Future of Interactive Technologies

The Forecasting of Interactive Technologies and their overall acceptance

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DEDICATED TO

My Parents

Acknowledgements

There are many people to whom acknowledgements are due; however, I am prevented from attempting to list them from fear of missing some out. All I can do is to mention briefly those without whom, it is patently obvious and this would never have been completed.

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I am grateful to my entire family for encouraging me to finish my studies, particularly my parents and my partner for their prayers, patience and continuous moral support.

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Above all, I thank GOD!

Abstract

The concept of interactivity continuously enhances our day-to-day living, allowing us to experience a more convenient and enjoyable life style. Existing analogue technologies such as the internet, mobile phone and satellite have now entered their digital phase, making it possible to increase their capacity for interactivity. The technologies which provide this increased interactivity, namely the internet, mobile and television, are classed as interactive technologies. Television has been successful at marketing, having launched an interactivity interface known as iTV which initially offered superior commercial prospects. However, after a decade, the iTV industry is still quite young and has not reached its full potential. This thesis adopts a range of research methodology with which to forecast the future of interactive technologies, especially interactive TV (iTV).

The uptake of new interactive technologies depends on many factors, notably the existing infrastructure in the country of adoption, cultural attitudes to new technology, the radicalism of the technology, social influences and interactions and ease of use, quality and cost. Beyond these, many other significant factors influence the acceptance of interactive technologies, the focus of this thesis is to ascertain the importance of those factors mentioned on technology adoption.

This study has adopted technological and judgemental forecasting techniques to predict the future of interactive technologies, following which Cross-Cultural and Technology Acceptance studies were carried out to investigate interactive technology adoption. In the Cross-Cultural study, survey data were collected from the UK, Hong Kong and Pakistan so as to examine cultural factors pertaining to the likelihood of adoption, while Growth Curves were used to model and forecast future levels of adoption.

Then technology trends in different countries were collected from the global marketing database Euromonitor. The Growth Curves, applied to a selection of interactive technologies, were evaluated and compared to identify the most useful model with which to forecast the future of interactive technologies. The

findings identified the Bass Model, Simple Logistic Model and Gompertz Model as the most suitable models for the purpose, with different models identified as best for different cultures.

The Judgemental study established that WWW will be the dominant service provider for financial services such as banking or financial products, while iTV will be the dominant service provider for entertainment. WWW will in fact be the dominant provider for most of the services, followed by iTV and then WAP. It is most likely that WWW, WAP and iTV will exhibit technology convergence in 20 years' time and in all probability will converge into WWW.

Further to this the Cross-Cultural study confirmed that there are significant differences between cultures regarding the acceptance of interactive technologies, as it is affected by demographic and social interactions and influences. In addition, the study showed that each interactive technology has its own significant elements which influence its acceptance. Overall, the key elements identified as influencing acceptance of interactive technologies were Knowledge and Confidence, followed by the number of hours the individual spends with his or her family.

The Technology Acceptance study identified a technology acceptance model for each interactive technology: WWW, WAP and iTV, which established the factors expected to influence the future growth of the technology. Managing these significant elements will assist further in promoting the growth of interactive technologies.

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Chapter 1 Future of Interactive Technologies

1.1. Introduction

Interactive technologies are among the more successful technologies in the current marketplace. In many ways, Interactive technologies have enhanced the way societies interact with each other. Fax, e-mail, Internet, mobile phones, interactive television, and Facebook have brought us even further into the information age. The knowledge economy has familiarised us with this concept of the information and digital age, so that the image of our era will be marked by the ability of individuals to transfer information freely and to have instant access to knowledge, which previously would have been difficult or impossible to obtain.

One of the main drivers of the knowledge society is the exponential growth of technological change. Andriessen (2004) has suggested that owing to new Information Communication Technology (ICT) the price of information processing has declined. The global access to information and knowledge allowed by ICT has encouraged the industrialised world to adopt a new economic paradigm.

At the same time, the accelerating growth of new interactive technologies has raised uncertainty as to the technology's future. Technological rivals and convergence have increased. Therefore, it is important to enquire into the future growth of interactive technology and identify its current promoters and inhibitors.

This thesis will examine the literature on interactive technologies and evaluate various forecasting methods and technology acceptance models. To extend them, it will undertake an empirical investigation into the future of interactive technologies.

The initial purpose of the research is to establish a valid diffusion model, applicable to interactive technologies, so as to forecast the future growth of interactive TV. To support the findings established through technological forecasting methods a judgemental approach will be adopted. Such an approach will also allow the establishment of key inhibitors and promoters of interactive technologies. The discovery of these key variables will assist in evaluating existing technology models and establishing a valid model for interactive technologies.

The three interactive technologies taken into consideration are internet, WAP, and interactive Television (iTV). However, the focus of this study will remain on interactive TV as this technology has been available for the past decade, although it is a long way from market saturation. Such analysis will help to identify the future growth of interactive technologies and will facilitate recommendations and suggestions concerning their potential expansion. In turn, projections of their future can help to provide valid business models for promoting them.

The core aim of the present chapter is to provide the context for this research thesis. In essence, the thesis focuses on the future of interactive technologies while evaluating their key promoters and inhibitors. The above overview of the research is followed by its justification and a discussion of aims and objectives. This is followed by a summary of the research methods employed. Finally, the structure of the thesis is outlined.

1.2. Research Justification and Aims and Objectives

1.2.1. Research Justification

Over the past years many scholars (Kangis and Rankin, (1996), Bartels and Reinders (2011), Srinivasan et al (2009), Im et al (2003, 2007), Burns (2007), Kowatsch and Maass (2010), Bo and Benbasat (2007), Kamis, Koufaris, and Stern (2008). Trujillo et al (2010) Bruner and Kumar (2005) and Wood and Moreau, (2006) have attempted to identify the characteristics of potential consumers, and especially those of innovators and potential early adopters.

Determining the characteristics of early and late adopters will allow technology providers to gain competitive advantage through targeting the correct audience and promoting their services to it, thus gaining an adequate return on the product development cost and capital invested. Kangis and Rankin (1996), Durmuşoğlu and Barczak (2011), Barczak, Griffin, and Kahn, (2009) stated that the new products are mostly driven by technology rather than market needs, as advances in technology generate more and more innovation. Interactive technologies are an example of technology driven innovation which has significant potential to grow in the current market.

There are numerous examples of interactive technologies such as World Wide Web (WWW), Wireless Application Protocol (WAP), interactive TV (iTV), internet Protocol TV (iPTV) and many more (Varadarajan et al (2010), Pazos-Arias et al (2008), Choi and Choi (2003), Huang (2008), Zhang and Gao (2011) and Kaasinen (2000).

Interactive technologies have advanced considerably over the years. The prime examples are the gaming consoles such as Play station, Xbox, Connect and Wii, which provide a vast amount of interactivity experience. These gaming consoles offer a new vision for the future, revealing capacities for interactivity that go well beyond earlier expectations. The introduction of interactivity in electronic gaming devices has made it possible to attract audiences of any age, while providing ever more sophisticated and advanced games for fun and entertainment. The greater interactivity of the gaming consoles has facilitated motion gaming and 3D operation. Besides this, mobile phones have substantially increased their interactivity capabilities so that they are no longer classed as simple two-way communication devices. Mobile phones are now more like personal assistants, equipped with processes, functions and features such as multimedia players, maps and web browsers. Television (TV), which has proved a successful technology for marketing, has now changed to offer its consumers an innovative service such as TV internet, allowing users to move into a more convenient life style.

However the iTV industry is still in its infancy in the UK even though the technology has been around for 40 years, with many trials such as QUBE and FSN in the US and others in Europe. However, with the development and growth of digital TV, there is more scope to expand the interactivity that television has promised over the years, providing viewers with a more active, immediate, asynchronous television experience, Klopfenstein, (1997).

In this thesis, the current prospects and growth of iTV will be compared with the status of WWW and WAP as they enter their third and fourth generations. This comparison is important for the purpose of establishing whether iTV can achieve the same level of success as WAP and WWW.

Demographic and individual differences can help to determine new interactive attitudes, as it is already well established that age and other social-demographic factors influence the adoption of new technology. As Mundorf and Bryant (2002), Vorderer (2000), Chaffin and Harlow (2005), Chung et al (2010), and Arning and Ziefle (2007) have suggested, the older generation seems to prefer “passive consumption” of media entertainment and technology, while Rockwell and Bryant (1999), Ching et al (2009), and Rogers and Price (2009) concluded that children enjoyed more interactive entertainment programs. The OFCom Market Communication report (2010) also established similar findings that people in the age group from 15 to 44 are more likely to adopt technology than those over 45. People of 65+ are very slow in adopting new technology. The mobile phone is the most widely accepted technology across all age groups; even among those over 65 at least 63% of the individuals have adopted a mobile, although the most broadly adopted technologies for the 65+ group are digital TV and computers. The least broadly adopted technology was the 3G handset. Illustrated in Figure 1.1 is the adoption of various new technologies by age group.

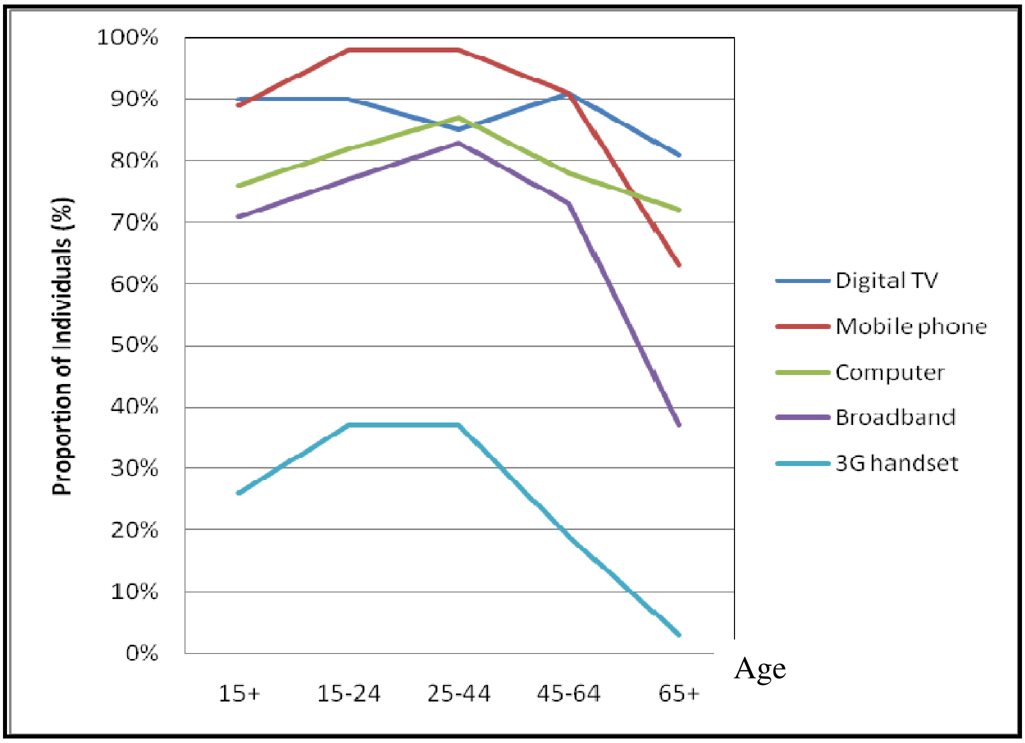

Figure 1.1 New Technology Adoption versus Age

Data Extracted from OFCom Market Communication Report 2010

However, such services might further divide societies into the information rich and poor, leading to political, economic and social issues. As OFCom Market Communication report (2010) identified that home internet access varies significantly by age and socio-economic group. This is illustrated in Figure 1.2, which shows that Socio–Economic group DE has only 54% access to home internet whereas Groups AB and C1 have among the highest rates of access. Of those aged 75+, only 23% have access to home internet, while the 25–54 age group are also among those with the greatest degree of access. Consumers are increasingly using the internet to shop and save money (OFCom, 2010).

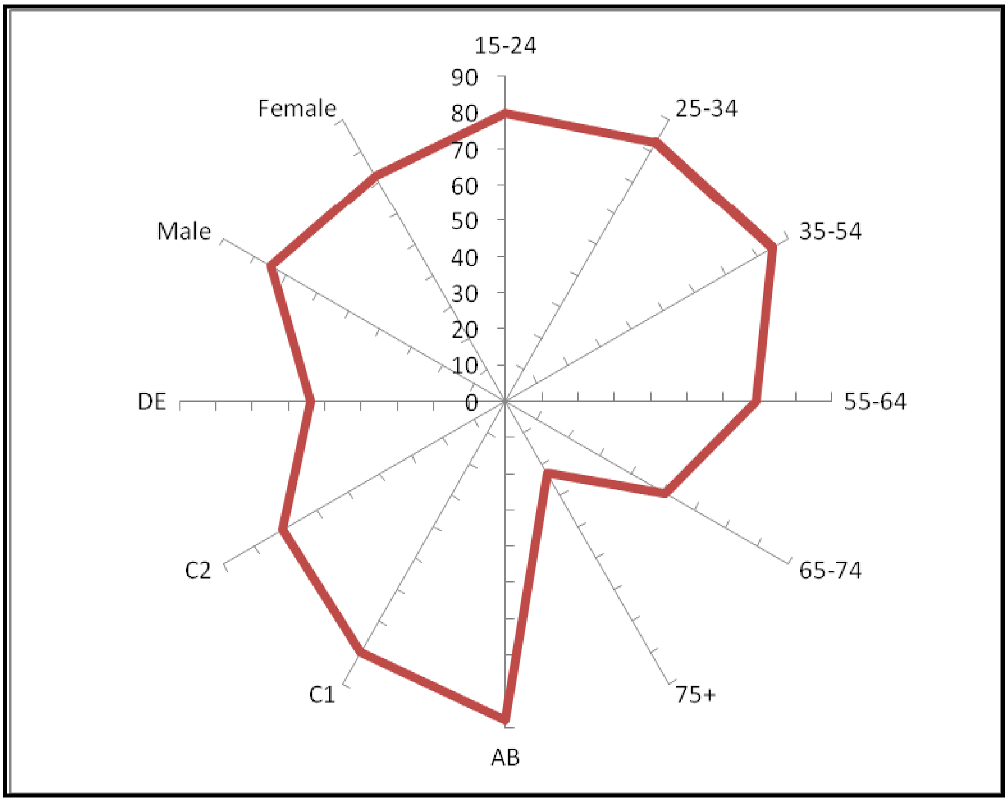

Figure 1.2 Internet Access by Age, Socio-Economic Group and Gender

Data Extracted from OFCom Market Communication Report 2010

In addition, the development and management of interactive technologies and services raise many issues such as technical complexity which might well require changes in consumer behaviour. Such developments will demand a substantial amount of investment in the network infrastructure, hardware components and software programmes, presenting a considerable risk to any new or existing firms that might consider entering these markets (Chorianopoulos et al 2011).

