating the role of Social, Organizational and Individual factors in European Higher Education,ò Procedia Computer Science, 2013, ELSEVIER.

[106] Richard V. Cox, Barry G. Haskell, Yenn Lecun, Behzad Shahraray, Lawrence Rabiner, ñScanning the Technology on applications of Multimedia Processing to Communications,ò Proceedings of The IEEE, Vol. 86, May 1998.

[107] Klaus Schaefers, ñUser Clustering in Smartphone Applications,ò Available: http://paginas.fe.up.pt/~prodei/dsie12/papers/paper_8.pdf

[108] Sui Smith, ñWhat Is a Smartphone App,ò eHow Contributer Available: http://www.ehow.com/info_8656054_smartphone-app.html

[109] Electronista Staff, ñConsumer Reports: Apple the best for post sales support, again,ò electronista, April 29, 2013. Available: http://www.electronista.com/articles/13/04/29/mac.maker.far.surpasses.rivals.even.bests.its.own.previous.score/

[110] Vincent Nguyen, ñConsumer Reports: Apple has best Tech support,ò Slash Gear, 2010. Available: http://www.slashgear.com/consumer-reports-apple-has-best-tech-support-1077322/

[111] Adam J. Fay, Alexander H. Jordan, Joyce Ehrlinger, ñHow social norms promote misleading social feedback and inaccurate Self-Assessment,ò Social and Personality Psychology Compass, Blackwell Publishing Ltd, 2012.

[112] Colin Phelan and Julie Wren, ñExploring Reliability in Academic Assessment,ò UNI Office of Academic Assessment, 2005-06. Available: http://www.uni.edu/chfasoa/reliabilityandvalidity.htm Accessed: 8 June 2014.

[113] Ticehurst, GW and Veal, AJ, ñBusiness research methods: A managerial approach,ò Pearson Education Australia, NSW, 2000.

[114] Sekaran, U, ñResearch methods for business: a skill-building approach,ò 4th edn, John Wiley & Sons, Inc, 2003.

[115] Joe F. Hair, Christian M. Ringle, and Marko Sarstedt, ñPLS-SEM: Indeed a Silver Bullet,ò Journal of Marketing Theory and Practice, M. E. Sharpe, Inc., Vol. 19, no. 2, pp 139-151, Spring 2011.

[116] Jorg Henseler, Christian M. Ringle, and Rudolf R. Sinkovics, ñThe Use of Partial Least Squares Path Modeling in International Marketing,ò New Challenges to International Marketing, Advances in International Marketing, Volume 20, pp. 277-319, 2009.

[117] Werts, C. E., Linn, R. L. & Joreskog, K.G., ñIntraclass reliability estimates: Testing structural assumptions,ò Educational and Psychological Measurement, pp. 25-33, 1974.

[118] Ken Kwong-Kay Wong, ñPartial Least Squares Structural Equation Modeling (PLS-SEM) Techniques Using SmartPLS-,ò Marketing Bulletin, 24, Technical Note 1, 2013.

[119] Bagozzi, R. P., and Yi, Y., ñOn the evaluation of structural equation models,ò Journal of the Academy of Marketing Science, pp. 74-94, 1988.

[120] Nunnally, Jum C., and Ira Bernstein, ñPsychometric Theory,ò 3rd ed, New York, McGraw-Hill, 1994.

[121] Esposito Vinz, V., Chin, W. W., Henseler, J., Wang, H., ñHandbook of Partial Least Squares, Concepts, Methods and Applications,ò Springer Handbooks of Computational Statistics.

[122] Hulland, J., ñUse of partial least squares (PLS) in strategic management research: a review of four recent studies,ò Strategic Management Journal, 195ï 204, 1999.

[123] Agbo, Aaron A., ñCronbachôs Alpha: Review of Limitations and Associated Recommendations,ò Journal of Psychology in Africa, Vol. 20, 2010.

[124] Kimmo Vehkalahti, Simo Puntanen, and Lauri Tarkkonen, ñEstimation of reliability: a better alternative for Cronbachôs alpha,ò Department of Mathematics and Statistics, University of Helsinki, Volume 430 of Reports in mathematics, Preprint submitted to ELSEVIER Science, February 2006.

[125] Cathy King Pike and Walter W. Hudson, ñReliability and Measurement Error in Presence of Homogeneity,ò Journal of Social Service Research, Vol. 24, Issue 1-2, pp.149-163, 1998.

[126] Wan Mohamad Asyraf Bin Wan Afthanorhan, ñA comparison of Partial Least Square Structural Equation Modeling (PLS-SEM) and Covariance Based Structural Equation Modeling (CB-SEM) for Confirmatory Factor Analysis,ò International Journal of Engineering Science and Innovative Technology (IJESIT), Volume 2, Issue 5, September 2013.

[127] Fornell, C., and Larcker, D.F., ñEvaluating structural equation models with unobservable variables and measurement error,ò Journal of Marketing Research, 18, pp. 39-50, 1981.

[128] Afthanorhan, W. M. A. B. W., and Ahmad, S., ñModelling The Multimediator On Motivation Among Youth In Higher Education Institution Towards Volunteerism Program,ò Mathematical Theory and Modeling, pp. 64-70, 2013.

[129] Chin, W. W., ñThe partial least squares approach to structural equation modeling,ò G. A. Marcoulides (Ed.), Modern Methods of Business Research, pp. 295 ï 358, 1998.

[130] ñThe t table ï critical values,ò Statistics Mentor, Available: http://www.statisticsmentor.com/tables/table_t.htm, Access Date: 24 June 2014.