In 1996, Kangis and Rankin reported that for the UK to update its communication network infrastructure to support interactive services the cost to British Telecom would be at least £10 billion, and to the cable industry another £10 billion. Therefore, considering the significant financial, strategic, social, political and economic issues presented by such development, it is very important to identify the early adopters of the interactive services.

The communication industry revenue in the UK is £52.8b. The communication market comprises revenue generated by radio, television, mobile and internet (The Communication Market Report, OFCom, 2010). Digital television has provided many opportunities to improve communication compared to analogue television. (Athanasiadis and Mitropoulos, 2010, Xing et al 2009, Digital switchover has been a key driver in promoting the digital TV technology. (Sourbati, 2011) Digital TV has grown considerably over the past few years. The number of users with access to interactive functions such as booking movies, searching government information pages, home shopping via Bid TV and betting and gambling has significantly increased. (The Communication Market Report OFCom, 2010) Digital Satellite TV is available nationally with 98% UK coverage, while Digital Terrestrial TV availability has increased dramatically over the past few years and now stands at 73%. Cable broadband availability still trails behind but is experiencing staggered growth. Altogether, the adoption of digital technology continues to grow in the UK. Figure 1.3 summarises the current technology acceptance phase for each digital technology.

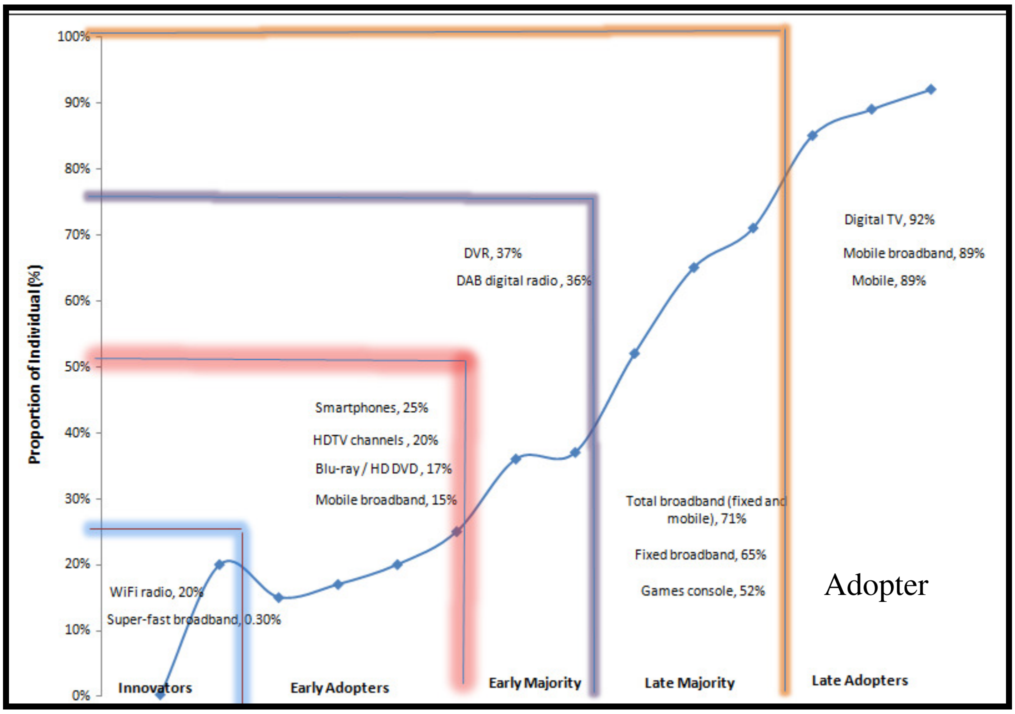

Figure 1.3 Digital Technology Adoption 2010

Data Extracted from OFCom Market Communication Report 2010

The above figure shows that Digital TV and Mobile Broadband are widely accepted digital technologies and at present only occupy a phase in which late technology adopters are accepting them. Users now have an opportunity to decide which digital technology to use because of the availability of a range of converged devices. The popular digital technologies are digital TV which is currently connected to over nine out of ten main television sets in the home, and broadband connection, now available to seven out of ten people.

The OFCom Communication Market report for 2010 has further revealed that consumption of television and radio services continued to play a large role in the total time consumers spent each day on communication services during 2009. According to OFCom's figures, adults in the UK spend 255 minutes daily watching television on a TV set. Illustrated in Figure 1.4 is the average time per day spent using communication services.

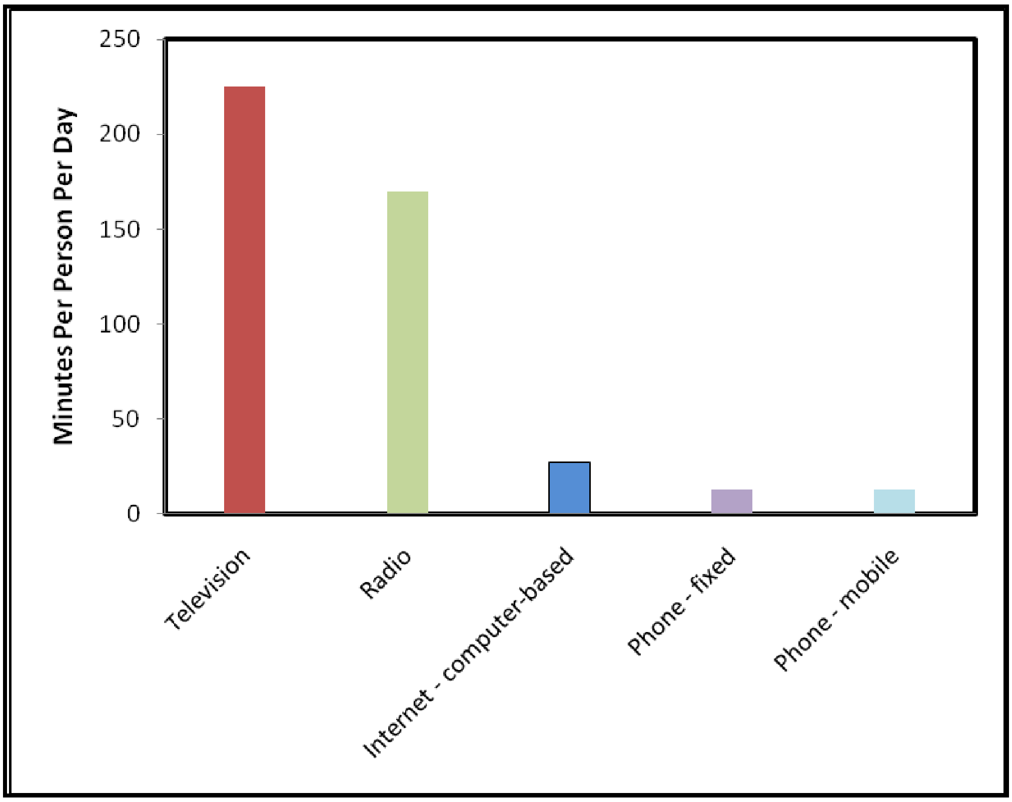

Figure 1.4 Average Time per Day Spent Using Communication Services

Data Extracted from OFCom Market Communication Report 2010

Television and radio services continue to be the main communication services utilised on a daily basis. Watching television is the media activity which most adults claim they would miss if they were deprived of it, the internet being the second most hypothetically missed activity among adults. This shows that television is an ideal medium for iTV as it attracts a larger audience than any other technology.

Users have more flexibility and choice than ever before when it comes to the way they access media content and use communication services. These opportunities have arisen because of the expansion of the range of devices now capable of supporting a wide variety of media content and service type. The situation has also been influenced by the speed of take-up of different technologies, together with the increased convergence of media. OFCom (2010) conducted research to discover how people use media and communication devices throughout the day.

Various opportunities have arisen as a result of interactive technologies and services. Interactive technology has received international attention from the regulators as they believe a communication infrastructure can be built in the current information age to become or remain economically competitive. (Rauschenbach 2006). Interacting by means of various technologies provides distinct communication methods. (Lu et al 2011, Hsieh and Cho 2011, Hernandez et al 2011, Sayago et al 2011 and Holmberg et al 2011)

iTV has been launched with high prospects. (Swedlow et al 2000). Interactive services will make it possible to broadcast the diverse forms of advertising required to target specific consumers and individuals, Chorianopoulos, (2001), Bellman et al (2011) and López-Nores (2011). It can only be a matter of time before advertisements received in each home are driven by the characteristics and habits of the occupants, Athanasiadis and Mitropoulos (2010). Bellman et al (2009), Cauberghe and De Pelsmacker (2008), Reading et al (2006). There is even more potential in iTV's promise to its consumers of instant buying power by means of such features as e-mails, enhanced TV, home shopping, and information pages, as well as the facility known as t-commerce for purchasing over the iTV. (Pazos-Arias, 2008 and Bellman et al, 2011).

iTV can change people's lives and have a great impact on our day-to-day living. But every new technology has both advantages and disadvantages. iTV can have an adverse effect on the national market economy if traditional retail stores and the government lose revenues. Also, shopping is seen as a social activity, so that if consumers decide to purchase through the TV, fewer will visit shopping malls, which will reduce social interaction. If large businesses experience a decrease in revenue, they may decide to limit retailing to the internet, WAP or iTV, removing the need for large shopping complexes, with the result that employment rates fall. A further effect could be an increase in globalisation and subsequent decline in the national economy. Jacobs and Dransfield, (1998), Swedlow et al (2000).

Advantages are that people will not need to leave their homes to go shopping or to work, while consumers will be able to search for more competitive products. E-commerce has brought success to many organisations by providing an effective supply chain for "business to consumers" and "business to businesses", Manvi and Venkataram (2005), and Mauldin et al (2006).
Since the Internet has become a business tool as well as a research tool, businesses both large and small have seized the opportunity to explore ways of becoming more productive and competitive. (Gunasekaran et al 2002).

Similar concepts may apply to WAP and iTV. It is thus worth comparing the history of iTV with that of WAP, another telecommunication product launched with high prospects. The first and second generations of m-commerce and WAP failed, mainly owing to technical difficulties over implementation. However, the re-launch of GPRS following some technical improvement has been a notable success. Sumita and Yoshii (2009), Teo and Pok (2003). iTV was launched 10 years ago and still has not achieved its full market potential, because of many usability and technical issues. Most current research is concerned with evaluating iTV's strengths and weaknesses. Many forecasters have tried to predict the future of iTV accurately, but have found it a "futile task". Therefore some forecasters decided to experiment with a different method. Instead of forecasting market value, a non-quantitative approach was adopted (Jacobs et al 1998 and Dransfield et al 2000).

The Carmel Group is a marketing company dedicated to analysis of the media, entertainment and telecommunications industries. The company has produced many papers which clearly indicate the great success of iTV. They have determined that

> "Personalization and profiling techniques provide satellite and cable operators with three critical elements for future business success in a highly competitive marketplace: 1. Revenue 2. Flexibility and 3. Control.'' (Stroud et al 2001)

In a briefing paper that summarises marketing strategies for driving the next generation of technology, Rookwood Consulting have predicted that t-commerce will present a considerable number of revenue opportunities (Johnson et al 2001).

Merrill Lynch provided an in-depth report on the global iTV infrastructure, which indicates that over $25 billion in revenue is predicted by 2005 in the US alone (Kaiser et al 2000). The London Business School's report on UK consumers' responses to iDTV has indicated that

> "Viewer regards some interactive programming (e.g. game shows) as a welcome addition to the viewing experience, although not all programmes or genres are suitable for concurrent interactivity."
> (Brodin et al,. 2002)

The report specifies that the takeup of iTV may be slow for t-commerce; but adoption models will need to be carefully examined to forecast with confidence the future of iTV and t-commerce.

Additional research has shown that 16 million Europeans are now using iTV for other purposes such as online voting, quiz shows and email. Greenspan et al (2002) expected iTV to be available to 31 million European households by the end of 2002, attracting over 2 million viewers. The key assumption here is that iTV may have been accepted as part of television. But the prospect of its becoming the next browser or web platform may be diminishing.

1.2.2. Aims

The aim is to undertake forecasting of interactive technologies and then to understand cultural influences on them and their overall acceptance. The uptake of new technology depends on many factors, notably the existing infrastructure in the country of adoption, the cultural attitude to new technology, and the technology's radicalism, ease of use and cost. Cross-cultural comparison of Growth models, Delphi study and Acceptance Modelling will be used to help determine the future of interactive technologies.

1.2.3. Objectives

1. Analysing secondary growth data for other telecommunication products will help to identify a suitable model for predicting the future of interactive technologies. Technological Forecasting models assist in forecasting the future growth of interactive technologies especially iTV where the future is unknown.

2. Establish an expert Delphi panel to predict the potential growth of interactive technologies, determine the key drivers and inhibitors of interactive TV and to evaluate their impact on the growth of interactive technologies.

3. Conduct cross-cultural examination to identify and understand the factors which promote the acceptance of interactive technologies. In order to accomplish this, a cross-cultural study is carried out across the UK, Hong Kong and Pakistan.

4. Evaluate three complementary theories, the Technology Acceptance Model (TAM), The Theory of Planned Behaviour (TPB) and the Decomposed Theory of Planned Behaviour (DTPB) to establish the best model for determining the acceptance of interactive technologies. Then further an overall technology acceptance model is established by evaluating additional factors such as Risk, Technology Quality,

Demographic and Social-Economic Factors, Enjoyment, Experience and External Influences.

1.3. Research Methodology

This section of the thesis presents the methods that will be used to analyse current market prospects and the future of each technology. In addition, it will discuss the current technical and usability issues for the leading commercial technologies. The current adoption model for iTV will also be demonstrated.
A comprehensive review will be conducted of published and unpublished work from secondary sources of data, including books, journals, magazines, conference proceedings and many financial and marketing reports.

To complete the empirical research successfully many different types of research method will be used. The quantitative method will be used to analyse existing data on the trends in adoption of new communication products in different societies and cultures. Qualitative research methods will be used to explore the drivers and inhibitors of each technology. Cross-cultural studies will be undertaken to establish the trends in different societies and cultures as they adapt to new technology. To understand user perspectives, questionnaires and surveys will take place in UK, Pakistan and Hong Kong among different age groups. Delphi forecasting technique will be used to forecast the future of iTV.

To measure the progress of commerce within the organizations, a study will be designed around a model of five stages of adoption. The model's purpose will be to assist in the analysis of the current market state of commerce technologies and to understand the trends followed when engaging in new products and technologies.

Cross-cultural research will help to understand the adoption models at various levels for different cultures. For this purpose Hong Kong, Pakistan and UK will be examined. Hong Kong was chosen because Edinburgh Napier University has good contacts with academics there, besides which Hong Kong is one of the leading producers of high technology components. Pakistan was chosen because it is a developing country with an Eastern culture and the researcher had strong ties with a well-established university in Lahore. Technology in Pakistan is not advanced, so presenting the idea of iTV in that country will be a good way to retrieve early adoption opinions. The UK was chosen because it is a Western country with a Western culture, and thus access to information there is unproblematic.

During cross-cultural data collection, two issues will need to be addressed carefully, namely, response equivalence and timing of data. For the cross-cultural questionnaire survey, it will be more appropriate to conduct it and compare it to other modes of data collection. The summary of the research methodology adopted is shown in Figure 1.5. Shown in this figure is that to undertake this research data was collect from primary and secondary data sources and summaries the objectives of each study.

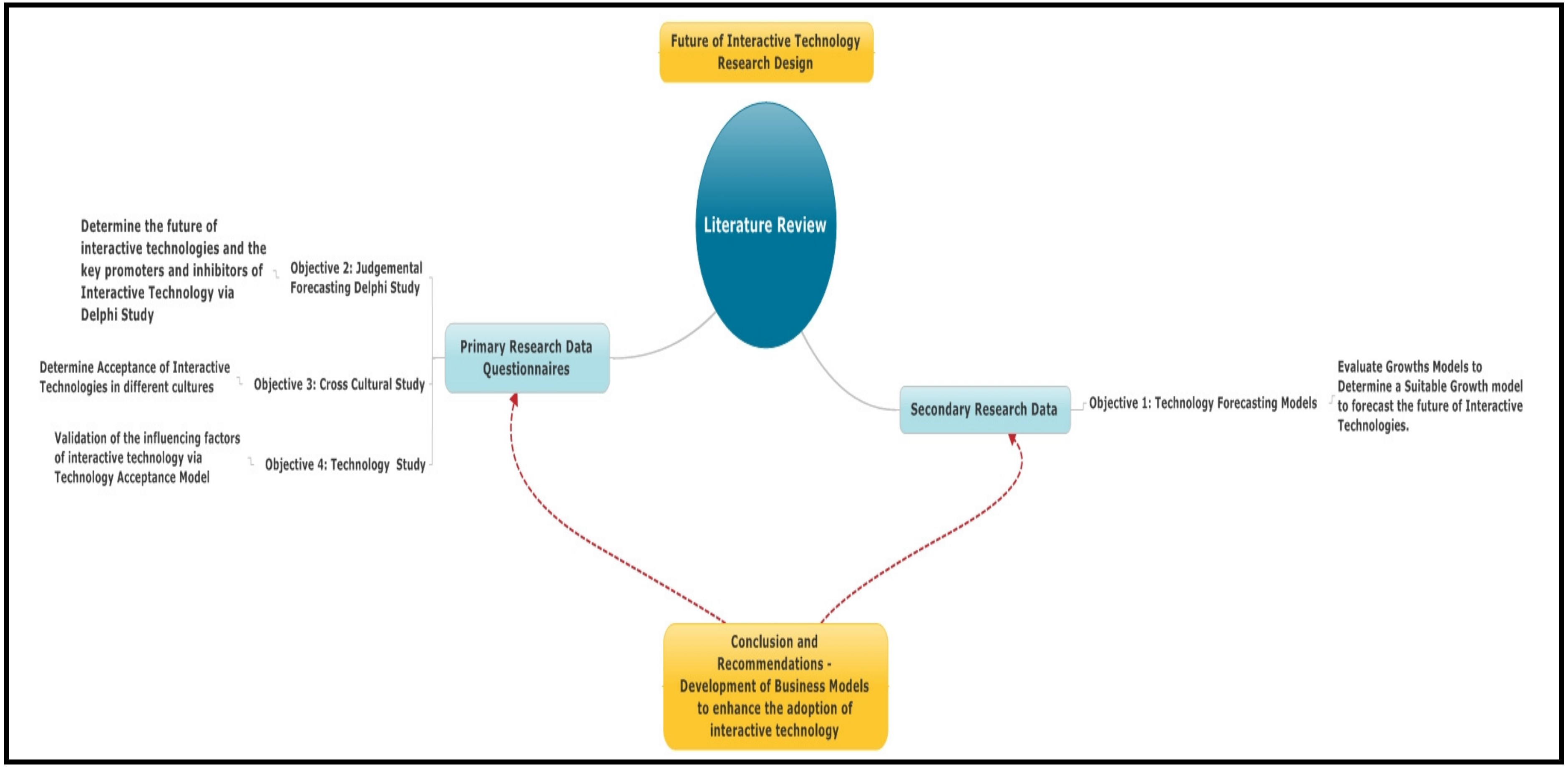

Figure 1.5 Summary of the Research Methodology

1.4. Structure of Thesis

This thesis is segmented into 11 chapters. The present chapter is a general introduction to the thesis, highlighting current developments in interactive technology and discussing the research justification, aims and objectives. In addition it describes the methodology adopted to achieve the objectives, justifies the research and summarises the methodology.

In chapters 2, 3 and 4, further relevant literature is reviewed in order to provide a comprehensive theoretical framework for the background to interactive technologies and to Forecasting and Technology Acceptance models.

Chapters 5 and 6 describe the hypotheses and methodology. Chapter 5 outlines the research objectives, research questions and hypotheses, then presents the research models. In chapter 6 are found the research methods and design utilised to achieve the research aims and objectives.

Presented in chapters 7 and 8 are the results and discussion of technological and Delphi forecasting techniques for predicting the future of interactive technology. In chapter seven various technological forecasting models are evaluated, and appropriate models are selected and considered in regard to some existing ICT applications so as to gain a better understanding of their effectiveness in accurately forecasting the future trend of the technology. These models are then applied to iTV, WWW and WAP to help to forecast the future of these technologies. In chapter eight the Delphi forecasting methodology is adopted to provide a judgemental forecast for the future of iTV, WWW, and WAP.

In chapters 9 and 10 an evaluation of the factors which will affect the acceptance of interactive technology is conducted. The acceptance is studied in two sections to achieve the overall objective. Initially a cross-cultural examination is used in order to understand the impact of different social and economic factors influencing the acceptance model of interactive technology. The second section analyses other factors which influence the technology's adoption, the overall aim of this part being to determine a technology acceptance model for interactive TV, WWW and WAP.

Chapter 11 concludes by summarising the research findings and discussing the contribution of this research. Limitations of the study are also outlined here; in addition, potential extension of the study and areas for future research are explored. Figure 1.6 summarises the framework of the thesis.

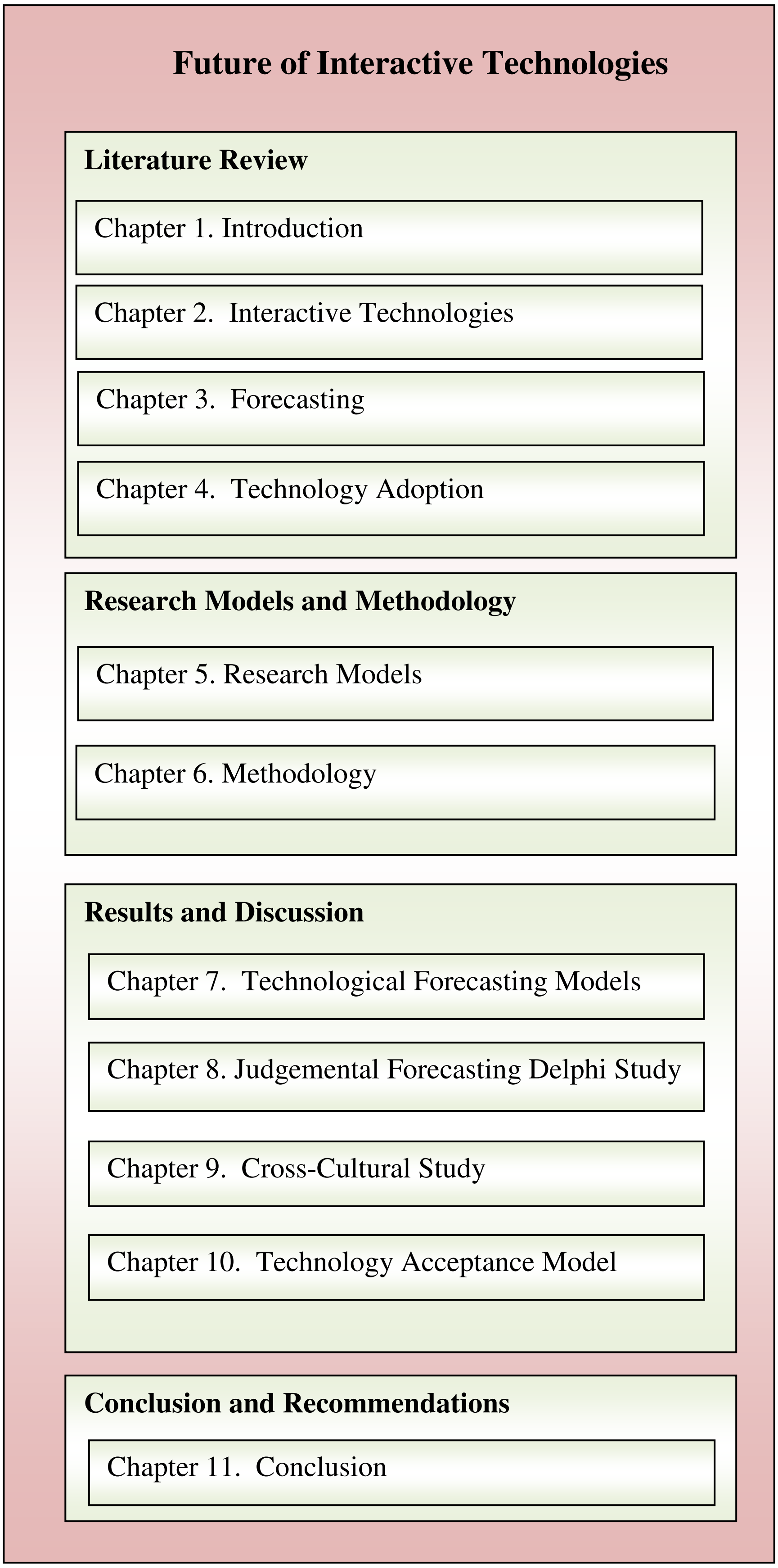

Figure 1.6 Framework for the Thesis

Chapter 2 Interactive Technologies

2.1. Introduction

Interactive technologies are among the successful technologies in the current market place and have greatly enhanced the way societies interact with each other, as well as increasing the standard value of the chain of supply. Internet, WAP and iTV are growing technologies providing interactivity at various levels. Fax, e-mail, internet, mobile phones such as IPhones, gaming consoles for example Wii, Play Station are established features of interactive technology, and even greater success can be expected for these technologies in future. The aim of the present chapter is to provide an overview of the interactive technologies currently available in this versatile market. This chapter focuses on these three and explains the current market position for each technology.