[131] ñStatistics Tutorial P_Values and T_Tables,ò University of Glasgow, Available: http://www.gla.ac.uk/sums/users/jdbmcdonald/PrePost_TTest/pandt2.html, Access Date: 24 June 2014.

[132] Gabriel L. Schlomer, Sheri Bauman, and Noel A. Card, ñBest Practices for Missing Data Management in Counseling Psychology,ò Journal of Counseling Psychology, American Psychological Association, Vol. 20, No. 1, pp. 1-10, 2010.

[133] ñIBM SPSS Missing Values 20,ò IBM Corporation, 2011.

[134] ñRerunning the analysis for Littleôs MCAR Test,ò SPSS statistics 20, Missing value analysis, IBM Knowledge Center, Available: http://www-01.ibm.com/support/knowledgecenter/SSLVMB_20.0.0/com.ibm.spss.statistics.cs/mva_describe_rerun_mcartest.htm, Access Date: 25 June 2014.

[135] Cemal Akuzum, and Cetin Tan, ñSocial Capital and Job Satisfaction as the Predictor of the Organizational Commitment,ò International Journal of Social Science and Education, Vol. 4, Issue 3, 2014.

[136] Ronnie H. Shroff, Christopher C. Deneen, and Eugenia M. W. Ng., ñAnalysis of the technology acceptance model in examining students behavioural intention to use an e-portfolio system,ò Australasian Journal of Education Technology, 2011.

[137] ñManual: Running SEM in AMOS,ò Wordpress.com, May 2002, Available: http://krmunger.files.wordpress.com/2007/09/amos_sem-manual2.pdf, Access Date: 2 July 2014.

[138] Mats Hedskold, Kerin Pukk-Harenstam, Elisabeth Berg, Marion Lindh, Michael Soop, John Ovretveit, and Magna Andreen Sachs, ñPsychometric properties of the hospital survey on patient safety culture, HSOPSC, applied on a large Swedish health care sample,ò BMC Health Services Research, 2013.

[139] Karin Schermelleh-Engel, Helfried Moosbrugger, and Hans Müller, ñEvaluating the Fit of Structural Equation Models: Tests of Significance and Descriptive Goodness-of-Fit Measures,ò Methods of Psychological Research Online, Vol.8, No.2, pp. 23-74, 2003.

[140] An Mariman, Dirk Vogelaers, Ignace Hanoulle, Liesbeth Delesie, Els Tobback, and Dirk Pevernagie, ñValidation of the three-factor model of the PSQI in a large sample of chronic fatigue syndrome (CFS) patients,ò Journal of Psychosomatic Research, ELSEVIER, 2012.

[141] Siu Loon Hoe, ñIssues and Procedures in adopting Structural Equation Modeling technique,ò Journal of Applied Quantitative Methods, JAQM, Vol. 3, No.1, 2008.

[142] Daire Hooper, Joseph Coughlan, and Michael Mullen, ñStructural Equation Modelling: Guidelines for Determining Model Fit,ò Electronic Journal of Business Research Methods, pp. 53-60, Vol. 6, 2008.

[143] Carter Bowles, ñThe P-Value ñFormula,ò Testing your Hypothesis,ò Trending Sideways, Practical Engineering and Statistics Updates, May 2013, Available: http://trendingsideways.com/index.php/the-p-value-formula-testing-your-hypothesis/, Access date: 6 July 2014.

[144] Courtney Taylor, ñThe Difference between the Null Hypothesis and Alternative Hypothesis,ò Statistics, about.com, Available: http://statistics.about.com/od/Inferential-Statistics/a/The-Difference-Between-The-Null-Hypothesis-And-Alternative-Hypothesis.htm, Access date: 6 July 2014.

[145] James L. Arbuckle, ñIBM SPSS Amos 21 Userôs Guide,ò IBM, Available: ftp://public.dhe.ibm.com/software/analytics/spss/documentation/amos/21.0/en/Manuals/IBM_SPSS_Amos_Users_Guide.pdf, Access date: 7 July 2014.

[146] ñTDIST,ò Microsoft Office Excel support, Available: http://office.microsoft.com/en-001/excel-help/tdist-HP005209312.aspx, Access date: 7 July 2014.

[147] Jamil Bojei, Alias Radam, and Mimi Liana Abu, ñThe Underlying Dimensions of Relationship Marketing in the Malaysian Mobile Service Sector,ò 3rd International

Conference on Business and Economic Research (3rd ICBER 2012) Proceeding, Indonesia, March 2012.

[148] Baba Hafiz, Jamal Abdul Nassir Shaari, ñConfirmatory Factor Analysis (CFA) of first order factor measurement model-ICT empowerment in Nigeria,ò International Journal of Business Management and Administration, Vol. 2(5), May 2013.

[149] Z. Jannoo, B. W. Yap, N. Auchoybur, M. A. Lazim, ñThe effect of Nonnormality on CB-SEM and PLS-SEM Path Estimates,ò World Academy of Science, Engineering and Technology, International Journal of Mathematical, Computational, Physical and Quantum Engineering, Vol. 8, No. 2, 2014.

[150] Tanagra, ñVARIMAX rotation in Principle Component Analysis,ò Tanagra ï Data Mining Tutorials, December, 2009, Available: http://data-mining-tutorials.blogspot.com/2009/12/varimax-rotation-in-principal-component.html, http://eric.univ-lyon2.fr/~ricco/tanagra/fichiers/en_Tanagra_Pca_Varimax.pdf, Access Date: 17 Aug 2014.

[151] Claes Fornell, ñA second generation of multivariate analysis: An overview,ò C. Fornell (Ed.), A second generation of multivariate analysis (Vol. 1), pp. 1-21, New York, Praeger, 1982.