2.2. Interactive TV (iTV)

Television has been seen as the main marketing tool by many businesses and organisations. Adopting the digital environment will provide many services such as iTV, Burke et al (2000), Bellman et al (2011), Kim et al(2006), Choi and Choi (2003), and Pazos-Arias et al (2008).

Through iTV, television can now offer increasing interactivity, enabling consumers to interact directly with its content, and thus producing even more commercial potential. The traditional television broadcast need only send the signal one way, while the new digital networks allow two-way communication over the same network path. Therefore it is now possible for iTV users to engage with the television and send messages back. Users will be able to surf the internet, send e-mails, play interactive games, bet and gamble, as well as purchase goods over the TV by means of the facility known as T-commerce (Wirtz and Schwarz (2001).

> "The television industry is entering a new era in the service of the consumers. Built around two-way interactive technologies, the rollout of the digital television (DTV) infrastructure opens up a new frontier in communication." (Whitaker et al., 2001).

A decade after the launch of iTV, it is still considered to be in its infancy. Many forecasters have tried to predict its future, but have found it a "futile task". Rookwood Consulting produced a briefing paper with a summary of the marketing strategies for driving the next generation of technology. They have predicted that t-commerce will present a vast number of revenue opportunities (Jensen et al 1999). Merrill Lynch's in-depth report on the global iTV infrastructure indicated that over $25 billion revenue is expected in the US alone by 2005 (Kaiser et al 2000).

Research has showed that 16 millions Europeans are now using iTV for purposes such as online voting, quiz shows and email. By the end of 2002, it was to be available to 31 million European households, which would create 72 million viewers according to Greenspan et al (2002).

Kim and Sawhney (2002) have suggested that iTV can provide an information and communication platform able to accommodate broadcasting channels, video on demand, home shopping, banking and information retrieval services, etc. For Pramataris et al (2001), iTV might simply provide iTV programming with associated interactive content. They suggested that any interactive content, for example in news and sports programmes and public opinion polls, etc., could enhance the viewer's appreciation of TV. Tsaih et al (2005) elaborated on that idea as follows:

> "The interactive content associated with an advertisement could contain answers to specific questions about the advertised products or services, could offer viewers free product samples (e.g. one-minute movie preview) or the possibility to arrange a product trial (e.g. test drive a car), and could even support the viewer throughout the purchasing process by allowing for direct ordering and after-sales support".

The arrival of iTV was announced over twenty-five years ago, but during those twenty-five years the technology has experienced many false starts. Finally, however, it has been successfully deployed globally (Burke et al 2000; Srivastava et al 2002).

Satellite, cable and terrestrial TV platforms all provide Digital TV for which British Sky Broadcasting (BSkyB) is the major market player. In December

2001 only 33% of homes in the UK were on a Digital TV platform, yet BSkyB switched off its analogue signal in September 2001, with most of their customers transferred to digital (Brodin et al 2002).

The iTV concept still means different things to different people according to Katz (2004). Almeida (2004) has observed that interest in iTV research has increased considerably in both the academic and industrial sectors. Much of the research being done is for the purpose of augmenting iTV's capacities.

The remote control was the first step toward interactivity, giving the audience control of their viewing (Katz, 2004). Viewers were now able to surf the channels during commercial breaks. The second breakthrough in TV interactivity was the VCR, which allowed the audience to control their viewing further by means of the recording facility, so that they could record programmes and watch them at a more convenient time (Katz, 2004). The first type of interactivity use took place in commercials either through telephone numbers or direct response television.

Advertisements on television have the advantage of being broadcast to a mass audience. Newman et al (2004) argued that advertisement on television is more effective than that on PCs. Dreze and Hussher (2003) further claimed that the banner advertisement displayed on WWW is only seen by 50% of users while they are surfing the internet.

Bergman (2000) commented that the environment of information technology is changing course; rather than the personal computer (PC) being the main provider, information obtained in different environments is envisioned. This means that we are in a post-PC era, so that to access information we no longer require a PC but can turn to alternative platforms such as iTV being one of the prime examples of such a platform. (Lee and Yang, 2003).

Guo et al (2010), Liao et al (2009), Norman (1998) and Mohageg and Wagner (2000), Lewis (1998) suggested that it is the computer network devices being attached to appliances that have made this possible; these appliances are termed "information appliances". Choi and Choi (2003) also concluded that iTV is a TV which is a home appliance having network functionality, and therefore is described as an information appliance. It may also be described as an Interactive Technology.

Choi and Choi (2003) summarised the position by stating that iTV can be seen as a type of information appliance which allows the use of interactive services through networks. Fitzgerald (2001) observed that since the iTV audiences can purchase products as they see them on their TV screens, the technology can act as a primary portal for shopping.

Ryu and Wong (2008) remarked that while many chores and activities are carried out at home, viewing TV is the most "enjoyable", "informative" and "relaxing" experience for many. This experience influences our social values, encourages people to interact with family and friends and allows them to share their views on various TV programmes (see Steuer and Hustedt, 2002).

Many new TV technologies have been introduced, for example, Web Based TV, Internet Protocol TV (IPTV) and iTV, a development which Ryu and Wong (2008) assert has led to the convergence of traditional TV and the internet. Thus the introduction of the new TV technologies has an impact on current TV viewing experiences. The term t-commerce has steadily emerged in the academic and business worlds (Chitty, 1997; Haley, 1999; Hogan, 2000; Pramataris et al 2001; Kim and Sawhney, 2002).

O'Brien (2001) predicted that the iTV market will grow by approximately 22 million in 2001 and that by 2005 there will be 259 million users of iTV. However, Kim (2001) argued that Internet TV, the predecessor of iTV, failed in the market. Internet TV allowed the user to connect to the internet through a set top box while connected to a traditional TV. Kim (2001) maintained that the reason this technology failed and was not accepted by the users was that the vendors did not clearly understand what the users wanted from the new technology. Most homes in the UK have at least one television, the latest research reveals that 34% of households own two sets and 23% have three, yet only 43% of UK householders own a PC. From these figures it can be seen that there is a significant potential television audience, which is one of the reasons why iTV will be successful in the future.

The key assumption here is that iTV has been accepted as a feature of television, but the expectation of its becoming the next browser or web platform may be unfounded.

2.3. Wireless Application Protocol (WAP)

Wireless application protocol (WAP) is a secure specification that allows users to access information instantly via handheld wireless devices such as mobile phones, pagers, two-way radios, smart phones and communications (Hung et al, 2005, Hung et al 2003, Kaiser et al 2004). Teo and Pok (2003), Hung et al (2005) argued that the acceptance of WAP services is critical to the survival of the mobile commerce market.

M-commerce combines the advantages of mobile communication with an existing e-commerce application to allow consumers to shop for goods and services from virtually anywhere, (Ratten, 2008). Communication and service through wireless telecommunication networks that interface with a mobile device are becoming increasingly popular on a global scale. They are made possible by the convergence of two technologies: the internet and wireless technology. (Quah and Seet, 2007)

WAP is one of the key enabling technologies of m-commerce as it allows mobile users to access the Internet from a mobile device. Consequently, the future consumer adoption of m-commerce relies heavily on the ease of using WAP in order to access and utilise these services. (Dholakia et al 2004, Godoe and Hansen et al 2009, Mahatanankoon et al 2005).

The first generation standard (1G) for voice only was developed in 1979. The most recent standard, 3G networks, are fully operable in many countries. The 3G telephone enables users to access data, voice and video as well as internet though WAP. It uses the wideband code division multiple access (WCDMA) technique which is basically a high speed 3G mobile wireless technology with the capacity to offer higher data speed. (Ngai and Gunasekaran, 2007, Chang et al 2010).

2.4. World Wide Web (WWW)

The internet, widely accepted as a medium of access to various activities, has led to a huge increase in the success of e-commerce. Having grown quickly over the last decade, it provides access to an online global market place, with millions of customers and millions of services and products available around the clock. It has equipped companies with new, more cost-effective and time-efficient means for working with customers and suppliers. (Lee et al 2007, Quaddus and Achjari, 2005, Martinsons, 2002).

The figures show that there were 9.8 million UK broadband connections by the end of December 2005 (The Communication Market Report OfCom 2006). OfCom (2006), the UK regulatory authority, estimates that at the end of September 2005 there were 15.5 million internet connections in the UK. Email and surfing continue to be the most popular internet activities, followed by online shopping, banking and media downloads. Growing broadband penetration and the corresponding rise in the number of people making purchases online have led to the internet becoming an increasingly significant retail channel. According to IMRG's data, UK consumers spent £19.2bn on online purchases in 2005, nearly a third more than in 2004. It has been estimated by IMRG that UK online sales will reach £78bn by 2010. (The Communication Market Report OfCom 2005, 2006).

2.5. Technology Convergence

Technology Convergence is increasing the availability of interactive content across different mediums. (Bores et al 2003). Papadakis (2007), Hacklin et al (2009) makes the case that technological convergence represents both a technical and a functional convergence. The technical side focuses on the ability of any infrastructure to transmit any type of data, whereas the functional side enables consumers to integrate functionality, and allows execution of multiple tasks.

Mundorf et al (1997) suggested that, in the past, new technology has raised concerns because of being seen as a replacement for some existing medium. Recently, however, a more optimistic view has been taken of the interrelationship and technological convergence of new and traditional media. Stipp (1998) emphasised that technology convergence is feasible, but has been restricted by people's lifestyle preferences and other factors; whereas Vorderer (2000) suggested that there are different expectations and levels of desirability in relation to the extent of interactivity required by different populations.

Mundorf and Bryant (2002) stressed that innovations in existing media products through convergence and co-evolution with other media products has increased the ability of the product to be more interactive. Cairncross (1997), for his part, concluded that most of these hybrid media products can be reached by a majority of the population, even in countries with insufficient internet access. He commented that users who have adequate access and perform relevant activities through converged traditional products with increased interactivity have the "potential to increase their economic well-being and quality of life".

Papadakis (2007) and Hacklin et al (2009) argued that technological convergence can play an important role in national economic and social development, since it offers massive opportunities for the emergence of new value-added services, along with increased convenience and efficiency plus the expansion of markets and consumer choice.

2.6. Examples of Interactive Technology Applications

According to Dholakia et al (1996), Martin (1999), Varadarajan et al (2010) the entertainment service has an increasingly segmented audience because of increasing viewing and medium choices.

Loebbeke et al (2004), Mundorf and Bryant (2002), and Bolton et al (2009) emphasised that applications which combine business and work have a higher revenue potential. For example, the following interactive applications -

teleworking, telebanking, teleshopping, telemedicine and distance learning – are potential generators of higher revenue.

Martin (1999), Varadarjan et al (2010), Slay et al (2008) suggested that there are financial benefits and incentives for both organisations and individuals in adopting the interactive technology. Private homes also benefit from teleworking, which enables workers to reduce their transportation budget considerably. Teleshopping, online banking, telemedicine, distance learning and many other interactive applications provide additional savings and convenience, offering improved access to facilities such as education, health care and economic opportunities.

2.6.1. Home shopping

Interactive technology has allowed electronic shopping, known as home shopping, to capture a substantial market share from catalogue and in-store shopping. Home shopping services allow individuals to buy food, clothes, music, books, furniture, electronic goods etc., using their television sets or personal computers. The interactive technology gives the user affordable and easy access to the product information required, besides being able to offer comparative pricing (Chang and Burke, 2007, Vijayasarathy, 2004).

Martin (1999) and Varadarajan et al (2010) observed that originally it was only computers, computer components and software that were being traded via electronic shopping. But soon consumer durable items took off and easily-shipped goods gained popularity, especially books and music CDs. Many companies which used catalogues to sell their products also identified the internet as an additional sales and marketing channel. Subsequently the market for used products such as cars, computers and many other items also emerged (Dholakia, 1999, Schwartz, 2000).

2.6.2. Betting and Sporting Events

LaPlante et al (2008), suggested that the Internet is a “controversial new medium” for Betting and Sporting Events. Interactive technology provides users to access major sporting events, also providing the option of watching the event from various angles. (Yu et al 2008) Additionally, the user has access to services such as placing a bet via major credit or debit cards. Hamalainen et al (2006) suggests that many new opportunities can be explored to provide Real-Time Betting.

2.6.3. News and Information

Interactive technologies allow delivering filtered personalised news and information. (Billsus and Pazzani, 2007, Nanas et al 2009). Through this service individuals can access personalised information from a wide range of magazines, newspapers, books and much other literature such as academic journals and articles. Lavie et al (2010) and Jokela et al (2001) suggest that personalization can assist users to cope with the abundance of information. As Saaksjarvi and Santonen (2003) state that personalized information can play a major role for marketing purposes. This will allow the marketers to utilising the personalized contents and target their audience.

2.6.4. Travel and Tourism

Buhalis and Law (2008) and Zhang et al (2009) both summarise that the Travel and Tourism heavily benefit from the Interactive Technologies. Especially when the industry is information –oriented. (Kozinets, 2002 and Casalo et al 2010) This service allows individuals to plan and book travel arrangements as well as to find exotic holiday destinations. The user is normally provided with a choice of competitive prices and a range of holiday types and dates via the internet or television, and is then able to book the chosen arrangements on the internet or over the phone. (Tsaih et al 2005).

2.6.5. Banking

Traditional banking methods often cause higher overheads, frustration and inconvenience to the banks and customers. Following the success of Automatic Teller Machines (ATM's), there is clear evidence of the enormous potential of electronic banking. Further to this Lin (2007), Hernandez-Murillo et al (2010) and Centeno (2004) argue that increase in information technology capability of a firm can increase its economic value and competitive advantages for banking firms. The adoption of telebanking is positively associated with income and education and inversely associated with age (Mundorf and Bryant, 2002). Banks currently offer internet-based banking along with the more traditional options. (Al-Somali et al 2009) Currently opportunities to arise to bank by television and mobile (Ratten, 2008): Digital Sky TV subscribers have this facility if they are HSBC customers. At present, HSBC is the only bank offering this service. (www.Sky.com).

2.6.6. Distance Learning

Mundorf and Bryant (2002), Pazos-Arias et a.l. (2008) and Huang et al (2008) suggested that for distance learning to succeed, it needs to possess some key interactive features and the ability to modify and individualize content. Goldberg (1998) noted that such interactive technologies offer students a greater involvement in and control over the learning process as compared with many traditional learning environments. Currently interactive distance learning is used as a complement to traditional approaches. (Zhang et al 2006, Hsieh et al 2011).

2.6.7. Gambling and Auction

Interactive technologies provide a lucrative market for gambling and auctions such as e-bay. (Peters and Bodkin, 2007 and LaPlante et al 2008). Users have access to many online gambling games and they can play in the comfort of their own home rather than visit the local bingo or casino clubs. (Jolley et al 2006). Gambling leaders such as Ladbroke and William Hill provide interactive services to their customers via many different platforms such as the WAP, internet and iTV. Auction sites like e-bay have introduced a more convenient and competitive market for online shopping. (Chang, 2010) Auction sites have been rolled out for every sector from beanie babies to steel and metal. Klein (1998) suggested that electronic auctions have attracted the most attention; the reason may be that people are intrigued by the dynamics of real-time price plus the opportunity to bargain. (Cunden 2004).

From the above evidence it is clear that interactive technologies have much potential and have brought many innovative advances in the ICT world. Interactive applications have improved services such as health care by providing adequate and reliable expert advice, and have also improved home shopping facilities which have saved time and been more convenient for individuals. Overall, improved interactive technologies have changed our techno-social culture. This section has given a summary of the current market for the three main interactive technologies. As limited data is available on the actual users of iTV, insight into the penetration success of the technology is provided by that of the digital TV services. The next chapter will examine the forecasting methods available to predict the future of Interactive Technologies. This information will help to identify appropriate techniques to adopt when forecasting.

Chapter 3 Literature Review -Forecasting

3.1. Introduction

Forecasting is a complex area of expertise and also the most crucial step in planning to ensure that effective and efficient use of resources is made during a product's lifecycle (Nikolopoulos et al 2003; Albright, 2002). In addition, forecasting of new products, especially a new ICT product, has become more challenging. Jun et al (2002), Nikolopoulos et al (2003), and Klassen and Flores Benito (2001) underlined the importance of new ICT forecasting inasmuch as it helps to determine the future success of and demand for the product, although it faces many difficulties since the new product is competing with many other advanced services and products. There are many forecasting methods that can be adopted in predicting the future of a new product.

> "Forecasting is an essential tool for planning and decision making. Understanding the role of forecasting in its organisational and managerial context is very important for a company in today's business." (Nikolopoulos et al 2003).

This chapter provides an overview of various Technological and Judgemental forecasting techniques and identify the most relevant methods to forecast the future of interactive technologies.

As the world of technology grows rapidly, many companies promote their newer and higher technology products to try to attract customers and thus capture the largest segment of the market. (Bobrowski and Bretschneider, 1994; Liao and Xu, 2007). Since the competition among companies is intense, interactive technology devices and applications are short-lived, being either converged with other technologies or replaced by newer interactive technology. (Park and Yoon, 2005; Chu et al 2009). Ortt et al (2007) argues that commercializing breakthrough technologies can be extremely risky for the technology provider, but if the technology is successful then the company can gain competitive advantage and enjoy significant growth and profitability. Sanders and Ritzman (2004) comment that accurate forecasting has become very challenging in today's business environment, as it is characterised by high uncertainty and short response times. Owing to rapid technological innovations, especially in the world of e-commerce, the use of historical data has limited use in predicting the future. Therefore combining quantitative forecasting methods with a judgemental assessment can produce a successful forecast for interactive technologies.

Accurate forecasting of new ICT products is crucial to the survival and success of firms. Indeed, it is an integral part of management's decision-making activities, (see Fildes and Kumar, 2002; Tseng et al 2009). In a large business market, such as that for mobile phones, it is difficult to maintain a steady increase in sales if the firm has no new products to introduce to the customers. (Ratten, 2008; Lieven and Gino, 2004). New products contain uncertainty, which means that successful new product forecasting is a critical management task. Because of the unknown factors and uncertainties, some companies tend to underestimate the new products and become pessimistic. (Teng et al 2009; Hibberd 2000; and Funk, 2007. As a consequence, the company may lose profit opportunities, dissatisfy customers or decrease their market share. (Preez and Pistorius, 2002). On the other hand, if the forecast errs in the direction of optimism and overestimates, then the company will incur wasted expense and increased inventory and end up in financial difficulties. Therefore an accurate forecasting model for any new product is extremely important. (Sohn et al 2008; Fuentelsaz et al 2003; Krishnan et al 1999; Milis and Mercken, 2004).

The future success of interactive technology is highly uncertain, as is that of any new product in the market. So an accurate forecast is necessary to ensure that service providers and technology innovators are investing to a level which will produce high returns. (Robertson et al 2007; Shen et al 2008; McBurney et al 2002; Corrocher, 2003; Chu and Pan, 2008). As this thesis focuses on the future of interactive technologies, it will be appropriate to apply technology forecasting techniques to predict that future. Although a number of techniques and methods have been adopted to forecast the future of ICT, research on forecasting the future of interactive technologies has been limited. Table 3.1 summarises the methods frequently used to forecast the future of ICT.

Table 3.1 Previous Research into Forecasting ICT Technologies.

Author	**Title**	**Technology Forecasting Method**
Chih-Peng Chu, Jin-Gu Pan (2008)	The Forecasting of mobile internet in Taiwan by Diffusion Models	Diffusion Models
Timothy R. Anderson, Tugrul U. Daim, Jisun Kim (2008)	Technology Forecasting for Wireless Communications	DEA
Mark Bell, Graeme Martin and Thomas Clarke (2004)	Engaging in the Future of e-learning : A scenarios based approach	Scenarios
Victor B Kreng and Hsi Tse Wang, (2009)	A technology replacement model with variable mark potential – An empirical Study of CRT and LCD TV	Diffusion Model
Feng-Shang Wu, Wen-Li Chu (2009)	Diffusion Model of Mobile Telephony	Diffusion Model
Ming-Yeu Wang, Wei–Ting Lan (2007)	Combined forecast process: Combining scenario analysis with the technological substitution model	Scenarios and Substitution Model
RajKumar Venkatesan and V. Kumar (2002)	A Genetic algorithms approach to growth phase of wireless subscribers	Genetic algorithms and Bass Model
Jeffrey L Funk (2005)	The Future of the mobile phone Internet: An Analysis of technology trajectories and lead users in the Japanese Market	Structured Interviews
Charisios Christodoulos, Christos Michalakelis, Dimitris Varoutas (2010)	Forecasting with limited Data: Combining ARIMA and Diffusion Models – Mobile and Broadband penetration	ARIMA and Diffusion Models
Jonghwa Kim, Deok-Joo Lee, and Jaekyoung Ahn (2006)	A dynamic competition analysis on the Korean mobile phone market using competitive diffusion model	Diffusion Model
Fang-Mei Tseng, Ai Chia Cheng, and Yi Neug Peng (2009)	Assessing market penetration combining scenario analysis, Delphi and technology substitution model: The case of the OLED TV Market	Delphi, Scenario, Substitution model
Robert J Kauffman and Angsana A. Techatassanasoontorn (2009)	Understanding early diffusion of digital wireless phones	Growth Curves

There are different types of forecasting techniques which can be utilised to forecast the future of interactive technology. As shown in previous sections, over the past decade many different aspects of these technologies have been introduced to the market. As can be seen, much research has been conducted on forecasting the future of various ITC products such as internet, wireless technologies and e-commerce, but there has not been as much regarding the future of interactive technologies. (Wu and Chu, 2009; Anderson et al 2008; Chu and Pan, 2008)

3.2. Technological Forecasting

Technology is described by Meredith et al (1995) as an application of science or art. Any technology will make use of science or art to develop its objectives. The point of product development or technology innovation it is important to decide whether to use currently available technologies or to delay product development until the arrival of a more advanced technology which is in the pipeline but currently not available. (Preez and Pistorius, 2002; Park and Yoon, 2005; Robertson et al 2007).

These choices are vital for technology innovation because they will help to determine the future of the new technological product. (Wang and Hsu, 2008; Lee and Tunzelmann, 2005). The new technical product must be compatible with current and future technologies to ensure it is functional in its expected life span. (Shen et al 2008; Bores et al 2003; Fildes and Kumar, 2002). Interactive technologies are also based on existing technology; for example interactive TV utilises television to deliver the technology, whereas the WAP uses the mobile. Also, interactive technologies are supplied through established technologies, e.g. television, mobiles and computers. and these mediums are already extremely successful in the market.

Meredith et al (1995) describes technology forecasting as

> "The process of predicating the future characteristics and timing of technology. When possible, the predication will be quantified, made through a specific logic, and will estimate the timing and degree of change in technological parameters, attributes and capabilities."

Technological forecasting is meant to be utilised to predict future technological capabilities, attributes and parameters (Lu et al 2005; Lopes –Nicolas et al 2008; Mundorf and Bryant, 2002). Scholars stress that such forecasting is not a method of predicting the technology's profitability. It is used purely to determine the potential of future characteristics as well as the timing of technology. (Shen et al 2008; Torkkeli and Tuominen, 2002; Lu et al 2005; Durkin et al 2008; Lopez-Nicolas et al 2008; Lee, Ryu and Kim, 2009).

The technological innovation process is affected by factors having an impact on the growth and direction of the technology. Features such as advances in technology, governmental and organisational policies, and technological infrastructure all have an effect on the future availability of a technology. Some policies and decisions will support the continuing need for the technology and others will not; these variables will have a significant influence on the innovation (Narvekar et al 2006).

> "Another characteristic of technological forecasting is uncertainty about the rate of change of technological capabilities. Many capabilities tend to grow exponentially until they reach some natural limits; for example aircraft speed, computer memory size, and memory access speed. This is because new technology builds on older technology and synergism results from the combination. When one technology impinges on another, the synergy often results in an unexpected and sudden increase in capability"
> (Meredith et al 1995)

Technological forecasting methodology has advanced significantly. Mishra (2002) underlines the importance of the quality of forecasting, which is greatly dependent on the selection and application of the appropriate techniques. In this respect, Martino (2003) notes that there have been significant developments in technological forecasting methodology which have helped to improve the quality of the forecasting.

Interactive technology firms, like other high technology firms, consist, as suggested by Bourgeois and Eisenhardt (1988), of a high velocity environment which evolves rapidly to accommodate changes in demand, competition and technological and regulatory changes.

A notable variety of techniques is employed in technological forecasting. There are so many that a number of different classification schemes could be used in considering major approaches to forecasting for a new product, but the most useful ones fall into three categories: quantitative, qualitative and composite methods. These approaches range from simple mechanical routines to sophisticated statistical models and subjective human judgement methods. Fildes (2006) provided a comprehensive review of the forecasting research. To add to it, De Gooijer and Hyndman (2006) carried out an extensive review of time series forecasting, while Meade and Islam (2006) offered a similar in-depth review of innovation diffusion. A review of judgemental forecasting progress over the last 25 years was conducted by Lawrence et al (2006).

Mishra et al (2002) has stressed that technological forecasting is known as an effective method for establishing technology strategies. A number of techniques have evolved to improve the quality of the forecast. Mishra et al (2002) expressed the view that the quality of the forecasting depends primarily on selecting the appropriate technique for the technology, thus helping to improve the forecast's accuracy and reliability. There are a number of technological forecasting techniques which can be utilised. The following section summarises the techniques available and their application to interactive technologies.

3.3. Technology Forecasting Techniques

There are many techniques available for performing technological forecasts. Linstone (1999), Ayres (1999), Martino (1999, 2003) and Porter (1999) have provided comprehensive overviews of the evolving technology forecasting techniques over time. Lawrence and Hodges (2004) have based the Five Views of the Future ™ framework on the five ways in which people envision the future, see following reference (http://www.tfi.com/pubs/w/pdf/5views_wp.pdf, last accessed on 01/05/2011). They categorised and classified technology forecasting models and produced a model known as Five Views of the Future, in which they suggest that collaboration using all five views, with each viewer using a different method, is likely to increase the quality of the forecast. They have made many successful forecasts in areas such as digital switching, mobile adoption, internet demand and many more by adopting the model. Adopting the Five views of the Future Model will yield a better understanding of the available techniques for forecasting the future of interactive technologies. The use of this model has assisted in identifying appropriate forecasting methods for interactive technology because that technology is based on telecommunication technologies. Since the model has enabled many valid forecasts to be made, it may also help with interactive technologies. To further explore quantitative and qualitative technology forecasting methods, the next section will evaluate the selection of techniques to justify those adopted for forecasting the future of interactive technology.