[152] Jan-Bernd Lohmoller, ñLatent Variable Path Modeling with Partial Least Squares,ò Springer-Verlag Berlin Heidelberg, 1989.

[153] Alex Atkins, ñWi-Fi vs. Cellular Networks: Why Wi-Fi Wins Every Time,ò SCRATCHWIRELESS, 2013, http://www.scratchwireless.com/pad/wi-fi-vs-cellular-networks-why-wi-fi-wins-every-time/, Access Date: 3 November 2014.

[154] London Evening Standard, ñDeloitte: Wi-fi the preferred route for smartphone users,ò 2012, http://www.standard.co.uk/business/business-news/deloitte-wifi-the-preferred-route-for-smartphone-users-7952902.html, Access Date: 3 November 2014.

[155] Doug Aamoth, ñSmartphones, Ask Techland: Whatôs the Importance of Wi-Fi on a Smartphone?,ò techland , 2011, Available: http://techland.time.com/2011/11/16/ask-techland-whats-the-importance-of-wi-fi-on-a-smartphone/, Access Date: 3 November 2014.

[156] Marguerite Reardon, ñCan you ditch your smartphone data plan for Wi-Fi?,ò CNET, 2012, http://www.cnet.com/news/can-you-ditch-your-smartphone-data-plan-for-wi-fi/, Access Date: 3 November 2014.

Appendix: A

TABLE HYPOTHESES:

HYPOTHESES NUMBER	HYPOTHESES STATEMENT	ASSOCIATED QUESTIONS
H 1-a	Wireless Internet connectivity option increases the Perceived Usefulness of a Smartphone	I believe that having Wi-Fi connectivity in a Smartphone makes it useful.
H 1-b	Wireless Internet connectivity option increases the Perceived Ease of Use of Smartphone	I believe that having Wi-Fi connectivity in a Smartphone makes it easier to use.
H 2-a	Design features increase the Perceived Usefulness of a Smartphone.	I prefer a Smartphone with a larger screen.
		I prefer a Smartphone that has a longer battery life.
		I prefer a durable Smartphone. (i.e. it can tolerate external damages/environment such as small impacts and water-proof casing)
		Smartphone external design is helpful for me to look stylish & fashionable. (i.e. Thinness, Color, Display, Appearance etc)
H 2-b	Design features increase the Perceived Ease of Use of a Smartphone.	I find it easy to navigate and use the Smartphone user interface. (i.e. menus, icons, text boxes, screen, buttons, theme)
H 3-a	Multimedia features increase the perceived usefulness of a Smartphone.	I would consider a Smartphone more useful that has high media support such as RAM, camera resolution, sound quality, picture quality, interactivity etc.
H 3-b	Multimedia features increase the Perceived Ease of Use of a Smartphone.	I feel that Smartphone with various media support is easier to use.
		I am comfortable with the Smartphone which offers a variety of interactive media capabilities. (such as GPS, smart gesture recognition, Smart answering, quad core processing capability, cloud services, mobile TV, teleconferencing etc)
H 4-a	Availability of preferred applications increase the Perceived Usefulness of a Smartphone.	I consider a Smartphone to be more useful that has many applications available for use.
		I believe that a Smartphone is useful that has applications relevant to my day to day tasks.
		I prefer Smartphone social applications to help me stay connected with friends, colleagues and family.
H 4-b	Availability of preferred applications base increase the Perceived Ease of Use of a Smartphone.	I consider a Smartphone easier to use that includes a variety of applications.
		I find Smartphone apps easy to use.
H 5-a ; H 5-b	After Sales Service increases the perceived usefulness of a Smartphone. ; After Sales Service increases the perceived ease of use of a Smartphone.	I feel that a Smartphone (Brand) is more useful that provides support for its services.
		If I have technical difficulties in using a Smartphone, the technical support personnel at a service center will help to resolve the issue.
		If I have technical difficulties in using a Smartphone, the technical support personnel at a service center will be easy to reach at any time.

HYPOTHESES NUMBER	HYPOTHESES STATEMENT	ASSOCIATED QUESTIONS
H 6	Perceived cost savings increase the perceived usefulness of a Smartphone.	A Smartphone supports many essential services that I need when I am travelling and saves me cost for carrying multiple devices.
		I can perform different activities on a Smartphone without much effort.
		I find Smartphone more cost effective than other technologies.
H 7	Technical barriers decrease the perceived ease of use of a Smartphone.	I find it difficult to install applications on Smartphone.
		I face difficulty in altering network configurations on Smartphone.
		I find it difficult to avail after sales support for Smartphone.
		I believe device specific trainings and user guides help me in using a Smartphone.
H 8	Social norms increase the Perceived Usefulness of a Smartphone.	I want to use a Smartphone because my friends do so.
		I believe that Smartphone characteristics including hardware capability and software quality reflects one's personality to others.
		I find people who own a Smartphone to have a good social status.
H 9-a	Perceived Ease of Use of a Smartphone increases its Perceived Usefulness.	I prefer a Smartphone (brand) that I can operate easily.
		I can easily increase my skills of using various features of Smartphone.
H 9-b	Perceived Ease of Use positively influences Intention to use a Smartphone.	I find Smartphone easy to use.
H 9-c	Perceived Usefulness positively influences Intention to use a Smartphone.	I find Smartphone useful in quickly accomplishing my daily tasks.
		I believe that using a Smartphone improves the quality of my daily tasks.
		I find Smartphone as a helpful mobile educational tool for improving learning experience.
H 10	Behavioral Intention directly affects the Actual Usage of Smartphone.	I intend to use the Smartphone in the future.
		Given that I do not own a Smartphone, I intend to buy one in the next 2 months.
		Given that I do not own a Smartphone, I intend to purchase one that costs less.
		I have the knowledge and skill to use a Smartphone.