3.3.1 Quantitative Methods

Quantitative methods mainly analyse historical data by generating statistical patterns and relationships. Examples of some of the quantitative techniques are:

Trend Extrapolation

This method examines trends and cycles in historical data, then uses mathematical techniques to extrapolate the future. It is good for short term forecasting. The stability of the environment is important in determining whether trend extrapolation is an appropriate forecasting model. There are Four approaches to its use; Statistical Curve Fitting, Limit Analysis, Trend Correlation and Multivariate Trend Correlation. (Hacklin et al 2009; Zhang and Qi, 2005; Kim and Park, 2009). The choice of an appropriate approach for a particular forecasting application depending on the historical data.

Trend Extrapolation has many disadvantages, especially the difficulty of selecting and validating appropriate historical data. The selection of inappropriate data will affect the quality of the forecast. As Meredith et al (1995) observe, Forecasting by using Trend Extrapolation methodology is not sensitive to the changes in the conditions that have produced the historical data, changes that may significantly alter the trend. Even when it is known that one or more possibly important conditions are going to change, technological advances cannot be predicted from the extrapolation.

Time Series

Time series forecasting has been an active area of research since the 1950s. Lemke et al (2010) suggest that traditionally, when utilising time series forecasting, experts usually examine time series characteristics visually and fit models according to their judgement. Much uncertainty surrounds the selection of an appropriate forecasting method for a problem. Box and Jenkins (1976) produced the popular time-series ARIMA (Autoregressive moving integrated moving average) type of forecasting model, often employed when there is insufficient data with which to build econometric or regression models (Hong et al 2010). However, there is a fundamental limitation on time-series forecasting in that it is unable to predict changes which are not evident from the historical data (Hong et al 2010). In general, the use of simple time series is an unsuitable technique to adopt for forecasting the future of interactive technologies, as there is limited historical data available on the growth of iTV, WAP and Internet. Nevertheless, there may be an opportunity to combine time series with other forecasting methods. Venkatesan and Kumar (2002) combined time series technique with diffusion models to forecast the growth phase of wireless subscribers, while Christodoulos et al (2010) combined ARIMA with a diffusion model to understand the penetration of mobile and broadband.

Growth Curves

Technological capabilities have a growth pattern similar to the S-shaped growth of a biological life (Meredith et al 1995). The technology growth curve is similar to the diffusion of the technological innovations process (Rogers, 2003). The growth curve increases gradually first during the invention and introduction phase. If the technology is successfully adopted it will go through an extensive diffusion and growth phase before reaching maturity. Once it finally reaches that phase and approaches saturation, the S-shaped curve levels off and growth becomes steady. Adopting technological forecasting techniques makes it possible to estimate the timing of these growth phases (Meredith et al 1995). The advantage of growth curve forecasting is that it allows determination of the upper limits of growth for an individual technology.

There are several mathematical models that can be utilised to generate growth curves. Chu et al (2009) and Young (1993) analysed nine different growth curves to establish the best procedures for selecting an appropriate technological growth curve based on the characteristic of the data set. Kauffman and Techatassanasoontom (2009) adopted growth curves to understand the early diffusion of digital wireless phones. Since most interactive technologies are currently in their innovation phase, it is considered advisable to adopt growth curves.

Interactive technologies product lifecycles have become shorter in order to remain competitive in current economic conditions and in a highly competitive market. Consequently there are limited data with which to perform market analysis and technology forecasting. Gregg (1964) identified the first three curves of the Norton and Brass model, namely, Modified Exponential Curve, Simple Logistic Curve and Gompertz Curve, as suitable for limited time series data. Many other growth curve models have been developed for forecasting market penetration, the most frequently used models being the simple logistic curve and the Gompertz curve. Meade and Islam (1995) evaluated 17 growth models for the telecommunication market. Their research concluded that basic forecasting models such as the simple logistic curve and the Gompertz curve have better forecasting capabilities than other, more complex models. However, Bengisu et al (2006) advised that when using these models the maximum market penetration needs to be carefully considered and set, as inaccurate predictions may otherwise result. Lackman (1993) and Morrison (1996) suggested that the simple logistic and Gompertz models are especially suitable for forecasting the future of new and high technology products. Boretos (2007) further utilised the simple logistic curve to demonstrate that the diffusion of the mobile exhibits the S-curve growth.

Simple Logistic Curve

This is one of the most important nonlinear models because many nonlinear model functions are based on it. They are S-shaped curves and symmetric about their points of inflection.(Phillips, 2007). Meyers et al (1999) suggest that the S-Shaped Curve is the best model for explaining growth and decline over a period of time. The simple logistic model is expressed as follows:

$$Y_t = \frac{m}{1 + ce^{(-bt)}} + \varepsilon_t \qquad \textit{Equation 1}$$

where *m* is the market potential over reference period of time and corresponds to the saturated value of growth; *C* is the scaling coefficient, *b* is a measure of the diffusion speed or how rapidly the adoption progress, Y_t represents the adoption during time period t and e_t is error term.

Gompertz Model

The Gompertz model is most applicable when the data follows a smooth curve. The Gompertz curve attains its maximum rate of growth at an earlier stage, and maintains a more constant rate later on, than the logistic curve. (Rouvinen, 2006, Robertson et al 2007). Vanston (2002) suggested that the Gompertz curve is valuable when the availability of relevant existing market data is limited. The application of the Gompertz curve has been demonstrated by Hendry (1972) for modelling monochrome TV adoption in the UK. As another widely used curve, Gompertz is not symmetric about its point of inflection, which occurs before market penetration has reached half the saturation level.

$$Y_t = me^{-c(e^{-(bt)})} + \varepsilon_t \qquad \textit{Equation 2}$$

where *m* is the market potential over reference period of time and corresponds to the saturated value of growth; *C* is the scaling coefficient, *b* is a measure of the diffusion speed or how rapidly the adoption progress, Y_t represents the adoption during time period t and e_t is error term.

Modified Exponential Model

The modified exponential curve is included for completeness rather than out of any expectation of its performing competitively. It has no point of inflection. Because the values of three coefficients (m, b and c) are required to define the curve, fitting the modified exponential curve using the method of least squares is not a simple procedure. The modified exponential model can be expressed as follows:

$$Y_t = m - ce^{(-bt)} + \varepsilon_t \qquad \textit{Equation 3}$$

where *m* is the market potential over reference period of time and corresponds to the saturated value of growth; *C* is the scaling coefficient, *b* is a measure of the diffusion speed or how rapidly the adoption progress, Y_t represents the adoption during time period t and e_t is error term.

Substitution Model

The technological substitution model, originally proposed in 1971 by Fisher and Pry, was designed to analyse the penetration process of new technologies replacing the older technology. The initial Fisher and Pry model suggests that the new product will reach 10 % market penetration, eventually achieving full market penetration after completing its full cycle. The Fisher and Pry model generates an S-shaped growth curve. (Tseng et al, 2009; Wang and Lan, 2007; Sohn et al 2008). The model's main advantage is that it is more qualitative than quantitative, which makes it particularly suitable for technological forecasting. The Fisher and Pry (1971) model has been well recognised within technological forecasting, mostly as a technological substitution model.

$$Y_t = \frac{m}{(1 + e^{(-c-bt)})} + \varepsilon_t \qquad \textit{Equation 4}$$

where *m* is the market potential over reference period of time and corresponds to the saturated value of growth; *C* is the scaling coefficient, *b* is a measure of the diffusion speed or how rapidly the adoption progress, Y_t represents the adoption during time period t and e_t is error term.

Kabir et al (1981) suggested that the increasing interest in technological substitution derives from the product lifecycle, as products have a limited duration before the technology becomes obsolete. Every technology provider wants to avoid being technologically surprised by competition. Palmer and Williams (2000) observe that Fisher and Pry is a simple model but extremely effective when utilised to model competitive substituting of one technology for another. The substitution model is based on technological advances which promote competitive substitution and replacement of one technology by another (Tseng et al 2009).

The substitution model follows an S-shaped growth curve. In the early years of growth, when the substitution process begins, the technology demonstrates its advantages over the existing technology. The new technology then starts to take over some of the market, and this is where the substitution rate increases as the technology is substituted for the existing one and growth becomes stable, levelling off as it approaches saturation. The substitution model is very useful for establishing early recognition of technical obsolescence. The Fisher and Pry model will be the model for understanding the advantages of interactive technologies over existing technologies. Wang and Lan (2007) used the substitution model combined with scenarios to understand the substitution of internet access technologies, while Tseng et al (2009) used it in combination with qualitative techniques to understand the OLED TV Market.

Diffusion Models

Diffusion models are generally applied in carrying out forecasts for product lifecycles and purchases (Chu et al, 2009; Chu and Pan, 2008; Sundqvist et al 2005). The best known first purchase diffusion models for new products in the market are those of Bass (1969), Fourt and Woodlock (1960), Mansfield (1961), and Easingwood, Mahajan and Muller (1981). These models played a major role in fitting diffusion processes for a number of industries. By utilising these models, it is possible to establish which stage of its lifecycle the product is in (Michalakelis et al 2008). These methods also make it possible to determine how consumers choose different products. Diffusion models can help technology providers to shape their policies and strategies for production, marketing and finance (Kreng et al 2009).

McDade et al (2010) observe that the diffusion process is purely innovative or purely imitative or a combination of both. Fourt and Woodlock (1960) put forward the Purely Imitative model, which assumed that only external factors such as government incentives, promotions etc. could influence the diffusion process. However, Fisher and Pry (1971) argued that the purely imitative model is limited by an assumption that only internal factors, such as social pressure and word of mouth, influence the diffusion process. The Bass (1969) model inferred that the diffusion process can be influenced by both external and internal factors. McDade et al (2010) suggested that the Bass model is the most powerful and renowned mixed diffusion model. According to Kreng et al (2009), the Bass diffusion model is predominantly applied to the investigation of diffusion patterns and demand forecasting. Since most of the previous diffusion models based on Bass (1969) models assume a monopolistic market, to improve the model Norton and Bass (1987) developed a multi-generation substitute model, which is now used to understand the substitution and diffusion of most high technology products. Meade and Islam (2006) have provided an in-depth study on the innovation of diffusion.

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Rogers (1995) perceived that the growth pattern of new technology generally follows an S-shaped curve. Meade and Islam (2006) revealed that major diffusion models had been established by 1970, and there has been academic interest since the 1960s after revolutionary findings were established by Fourt and Woodlock (1960), Mansfield (1961), Floyd (1962), Rogers (1962), Chow (1967) and Bass (1969).

Bass Model

According to Chu and Pan (2008), Cheng et al (2009), Bass (1969) was the first to demonstrate empirical evidence of the existence of an S-shaped curve for the growth of new durable products. Since then the Bass model has proved its superiority in predicting the growth patterns of many new technologies. For example, Jang et al (2005) applied the Bass model to understand the diffusion of mobile telecommunication in Taiwan, which demonstrated an S-shaped growth. The Bass model articulates the diffusion of innovation and illustrates the different growth phases of launch, growth, maturity and decline.

Interactive technologies occupy a competitive market and continuously compete with each other. They can be described as multi-generation and multi-product interactive technologies inasmuch as several similar interactive products are available, such as WWW, WAP, interactive TV and IPTV, and interrelate with each other. As Chu and Pan (2008) suggest, the relationship between technologies cannot be disregarded; thus the Bass model, which assumes a single product market, is not very suitable.

Norton and Bass (1987) were the first to develop the concept of the multi generation diffusion model, which demonstrated the diffusion and technological substitution of high technology products such as mobile internet technologies. Peterson and Mahajan (1978) introduced the concept of multi product diffusion and explored the market interactions.

The Bass diffusion model has been applied to many products and has provided superior insight into the demand for and growth of the product, although, as noted, the interactive technology market is not a single-product or non monopoly market. When performing a cross-cultural comparison of interactive technology diffusion, the Bass model needs to be parameterised for particular countries.

The general form of the Bass model is expressed in the following equation:

$$Y_t = (P + \frac{q}{m} Y_t - 1)(m - Y_t - 1) + \varepsilon_t \qquad \textit{Equation 5}$$

where *m* is the market potential over reference period of time and corresponds to the saturated value of growth; *P* is the coefficient of innovation; this equals the rate of product adoption when there has been no previous purchases *q* represents the coefficient of imitation which captures the behaviour of future adopters; Y_t represents the adoption during time period t and e_t is error term.

Chu et al (2009) conducted extensive research into the diffusion of mobile telephony in Taiwan by comparing the three leading traditional models so as to determine an appropriate model to apply to mobile telephony. The logistic model was found to be superior, since external influences demonstrated an impact similar to the imitation effect in the Bass model. McDade et al (2010) carried out further study to examine the forecasting accuracy of diffusion models when applied to high technology products innovation among organizational adopters. The research suggested that if the high technology product is revolutionary then the Bass model is more appropriate, as ground-breaking innovation is most likely to display an S- shaped curve diffusion growth.

Local Logistic Model

$$Y_t = \frac{mY_{t-1}}{Y_{t-1} + e^{-q}(m - Y_{t-1)})} + \varepsilon_t \qquad \text{Equation 6}$$

where *m* is the market potential over reference period of time and corresponds to the saturated value of growth; *q* represents the coefficient of imitation which captures the behaviour of future adopters; Y_t represents the adoption during time period t and e_t is error term.

The local logistic curve proposed by Meade (1984) is an additional model which can be used to model the growth of new products. The principle of the local logistic curve is to produce the forecast of market development from the last observation rather than fitting a global trend. Like the simple logistic and Gompertz curves, the local logistic curve will be estimated using both non-linear least squares and maximum likelihood estimation. This version of the local logistic model was used for human population forecasting by Meade (1984) and to forecast telecommunication markets by Meade and Islam (1995).

Log Logistic Model

Tanner (1978) first used this model. The replacement of time by ln(t) in the log-logistic curve means that the curve is asymmetric about its point of inflection which occurs before the growth reach half of the saturation level, m/2.

$$Y_t = \frac{m}{1 + ce^{-b\ln(t)}} + \varepsilon_t \qquad \text{Equation 7}$$

where *m* is the market potential over reference period of time and corresponds to the saturated value of growth; *b* is a measure of the diffusion speed or how rapidly the adoption progress, Y_t represents the adoption during time period t and e_t is error term.

To improve the diffusion models further and understand the interaction between the two competing species in a competitive market, the Lotka-Volterra equation was developed based on a logistic curve (Kim et al 2006; Kreng et al 2009). Various studies applied the Lotka-Voltera equation; for example Modis (1999) used this model to analyse behaviour between common stock bonds, as if they were competing for investors' resources; whereas Maurer and Huberman (2003) adopted the Lotka-Voltera equation in order to understand the competitive dynamics of websites and how they affect the market. Kreng et al (2009) used the same equation to examine the competitive relationship between PDP TV and LCD TV.

Adopting diffusion models to forecast the future of interactive technologies will be useful for understanding which phase of the product lifecycle the technologies occupy. Many other scholars have used diffusion models to forecast the future; for example, Chu and Pan (2008) adopted them to forecast the future of mobile internet. Kreng and Wang (2009), for their part, utilised the model to understand the potential of CRT and LCD TV. Wu and Chu (2009) used it to develop a diffusion model for mobile telephony and Kim et al (2006) further employed it to perform a dynamic competition analysis of the mobile phone market.

Anderson et al (2008) and Yoo and Moon (2006) suggested that, according to the literature, the use of different statistical methods helps to improve the quality of the forecast and prevent false assumptions.

3.3.2 Qualitative Methods

Qualitative methods, also known as Judgement-Based Technological Forecasting Techniques, are used when there is little or no qualitative data available. In past years interest in judgemental approaches has grown. Lawrence et al (2006) concluded that, while initially judgemental forecasting was considered an enemy of accuracy, judgement is now recognised as an indispensable element of forecasting. Much research has been performed to understand and improve its use. Since new products have no historical data, companies seek means of forecasting sales figures before these products enter the market. In this case, judgemental methods are among the best ways of doing the forecasting. Empirical research suggests that the most practical forecasting has a strong judgemental component (Lawrence and O'Connor, 1992). This method is based on the belief that human judgement, combined with an appropriate degree of help and structure, offers the best option for predicting the impact of the change. In other words, imagination, together with individual talent, knowledge, foresight and judgement, are required to predict long-term changes effectively. The advantage of using this approach is that, being human-based, it can identify systematic change relatively quickly, and interpret easily the effect of such change on the future. However, the disadvantage is that the human decision might be biased. Various formal techniques have been devised to help remove personal bias and oblige forecasters to consider all the factors involved in the forecast. There are a number of judgemental forecasting techniques which can be utilised. The following section summarises the techniques available and their application to interactive technologies.

Scanning & Monitoring

Scanning and monitoring allow forecasters to evaluate the technology as it is being developed. Scanning and monitoring techniques are quite similar although scanning is more generalised whereas monitoring is more focused on a specific area. The forecaster is required to analyse various examples of technical and scientific literature to understand the technology and its potential for growth. Martino et al (2003) stated that observing and monitoring the technology innovation at its early stages may provide useful insight for shaping its future. Although the scanning and monitoring technique may seem unsophisticated, it has considerable potential value if all data are collected and analysed properly, enabling the data to be further utilised to forecast trends. Meredith and Mantel (1995) claimed that scanning and monitoring had the advantages of being its unsophisticated, less expensive than other methods and a good initial technology forecasting technique. However they also believe that scanning and monitoring are very time-consuming, requiring the review of a great quantity of material. It would seem that scanning and monitoring cannot be utilised to forecast the future of interactive technologies because of being so time-consuming and because all the documentation that would need to be monitored and scanned might not be available.

Scenarios

Scenario forecasting technique consists of a hypothetical view of the future based on past experience. The method has been employed since the 1960s to project future developments (Tseng et al 2009). It generally produces three scenarios. The first describes the future as it is expected to be if current trends continue; this defines a base for further scenarios. The other two scenarios usually describe optimistic and pessimistic futures based on assumptions about the environment that differ from the first scenario, giving respectively a positive and negative outlook. Scenarios are useful when forecasting the adoption of technological change. When developing them it is vital to identify the organizational, economic, social, technological, and political variables that can affect the forecast. Bell et al (2004) believed that construction of scenarios can provide a valuable starting point from which to carry out forecasting, and that they allow the implementation of any required controls. Martino et al (2003), Wang and Lan (2007), and Tseng et al (2009) suggested that scenarios can be combined with other forecasting techniques, as substitution models and Delphi will improve the quality of the forecasting.

Meredith and Mantel (1995) considered scenarios a useful aid in understanding the present and developing a plan of action for the future. According to Lemos and Porto (1998), even though the scenario approach is not a formal technique, it helps to identify threats to and opportunities for the business; but they felt that the method does have some drawbacks, namely, being overly general and too expensive to carry out. In addition, Tseng et al (2009) believe that scenarios are unable to provide clear quantified information about the forecasted market share of the new technology.

Prediction Markets

Prediction market has similar characteristics to Delphi as they both are structured approaches that aggregate diverse opinions from groups. Green et al (2007) addresses that Prediction markets are gaining attention in various fields of forecasting. Wolfers and Zitzewitz (2004) and Graefe et al (2010) suggest that Prediction markets go beyond simple forecasting and can contribute to foresight by providing advantages in terms of continuous and real time information aggregation. The participants of this forecasting technique are motivated by incentives therefore this improves the quality of the forecast. Also Participants do not have to be selected and recruited manually by the facilitator. This method of forecasting is described to easy to implement and cost efficient approach to continuously provide new information in forecast. Although Prediction Market is more suitable for forecasting over a long period of time. (Graefe et al 2008 and Salo et al 2003)

Delphi Methods

The concept of the Delphi forecasting technique was adapted from Greek mythology who introduced the Delphic oracle who could predict future events (Buckley, 1995). Humans have many traits and one of them is to question the future. The Delphi method incorporates this human trait and allows experts to predict the future by means of educated guesswork (Buckley, 1995). The Delphi method is now widely used to forecast developments in technology, education, health care, the travel and tourism industry and many other fields; for examples see Adler and Ziglio (1996) and Bradley and Stewart (2003).

Delphi in Theory and Practice

Initially the Delphi method was developed and used in 1944 for technology forecasting studies as exemplified by Cornish (1977). In the 1950s the Rand Corporation formalised the concept of Delphi method forecasting with the help of Delphi pioneers Olaf Helmer and Norman Dalkey, both of whom were involved in standardising theoretical assumptions and methodological procedures to overcome any ambiguity.

Delphi forecasting focuses on the use of expert opinion. Linstone and Turoff (1975) gave the following definition:

> "Delphi may be characterised as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with complex problem."

Adler and Ziglio (1996) and Mullen (2003) described the Delphi method as a structured process for collecting and filtering knowledge from the experts by the use of a series of questionnaires and controlled constructive feedback. The method is used to pose various research questions under many different conditions and in a multitude of sectors (Steinert, 2009). It has established itself among the standard techniques for accumulating, pooling and appraising expert opinions. As such, it has been widely employed in tackling research questions.

The Delphi method involves conducting a series of structured or unstructured questionnaires submitted to experts through several rounds until a consensus is achieved by the expert panellists (Bradley and Stewart, 2003) and Mullen (2003). According to Delbecq et al (1986) , the first round of the Delphi study is usually a general discussion of the area of study. The results from this round are collated to produce a summary of the findings. Then in the second round a summary of the results, with the original or updated version of the questionnaire, is sent to the panel of experts, who are further requested to provide feedback on the findings and are invited to confirm or modify their opinions, especially in the case of those with a deviating view. Delphi study generally comprises a series of rounds, with feedback provided to the experts between rounds, ensuring that their responses are kept anonymous. Rowe et al (1991) argued that feedback increases the level of information and allows further convergence of opinions toward a consensus.

According to Nielsen (2007), the panellists are usually individuals with relevant knowledge and expertise in the field, who, through answering the questionnaire over a series of rounds, should be encouraged to think out of the box, thus generating innovative and creative ideas as they acquire a greater understanding of the research topic.

Prendergast and Marr (1994) noted that the final round of the Delphi study allows the participants either to agree or to disagree with the consensus. Rowe and Wright (1999) identified three key aspects of the Delphi study: ensuring that the expert panellists' responses are anonymous between rounds, controlling feedback, and presenting a group response rather than results from individuals.

There are three main types of the method: Classic, Policy and Decision Delphi. The three types have overlapping characteristics, but the major difference lies in the focus on the research topic. Classical Delphi mostly focuses on forecasting future developments. Policy Delphi is usually referred to as a Strategic Planning and Public Policy, according to Gordon (2004), as it is mostly used to generate new policies for the purpose of achieving desired goals and eliminating any undesirable consequences. This type of Delphi is usually employed in the areas of social science and politics (Nielsen et al 2007; Gordon, 2004). Van Zolingen and Klaassen (2003) suggested that Decision Delphi allows all relevant decision makers to engage in improving the quality of a decision which may be used to resolve social issues.

One of the strongest features of the Delphi process is that the participating experts stay anonymous and any coordination and communication among them is prohibited. Anonymity removes complications such as status, power, strong and dominant personalities and group pressure which might otherwise arise during the Delphi process (Charlton et al 1981).

Criticism of the Delphi Method

The Delphi method has received criticism as well as support. Helmer (1977) described it as a valuable communication tool which allows experts to form a group judgement which provides compelling consensus on the Delphi topic. But Delphi results are used more as an indication of the potential issues or objectives rather than as a forceful instructive guide to the problem. The technique facilitates expert discussions while eliminating certain social interactive behaviour that may hinder the final consensus. Since the Delphi process depends on the selection of experts, one of the most commonly expressed criticisms of the method is: how do you determine who your experts are? Baldwin (1982) suggested that because of the scarcity of scientific knowledge, the decision is based purely on the selectors' perception and instinct. Tetlock (2005) carried out extensive research on the experts of Delphi and concluded that experts lack of accuracy in forecasting. Sackman (1974) and Armstrong (1978), supporting Sackman's criticism, agreed that the Delphi methodology is unscientific, comparatively unreliable and deficient in statistical and sampling methods. Steinert (2009), Woudenberg (1991), Martino (1993), Kaynak et al (1994) and Mitchell and McGoldrick (1994) all maintained that the Delphi method should be employed only if no other technique or model can be applied to the complex problem and a more judgemental analysis is required. However, Helmer (1977) stated that the use of intuitive judgement is not only to be used as a temporary measure but may be a mandatory requirement.

Makridakis and Wheelright (1978) and Martino (1993) summarised many complaints and concerns about the Delphi method: for example, the possibility that some experts might be poor forecasters, plus the difficulty of weighing their level of expertise. Other concerns involved data sensitivity and possible manipulation during each round in the hope of achieving the desired consensus. Also, if the Delphi survey is executed poorly, the participants' level of attention may decline.

Combining quantitative analysis with the Delphi method makes it possible to increase forecasting power (Nielsen, 2007). However, Linstone and Turoff (1975) suggested that the weakness of Classical Delphi lies in its failure to take trends and events into consideration during the forecasting process. The use of Cross Impact analysis can help to overcome this problem and improve the quality of the forecast by considering the probabilities of events. Gordon (2004) gave an example of this technique, used by the United Nations, in which the expert panel were able to change the scenarios and take the consequences into consideration.

Trend Impact Analysis is another quantitative method that can be combined with the Delphi technique. Most quantitative methods assume that past development will continue in the future. By contrast, Trend Impact Analysis injects various events, with the probability of their recurrence, into the forecast, thus shifting it away from expected trends. Developments such as technological, political, social and economic trends are taken into account, as observed by Gordon (2004) and Nielsen (2007). There have been many poorly conducted Delphi projects according to Goldschmidt (1975), although many studies have supported the method, e.g. Ament (1970), Wissema (1982) and Helmer (1983).

When Basu and Schroeder (1977) performed a Delphi study to forecast five-year sales figures, the Delphi result showed a smaller level of error than quantitative methods when compared to actual sales figures. To improve the Delphi method, cross impact analysis has been added as an extension to it.

The Delphi Method in Interactive Technology Forecasting

Anderla (1973) demonstrated his success in forecasting by the use of Delphi method. In 1970 he made many predictions regarding the development of information technology. Some of the predictions were:

- Electronic data processing will evolve to become more complex and will depend on the telecommunication network.
- By the end of the 1970s the technology required to produce automated information systems for the industry will exist.
- The price of the automated systems will decrease rapidly as the cost of manual data handling rises. He used a mathematical model to show that this would happen around 1978.
- After this turning point, he suggested, the growth of automated system would increase by 30% per year.

However, when forecasting in 1970 he underestimated technological advances such as the development of the silicon chip, and so did not expect that microcomputer technology would overtake the mainframes. Anderla (1973) also assumed that technological innovations in hardware, software, peripherals and telecommunication would occur between 1980 and 1990, whereas it actually began between 1975 and 1985. In addition, he foresaw government intervention in the development of information communication technologies, which had an impact on the information technology industry. Koskiala and Huhtanen (1989) reported on another Delphi study undertaken by Ryden (1971) to predict the future of libraries. The Delphi study predicated that microfilm and microfiche would be the main carriers of information in the 1970s. In 1980 there would be a major advance in online database systems on large mainframe computers, which would then be the main source providers. It was also predicted that transmission and storage of graphic information would begin after 1985. The Ryden (1971) forecast seemed accurate and reasonable as there were no major developments in information technology for library systems until a later date. Williams (1988) envisioned that

> "New products would continue to be developed, their integration with other products and services was equally significant. The major changes in technology affecting information users would relate to increased transparency of systems and include new storage media and devices as well as new processing and display technology."