QUESTIONNAIRE *Appendix: B*

NUST School of Electrical Engineering & Computer Science (SEECS)

Dear Respondent,

This research is being conducted at NUST School of Electrical Engineering & Computer Science (SEECS), Department of Computing. This research is aimed at finding the factors that might influence the **Smartphone** usage by individuals.

"A **Smartphone** is a phone with an ability to be connected to Internet permanently and to run various applications. They possess multitude smart features such as (**but not limited to**):

- social media *(facebook, twitter etc)*,
- teleconferencing *(Skype etc)*,
- email *(Gmail etc)*,
- chat applications *(WeChat etc)*,
- web browsing,
- camera functionality,
- music,
- app stores *(Google Play, Apple apps etc)* ,
- multimedia services *(Dropbox, Youtube etc)*,
- live alerts and GPS services *(CNN news, weather forecast etc)* ,
- Games,
- productivity tools *(Task Manager, doodle, Calender, ThinkFree office etc)* "

Examples of Smartphone are Apple iPhone Smartphone series, Samsung Galaxy Smartphone series, Nokia Lumia Smartphone series, Qmobile Noir, HTC etc.

On the other hand, "a ***featured phone*** is a cellphone that contains a fixed set of functions apart from voice calling and text messaging. It is not as extensive as a Smartphone." For example, feature phones may offer Web browsing and e-mail, but they generally cannot download apps from an online marketplace.

This survey is for academic purpose only. All the information will remain confidential and will not be shared with third parties. All responses will be anonymous. If you have any questions, or concerns, please contact Mr. Mohsin Ikram (12msitmikram@seecs.edu.pk). Thank you for your cooperation, and being a part of this study.

Sincerely,

Mohsin Ikram MS (IT) ï 13
Dr. Sarah S Khan

Q. Have you ever experienced a Smartphone? □ **Yes** □ **No**

If your answer is ñ*No*ò, *you may exit the survey now.*

If your answer is "Yes", then:

Are you currently using a Smartphone? □ **Yes** □ **No**

❖ ***Please answer the following questions to the best of your knowledge.***

1. I find Smartphone useful in quickly accomplishing my daily tasks.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

2. I believe that using a Smartphone improves the quality of my daily tasks.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

3. I find Smartphone as a helpful mobile educational tool for improving learning experience.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

4. I find Smartphone easy to use.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

5. I prefer a Smartphone (brand) that I can operate easily.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

6. I can easily increase my skills of using various features of Smartphone.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

7. I have the means and resources to use a Smartphone.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

8. I have the knowledge and skill to use a Smartphone.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

9. A Smartphone supports many essential services that I need when I am travelling and saves me cost for carrying multiple devices.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

10. I can perform different activities on a Smartphone without much effort.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

11. I find Smartphone more cost effective than other technologies. (e.g. Laptops, Tablets, iPad, Kindle)

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

12. I want to use a Smartphone because my friends do so.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

13. I believe that Smartphone characteristics including hardware capability and software quality reflects one's personality to others.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

14. I find people who own a Smartphone to have a good social status.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

15. I find it difficult to install applications on Smartphone.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

16. I face difficulty in altering network configurations on Smartphone.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

17. I find it difficult to avail after sales support for Smartphone.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

18. I believe device specific trainings and user guides help me in using a Smartphone.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

19. I believe that having Wi-Fi connectivity in a Smartphone makes it useful.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

20. I believe that having Wi-Fi connectivity in a Smartphone makes it easier to use.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

21. I prefer a Smartphone with a larger screen.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

22. I prefer a Smartphone that has a longer battery life.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

23. I prefer a durable Smartphone. (i.e. it can tolerate external damages/environment such as small impacts and water-proof casing)

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

24. Smartphone external design is helpful for me to look stylish & fashionable. (i.e. Thinness, Color, Display, Appearance etc)

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

25. I find it easy to navigate and use the Smartphone user interface. (i.e. menus, icons, text boxes, screen, buttons, theme)

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

26. I would consider a Smartphone more useful that has high media support such as RAM, camera resolution, sound quality, picture quality, interactivity etc.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

27. I feel that Smartphone with various media support is easier to use.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

28. I am comfortable with the Smartphone which offers a variety of interactive media capabilities. (such as GPS, smart gesture recognition, Smart answering, quad core processing capability, cloud services, mobile TV, teleconferencing etc)

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

29. I consider a Smartphone to be more useful that has many applications available for use.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

30. I believe that a Smartphone is useful that has applications relevant to my day to day tasks.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

31. I consider a Smartphone easier to use that includes a variety of applications.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

32. I prefer Smartphone social applications to help me stay connected with friends, colleagues and family.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

33. I find Smartphone apps easy to use.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

34. I feel that a Smartphone (Brand) is more useful that provides support for its services.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

35. If I have technical difficulties in using a Smartphone, the technical support personnel at a service center will help to resolve the issue.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

36. If I have technical difficulties in using a Smartphone, the technical support personnel at a service center will be easy to reach at any time.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

37. I intend to use the Smartphone in the future.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

38. I intend to buy a Smartphone in the next 2 months.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

39. I intend to purchase a Smartphone that costs less.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

40. I use Smartphone routinely and regularly.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

- Gender: □ Male □ Female
- Age: _____
- Name the Smartphone Brand (Company name) you use: _____ , Model name: _____
- Home Town: _____
- Education: □ B.Sc / BE □ MS □ PhD
- While using Smartphone, what is your primary mode of Internet access? (Choose one option)

□ **Gprs / Edge (Data package)** □ **Wi-Fi** □ **Other, please specify_____**

- Please indicate the extent of features used by you that are generally offered by Smartphone:

Features	Never	Rarely	Sometimes	Often	Always
Calls	□	□	□	□	□
Text Messaging (SMS)	□	□	□	□	□
Internet (e.g. Web Browsing)	□	□	□	□	□
E-mail client	□	□	□	□	□
Social Media Connectivity (e.g. Facebook)	□	□	□	□	□
Camera Function	□	□	□	□	□
Data Synchronization (e.g. backups, addresses, outlook)	□	□	□	□	□
Instant Messaging Client (e.g. Whatsapp, 'Ping', MSN, Yahoo, Skype)	□	□	□	□	□
Personal information management (e.g. contacts, calendar, agenda)	□	□	□	□	□
GPS navigation (e.g. location identification, traffic route)	□	□	□	□	□
Office tasks (e.g. Presentation, documentation, excel sheet)	□	□	□	□	□
Video Conferencing (e.g. Skype)	□	□	□	□	□
Online TV Channels	□	□	□	□	□
Games	□	□	□	□	□
Online shopping	□	□	□	□	□
Reading e-books	□	□	□	□	□
Learning & education	□	□	□	□	□
Web based application Services (e.g. Dropbox)	□	□	□	□	□
Downloading / Listening Music	□	□	□	□	□
Video playback	□	□	□	□	□
News / Weather, Traffic, other information services	□	□	□	□	□
Exploring & Experimentation with applications	□	□	□	□	□
Importing and exporting personal data	□	□	□	□	□
As a Business Tool (using it with applications relating to a job such as logistics management app)	□	□	□	□	□
Synching other devices (Name them _____)	□	□	□	□	□

- I mostly use a Smartphone for: (Choose all that apply)

  □ **Work related activities** □ **Study related activities** □ **Personal related activities**

- What is your family monthly income?

  □ **Below Rs. 28,000** □ **Between Rs. 75,000 to 1, 50,000** □ **Above Rs. 3, 00,000**

  □ **Between Rs. 28,000 to 75,000** □ **Between Rs. 1, 50,000 to 3, 00,000**

- How many people live in your house? _____. Out of which how many use a Smartphone? _____

- Please rank **top 3** Smartphone brands that you prefer:

  (Samsung, Apple, Nokia, HTC, LG, Sony Ericsson, BlackBerry, Motorola, etc)

  1._____ **2.**_____ **3.**_____

- Please share your email address to avail the chance of **winning free movie tickets (2)** through a lucky draw for **Cinepax/Arena**. Lucky draw will be conducted for all participants of this survey.

Email:_____

Appendix: C

KEY

Question #	Construct
1.	Perceived Usefulness
2.	Perceived Usefulness
3.	Perceived Usefulness
4.	Perceived Ease of Use
5.	Perceived Ease of Use
6.	Perceived Ease of Use
7.	Perceived Behavioral Control
8.	Perceived Behavioral Control
9.	Perceived Cost Savings
10.	Perceived Cost Savings
11.	Perceived Cost Savings
12.	Social Norm
13.	Social Norm
14.	Social Norm
15.	Technical Barriers
16.	Technical Barriers
17.	Technical Barriers
18.	Technical Barriers
19.	Wireless Internet
20.	Wireless Internet
21.	Design
22.	Design
23.	Design
24.	Design
25.	Design
26.	Multimedia
27.	Multimedia
28.	Multimedia
29.	Applications
30.	Applications
31.	Applications
32.	Applications
33.	Applications
34.	After Sales Services
35.	After Sales Services
36.	After Sales Services
37.	Behavioral Intention
38.	Behavioral Intention
39.	Behavioral Intention
40.	Actual Use

Appendix: D

DATA SHEET CODING

Questions	**Coding**
Q. [*Cellphone*]	1= a) Smartphone, 0= b) Featured phone
[*Q. b)*]	1= Yes / Not Sure, 0=No
1 ï 40 [*PU(123), PEOU(123), PBC(12), PCS(123), SN(123), TB(1234), WI(12), D(12345), MM(123), A(12345), AS(123), BI(123), AU*]	1= Strongly Disagree, 2= Disagree, 3= Slightly Disagree, 4= Neutral, 5= Slightly Agree, 6= Agree, 7= Strongly Agree
[*Gender*]	1=Female, 0=Male
[*Age*]	15 ï 120
[*Name of Smartphone*]	1=NOKIA, 2=SAMSUNG, 3=APPLE, 4=QMOBILE, 5=SONY, 6=HTC, 7=BLACKBERRY, 8=LG, 9=HUAWEI, 10=GFIVE, 11=MEGAGATE, 12=MOTOROLA, 13=VOICE, 14=GOOGLE
Smartphone Model [*SP Model*]	Continuous (Alpha-numeric)
[*Home Town*]	Region Name
[*Education*]	1=B.Sc/BE, 2=MS, 3=PhD
[*Primary Mode Internet access*]	1=Gprs/Edge (Data Package), 2=Wi-Fi, 3=Other
Features Table *[F(1 to 25)*]	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Always
Smartphone use (Multiple selections _ _ _ _) [*SP Use*]	1=Work, 2=Study, 3=Personal, 4=Other
Family income [*F Income*]	1=Below 28,000 , 2=Between 28,000 to 75,000 , 3=Between 75,000 to 1,50,000 , 4=Between 1,50,000 to 3,00,000 , 5=Above 3,00,000
House members [*H Members*]	Continuous (Numeric)
Smartphone users [*SP Users*]	Continuous (Numeric)
Top 3 Smartphone Brands (Multiple selections _ _ _) [*T Brands*]	1=NOKIA, 2=SAMSUNG, 3=APPLE, 4=QMOBILE, 5=SONY, 6=HTC, 7=BLACKBERRY, 8=LG, 9=HUAWEI, 10=GFIVE, 11=MEGAGATE, 12=MOTOROLA, 13=VOICE, 14=GOOGLE
Email address [*Email*]	Email (Alpha-numeric)
[*Sync dev name*]	Synching Device name

Appendix: E

CONSTRUCTS STATEMENTS TABLE

CONSTRUCTS & Questionnaire ITEMS		Reference Question Wording	Ref. Context + [Focus]	REFERENCE
Perceived Usefulness	I find Smartphone useful in quickly accomplishing my daily tasks.	The service is useful in my work/Studies. , Using DSS enables us to accomplish tasks more quickly.	c), d) [Swiftness]	Hannu Verkasalo et al., [71], Dulcic et al., [72]
	Using Smartphone makes me more efficient in my tasks.	The service improves my efficiency. , Using a smartphone would enhance my effectiveness on the job.	c), b) [Efficiency]	Hannu Verkasalo et al., [71] , S. H. Kim [2]
	I find the Smartphone to be useful in saving my time on daily activities.	Using the system in my job increases my productivity. , The Personal Computer Technology provided to me makes it easier for me to do my job.	a), e) [Time]	Venkatesh & Davis [22], M. Hammer et al., [76]
	I believe that using a Smartphone improves the quality of my daily tasks.	I find the system to be useful in my job.	a) [Quality]	Venkatesh & Davis [22]
	I find Smartphone as a helpful mobile educational tool for improving learning experience.	Using smart phone would improve my efficiency of learning. , I would find smart phone useful for online learning.	n) [learning]	Yong-Wee Sek et al.,
Perceived Ease of Use	My interaction with the Smartphone is clear and understandable.	My interaction with the system is clear and understandable. , My interaction with a smartphone would be clear and understandable.	a), b) [clear & understandable]	Venkatesh & Davis [22] , S. H. Kim [2]
	I find Smartphone easy to use.	I find the system to be easy to use. , I would find a smartphone easy to use.	a), b) [easy use]	Venkatesh & Davis [22] , S. H. Kim [2]
	I prefer a Smartphone (brand) that I can operate easily.	I would find it easy to get a smart phone to do what I want it to do.	n) [Easy means useful]	Yong-Wee Sek et al.,
	I can easily increase my skills of using various features of Smartphone.	It would be easy for me to become skilful at using smart phone.	n) [Skill]	Yong-Wee Sek et al.,
	I find it easy to get a Smartphone to do what I want it to do.	I find it easy to get the system to do what I want it to do. ; I would find it easy to get a smart phone to do what I want it to do.	a), n) [easy to do tasks]	Venkatesh & Davis [22] , Yong-Wee Sek et al.,
	Interacting with the Smartphone does not require a lot of my mental effort.	Interacting with the system does not require a lot of my mental effort.	a) [less mental effort]	Venkatesh & Davis [22]
Behavioral Intention	I intend to use the Smartphone in the future.	Assuming I have access to the system, I intend to use it. , Assuming I have access to a smartphone, I intend to use it.	a), b) [Accessibility]	Venkatesh & Davis [22] , S. H. Kim [2]
	Given that I own a Smartphone, I predict that I would use it.	Given that I have access to the system, I predict that I would use it. , Given that I have access to a Smartphone, I predict that I would use it.	a), b) [Ownership]	Venkatesh & Davis [22] , S. H. Kim [2]
	Given that I do not own a Smartphone, I intend to buy one in the next 2 months.	I intend to use the service now or within the next 10 years.	c) [Future Intention]	Hannu Verkasalo et al., [71]
	Given that I do not own a Smartphone, I intend to purchase one that costs less.	I intend to use the service in the next two months.	c) [Purchase Cost range]	Hannu Verkasalo et al., [71]
Actual Use	I access the Internet by using a Smartphone which helps in improving my personal knowledge.	Using the Internet helps in improving my personal knowledge.	g) [Increase personal knowledge]	N. Kripanont
	How many hours per week	How many hours per week do you	b) [No. of	S. H. Kim [2]

CONSTRUCTS & Questionnaire ITEMS		Reference Question Wording	Ref. Context + [Focus]	REFERENCE
	do you believe to use a Smartphone?	believe you use a Smartphone?	Hours]	
	How frequently do you believe that you use a Smartphone?	How frequently do you believe you use a Smartphone?	b) [Frequency]	S. H. Kim [2]
	I use Smartphone routinely and regularly.	I use DSS routinely and regularly.	d) [Regular User]	Dulcic et al., [72]
Perceived Behavioral Control	I can use Smartphone Services without help from others.	I can use the service without help from others.	c) [degree of self control]	Hannu Verkasalo et al., [71]
	I have the means and resources to use a Smartphone.	I have the means and resources to use the service.	c) [resources]	Hannu Verkasalo et al., [71]
	I have the knowledge and skill to use a Smartphone.	I have the knowledge and skills to use the services.	c) [device knowledge & skill]	Hannu Verkasalo et al., [71]
Social Norms	I want to use a Smartphone because my friends do so.	I want to use the service because my friends do so, and I want to belong to the Group.	c) [Group type]	Hannu Verkasalo et al., [71]
	I believe that Smartphone characteristics including hardware capability and software quality reflects one's personality to others.	Using the service also reflects my personality to other people.	c) [Personality consciousness]	Hannu Verkasalo et al., [71]
	According to people who are important to me, I should use a Smartphone.	According to people who are important to me, I should use the service. ; People who are important to me think that I should use the system.	c), a) [Family / Relatives opinion]	Hannu Verkasalo et al., [71], Venkatesh & Davis [22]
	I find people who own a Smartphone to have a good social status.	Having a cellular telephone is helpful for me to have it as a status symbol.	i) [Status Symbol]	L. Leung and R. Wei [4]
	People who have a Smartphone are admired.	People who have a Smartphone have more prestige than those without one.	h) [admire/ appreciation]	Jurjen Jongepier
Perceived Cost Savings	A Smartphone supports many essential services that I need when I am travelling and saves me cost for carrying multiple devices.	In my job, I can avoid any unnecessary cost and time by using a Smartphone.	b) [Time saving]	S. H. Kim [2]
	I can perform different activities on a Smartphone without much effort.	In my job, the use of Smartphone saves costs related to time and effort.	b) [Effort Cost]	S. H. Kim [2]
	I find Smartphone more cost effective than other technologies.	A Smartphone is more cost effective than other technologies in my job.	b) [Cost Effective]	S. H. Kim [2]
Technical Barriers	I find it difficult to install applications on Smartphone.	Difficulties in finding and installing the application has a negative impact on my usage.	c) [Finding & Installing the right apps]	Hannu Verkasalo et al., [71]
	I face difficulty in altering network configurations on Smartphone.	Difficult configuration has a negative impact on my usage.	c) [Network Configurations]	Hannu Verkasalo et al., [71]
	I find it difficult to avail after sales support for Smartphone.	Difficult configuration has a negative impact on my usage. , The training gave me confidence in mobile computing device.	c), k) [after sales support]	Hannu Verkasalo et al., [71], Hyojoo et al., [104]
	I believe device specific trainings and user guides help me in using a Smartphone.	My level of understanding was substantially improved after going through the training program.	k) [Training / user guides]	Hyojoo et al., [104]

CONSTRUCTS & Questionnaire ITEMS			Reference Question Wording	Ref. Context + [Focus]	REFERENCE
External Variables / Attributes	Wireless	I believe that having Wi-Fi connectivity in a Smartphone makes it useful.	Overall, I find WIMD useful in my daily life. ; Use of WIMD can decrease the time needed for my work/study/life tasks. ; Use of WIMD can increase the effectiveness of my performance. ; Use of WIMD can increase the quality of output for the same amount of effort. ;; I believe the use of wireless technology would improve my job performance.	j), l) [Wi-Fi Internet usefulness, performance]	June et al., [3], Chin et al.,
		I believe the use of wireless technology in a Smartphone would improve my work/studies/life tasks performance.			
		I believe that having Wi-Fi connectivity in a Smartphone makes it easier to use.	I find it easy to get WIMD to do what I want it to do. , Interacting with WIMD does not require a lot of my mental effort.	j) [Wi-Fi easiness]	June et al., [3]
		While using my Smartphone I feel no difficulty in accessing any network or the Internet.	I have no difficulty in accessing the network.	k) [Wireless Network & Internet access]	Hyojoo et al., [104]
		I believe that the upcoming 3G technology in Pakistan will make Smartphone more useful.	Given that I have access to WIMD, I predict that I would adopt it. ; Assuming that I have access to WIMD, I intend to adopt it.	j) [3G wireless broadband experience]	June et al., [3]
	Design	I prefer personalized user interface design for Smartphone, for example number of items per page, color theme etc	Using the service also reflects my personality to other people.	c) [Personalization]	Hannu Verkasalo et al., [71]
		I prefer a Smartphone with a larger screen.			
		I prefer a Smartphone that has a longer battery life.			
		I prefer a durable Smartphone. (i.e. it can tolerate external damages/environment such as small impacts and water-proof casing)			
		I have no difficulty in reading the information displayed on Smartphone screen.	I have no difficulty in reading the information displayed on the mobile computing device's screen.	k) [Readability]	Hyojoo et al., [104]
		Smartphone external design is helpful for me to look stylish & fashionable. (i.e. Thinness, Color, Display, Appearance etc)	The smartphone case fulfills my esthetic requirements. ; Having a cellular telephone is helpful for me to look stylish / fashionable.	m), i) [esthetic sense]	Jaehyun Park & Sung H. Han, L. Leung and R. Wei [4]
		I have no difficulty in entering data using the Smartphone touch screen.	I have no difficulty in entering data on the mobile computing device.	k) [ease touch screen data entry]	Hyojoo et al., [104]
		I find it easy to navigate and use the Smartphone user interface. (i.e. menus, icons, text boxes, screen, buttons, theme)	I have no difficulty in navigating menus through GUI in mobile computing device.	k) [Menu Navigation]	Hyojoo et al., [104]
		I would prefer Smartphone which offers accessories such as Smart-Watch gadget.	I have no difficulty in exporting / importing data between the mobile computing device and other systems.	k) [Accessories, easy data sharing]	Hyojoo et al., [104]
		I have no difficulty in exporting / importing data between a Smartphone and other systems.			
	Multimedia	I would consider a Smartphone more useful	Classes with digital textbooks increase the interaction among students. , E-	o), p), q)	Mi-Ryang Kim et al.,, Ibrahim abdalla,

CONSTRUCTS & Questionnaire ITEMS			Reference Question Wording	Ref. Context + [Focus]	REFERENCE
		that has high media support such as RAM, camera resolution, sound quality, picture quality, interactivity etc.	Blackboard provides an attractive learning environment. , The use of technologies made the activity much better.	[Media Capabilities, Technology Experience for tasks, Recognition ability]	Marina Abad,
		The use of various technologies in a Smartphone improves the experience of performing tasks e.g. Smart video pause, smart gesture task control, Smart answering, quad core processor, cloud services etc			
		I prefer a Smartphone that provides a range of recognition abilities for example voice recognition or face recognition.			
		I feel that Smartphone with various media support is easier to use.	I feel comfortable with the class using digital textbooks. , Using E-Blackboard made it easier to study / learn. , I am skilled user of these kinds of systems.	o), p), q) [number of media functionalities, Media Interactivity]	Mi-Ryang Kim et al.,, Ibrahim abdalla, Marina Abad,
		I am comfortable with the Smartphone which offers a variety of interactive media capabilities. (such as GPS, smart gesture recognition, Smart answering, quad core processing capability, cloud services, mobile TV, teleconferencing etc)			
	Applications	I consider a Smartphone to be more useful that has many applications available for use.	I prefer advance availability or exclusiveness of products in Apps.	f) [No. of Apps]	Tam Ka Wai
		I believe that a Smartphone is useful that has applications relevant to my day to day tasks.	Using Apps for purchasing fashion products enable me to finish my task of shopping efficiently.	f) [App relevance]	Tam Ka Wai
		I consider a Smartphone easier to use that includes a variety of applications.	The Apps channel is more convenient for shopping than other channels. (e.g Internet, Physical Store)	f) [No. of applications variety gives ease, app store channel]	Tam Ka Wai
		The Apps channel (e.g. Google play, Apple app store) is more convenient for searching apps and shopping as compared to other channels (i.e. Physical store).			
		Apps provide a wide range of information that helps me increase my knowledge.	Apps providing wide range of information help me to make better purchase decision. (i.e. product details & promotion)	f) [Knowledge]	Tam Ka Wai
		Apps providing real-time and updated information help me in my daily tasks.	Apps providing real-time and updated information help me to make better purchase decision.	f) [real time information]	Tam Ka Wai
		Apps provide recommendations through advertisements which are useful to me.	Apps making products recommendation based on my browsing / shopping history is useful to me.	f) [Advertisements]	Tam Ka Wai
		I prefer Smartphone social applications to help me stay connected with friends, colleagues and family.	It is enjoyable to have social shopping for fashion products via Apps. (e.g. instant sharing with friends via social media platform in Apps)	f) [Social Media Apps]	Tam Ka Wai
		I find Smartphone apps	Learning to use Apps for purchasing	f) [easy to	Tam Ka Wai

CONSTRUCTS & Questionnaire ITEMS			Reference Question Wording	Ref. Context + [Focus]	REFERENCE
		easy to use.	fashion products is easy to me.	use apps]	
	After Sales Services	I feel that a Smartphone (Brand) is more useful that provides support for its services.	If I have technical difficulties in using mobile computing device, the technical support personnel will provide a satisfying response. ; If I have technical difficulties in using mobile computing device, the technical support personnel will be easy to reach at any time.	k) [Usefulness, resolution effectiveness, support reachability]	Hyojoo et al., [104]
		If I have technical difficulties in using a Smartphone, the technical support personnel at a service center will help to resolve the issue.			
		If I have technical difficulties in using a Smartphone, the technical support personnel at a service center will be easy to reach at any time.			

Constructs Contextual Details:

a) To generalize results four different field studies were conducted. Two sites where system usage was voluntary and other two where the system use was mandatory.

1) Manufacturing medium sized firm with 48 supervisors who were introduced with a proprietary system (no prior knowledge) for using it in daily activities.

2) A large financial services firm with 50 employees from different hierarchy, who were to use a new system that moved all mainframe operations into a Windows based environment.

3) A small accounting service firm with target subjects of 51 employees from different hierarchy, who were to use a new Window based customer account management system which replaced older DOS system and paper based system. Activities related to customer accounts and telephone service.

4) A small international investment banking firm with 51 target employees to use a new system for international stock management with better analytics and portfolio development.

b) TAM is extended to include user's intention to use a Mobile Wireless Technology (MWT)

c) Adoption of Smartphone applications. Focus to study users and non users of Smartphone to have an intention to use three selected mobile applications. Kinds of applications include game applications, map applications and mobile Internet applications.

d) Investigates Decision Support System (DSS) and their intended use in medium as well as large business organizations in Croatia by applying TAM.

e) The paper provides a study for assessing the use of Personal Computer Technology (PCT) using TAM in public organizations of developing countries especially South Asia and in particular 'Pakistan'.

f) The study of consumer attitudes towards Smartphone applications commerce in Hong Kong Fashion Retail Industry. (Thesis 2012)

g) Uses TAM to examine Internet usage by Academics in Thai Business School. (Thesis 2007)

h) Examines Smartphone adoption decisions by young people. (Thesis 2011)

i) Uses and gratification of Cellular phone.

j) Adoption of Wireless Internet services via Mobile Technology (WIMT) with questionnaire related to Wireless Internet Mobile Device (WIMD).

k) Investigated the factors that successfully influence the implementation of mobile computing devices in construction industry using TAM. Focus on user satisfaction and individual perception about performance.

l) Uses two versions of TAM to understand determinants of wireless technology usage intention in an organizational context. (User acceptance of wireless technology in organizations: A comparison of alternative models. Chin-Shan Wu , F.F. Cheng, David C. Y., Y.W. Huang)

m) User values are considered as a subset of life values and the relationship with certain products or services. Study focuses on user values elements towards smartphone from a list of elements using a longitudinal observation approach. (Defining User value: A case study of a smartphone)

n) Exploration of smart phone acceptance using TAM. (Predictions of User Acceptance and adoption of Smart phone for Learning with Technology Acceptance Model 2010)

o) Factors influencing usage and acceptance of multimedia based digital textbooks in a Pilot school. (2012, Mi-Ryang Kim et al.,)

p) Evaluating the effectiveness of E-Blackboard system using TAM. (2007 AACE Journal)

q) Mobile Technology acceptance for scenario of individual's use of mobile device for leisure activities. (2010)