(Koskiala and Huhtanen (1989) The Finnish Delphi Study: Forecasting the extent of information technology in libraries in 1996 and 2000)

According to Koskiala and Huhtanen (1989), most of the technology forecasting already undertaken stressed the importance of considering economic factors as well as recognising new technological advances and inventions. The Finnish Delphi study took place between 1987 and 1988 to predict the future development of information technology in libraries and information services in Finland. The later study by Koskiala and Huhtanen (1989) forecasted the development of information technology usage in libraries in 1996 and 2010. Most of the forecasts made had already become true in 2006–2008: for example, in regard to reading and browsing electronic professional journals for work-related information gathering. It was predicted that the total usage of this service in 2010 would be 93%.

This Chapter has given an overview of various quantitative and qualitative forecasting techniques and put forward methods which can be used to forecast the growth of interactive technology. To understand further how technology is adopted, various technology acceptance models have been developed. The next chapter will provide an extensive review of the models most frequently employed for the purpose of understanding technology adoption.

Chapter 4 Literature Review Adoption

4.1. Introduction

Adoption refers to the stage at which a technology is selected for use by an individual or an organisation (Rogers, 2005). Diffusion refers to the stage at which it spreads into general use and application. Integration indicates a sense of adoption within user acceptance. Adoption of new technology is affected by many factors; for example, technical infrastructure, the cultural attitude and social pressure to new technology, the radicalism of the technology, its ease of use and its cost. (Gong, 2009; Castaneda et al 2007; Hassanein et al 2007; Singh et al 2003; Lu et al 2005; Slowikowski and Jarratt, 1997 ; and Hsu and Lu, 2004). Many theoretical models have been proposed to determine how to analyse the significance of these factors for technology adoption. (Moon and Kim, 2001; Saaksjarvi, 2003; Kim et al 2007; Maldifassi et al 2009 and Choi et al 2008) The purpose of this study is to establish a generic technology acceptance model for interactive technologies such as WWW, WAP and iTV. To develop a solid theoretical research framework, this chapter will review the relevant literature and provide an extensive study of the technology acceptance models most frequently employed in determining the technology adoption of information systems.

4.2. Adoption Process

The Diffusion of Innovation (DOI) theory (Rogers, 2005) clarified how adoption takes place over time within a social system (Gong, 2009; Hassanein and Head, 2007 and Singh et al 2003). Rogers (2005) defines Diffusion of Innovation as the process by which an innovation is communicated through certain channels over time among the members of a social system and Innovation as an idea, practice or object that is perceived as new by an individual or another unit of adoption.

The diffusion of innovation theory tries to explain the innovation decision process, the factors contributing to the rate of adoption and the different categories of adopter. (Lee et al 2009 and Zhu and He, 2002) It assists in predicting the likelihood and rate of adoption of an innovation. Rogers (2005) described adoption as a normal distribution based on timing of adoption. DOI Theory allows diffusion analyses to be carried out on the individual level or the social system level. Chen et al (2002) observed that Rogers's (1962, 1983, 1995) diffusion of innovation model is one of the theories most frequently applied in subject areas such as anthropology, sociology, education, communication and marketing. As Gong (2009) showed, the factors can contribute to further analysis:

> "These factors can be used to compare the adoption rates of different innovations as well as the relative extent to which an innovation is adopted within communities, countries, or other social units of different economic, demographic and cultural characteristics."
>
> (Extracted from Gong, 2009, "National Culture and Global diffusion of business t consumer e-commerce" Cross Cultural Management: An International Journal. Vol. 16 No. 1 PP. 86)

Parker and Castleman (2009) pointed out that the DOI theory is an over arching framework which seeks to clarify the social and relational elements of innovation diffusion and how it transpires over a period of time in the social system. Rogers (1983) focused on four significant elements that influence the rate of adoption of an innovation. These are the innovation, the social system, the communication channels and time. Parker and Castleman (2007) argued that, according to Rogers's concept, e-commerce is more of a technology cluster than an innovation, since it contains various services and applications e.g. online banking, online information, shopping and booking services. Rogers (1995) presented several adoption/diffusion theories. These are now outlined:

Innovation Decision Process theory – This theory proposes that the prospective adopters of technology innovation over a given period of time go through five phases of the diffusion process which are Knowledge, Persuasion, Decision, implementation and Implementation and Confirmation.

Individual Innovativeness theory – This theory applies to those individuals who are risk takers or otherwise innovative who will adopt an innovation relatively early in the process of adoption/diffusion (Rogers, 1995).

Rate of Adoption theory – This theory accounts for the rate of adoption, measuring the diffusion taking place over time with innovations accumulating through a slow, gradual growth period, followed by dramatic and rapid growth, gradual stabilization and final decline (Rogers, 1995). According to Rogers (1983), the adoption rate of an innovation is affected by innovation characteristics, the successful marketing of the innovation's benefits through appropriate communication channels, the time elapsed since the introduction of the innovation, and the social system in which the innovation is to diffuse.

Mahajan et al (1990) argued that the main focus of DOI theory is on communication channels. Social influences rely on media, interpersonal channels or nonverbal observations to obtain information about a new innovation. The Rate of Adoption theory, an S-curve representing the rate of adoption of an innovation over time, is depicted in Figure 4.1.

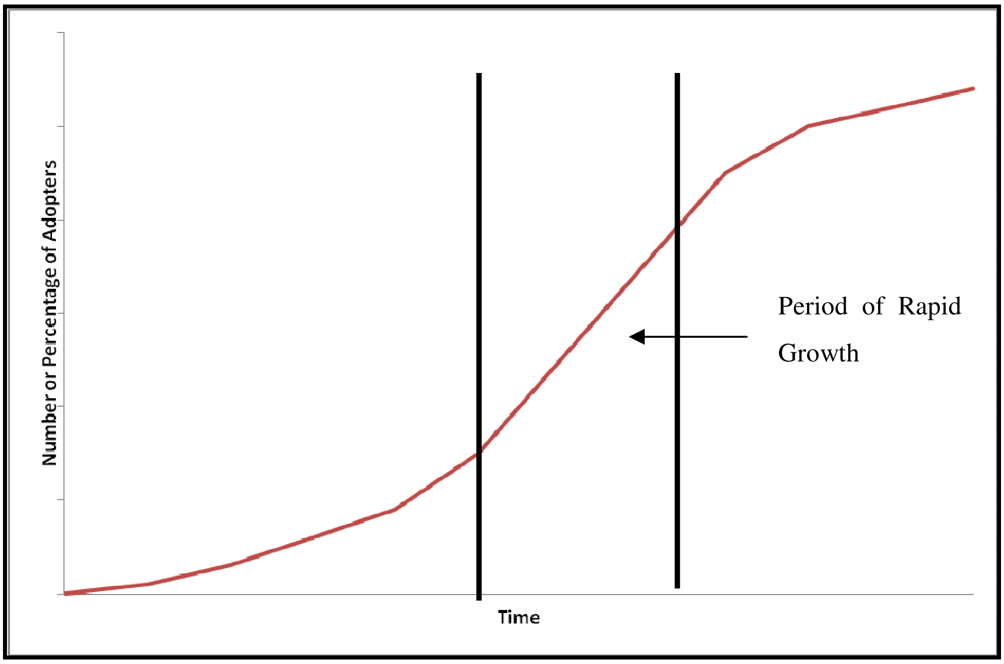


Figure 4.1 Rate of Adoption Theory (Rogers, 2005)

Extracted from Rogers , E.M., (1995). "Diffusion of Innovations" The Free Press, New York. PP. 106

Perceived Attributes theory: This theory suggests that there are five attributes which allow innovation to be considered. These are Trialability, which permits the innovation to be tried before it is accepted; Observability, which takes account of the observable results of the trial; Relative Advantage, the advantage of the innovation compared to others; Complexity, or the difficulty of using and adapting to the innovation; and Compatibility, or how well the innovation will be adapted to the adopter's existing life style and circumstances.

Previous research, for example that of Al-Qirim (2005), Ching and Ellis (2004), Chong (2006), Chen et al (2002) and Parker and Castleman (2009), has established that the DOI innovation variables of relative advantage, compatibility, complexity, trialability and observability can explain 49-87% of the variance in the rate of adoption of e-commerce applications.

Individual Innovativeness theory: According to this theory, there are five categories of potential technology adopters. In the first category are the

Innovators, those individuals who tend to adopt the technology earliest. They are described as experimentalists with a general interest in new developments (Gong, 2009). Next come the Early Adopters, technically knowledgeable individuals who are interested in technology for resolving professional and academic problems. These pragmatic individuals comprise the first mainstream of adopters. The Late Majority are less comfortable with the innovation and form the pessimistic second half of the mainstream. Finally, the laggards are the individuals who may never adopt the technology. The Individual Innovativeness theory is displayed in Figure 4.2, which shows the bell-shaped distribution of Individual Innovativeness and the percentage of potential adopters who fall into each category.

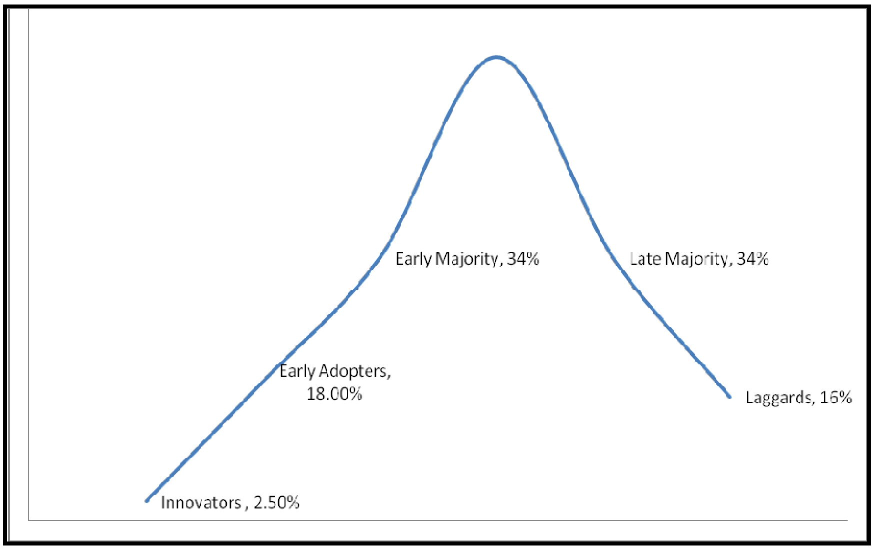


Figure 4.2 Individual Innovativeness Theory

Extracted from Rogers, E.M., (1995). "Diffusion of Innovations" The Free Press, New York. PP. 262

Information systems implementation is expensive and has a relatively low success rate (Legris, 2003). Hossain (2009) and Lee (2003) observe that lack of technology user acceptance can lead to severe financial loss. Companies need to invest in new innovations for many reasons such as cutting cost, producing more without increasing cost, decreasing infrastructure cost and simply improving service and products in order to stay in business. During the past three decades, extensive research into information systems has yielded a better understanding of the technology adoption process and its outcomes. Therefore it is important for the major information technology providers to identify clearly which factors will contribute to the user adoption and success of the new innovation (DeLone et al 1992). Succi and Walter (1999), Davis et al (1989), and Venkatesh and Davis (1996) stress that the user's attitude has a significant impact on the acceptance and success of new technology. Therefore it is necessary to identify the factors that contribute to the technology's acceptance. Global interactive technology companies urgently need to understand why particular countries are more willing than others to adopt interactive innovation, especially where developing countries are concerned. Gong's (2009) findings show that high context and polychromic, relaxed cultures are more likely to acclimatise to the adoption and diffusion process of B2C e-commerce. It is critical to understand the underlying factors affecting the adoption process for interactive applications across countries.

A number of studies have been undertaken to examine interactive technologies and services such as WWW and WAP. Lu et al (2005), Agarwal and Karahanna (2000), Castaneda et al (2007), Schierz et al (2010), Chang, (2010) and Ma and Liu (2004) established that there are many profiles of interactive technology users and have ascertained many underlying factors which permit the identification of individuals who will adopt these technologies and services. However, only limited research has been carried out to establish an overall model which can be applied to any interactive application such as iTV.

4.3. Theoretical Framework

There have been a number of studies, utilising different theoretical models, which seek to understand and explain the factors contributing to improved user acceptance of information technology. Cheung et al (2005) carried out an extensive review of research done between year 1994 to 2002 on technology adoption and adopter profiles. It was concluded that Theory of Perceived Behaviour (TPB) e.g. Ajzen, 1991; Mathieson, (1991), Decomposed Theory of Perceived Behaviour (DTPB) e.g. Taylor and

Todd, (1995), Theory of Reasoned Action (TRA), Diffusion of Innovation (DOI) and Technology Acceptance Model (TAM) e.g. Davis, 1989; Davis et al (1989) are the most dominant models for determining acceptance of information technology and services. These models are all valid for discovering the individual's acceptance of new information systems (Hung and Chang, 2005; Shin , 2007; Li et al 2008; Lee, 2009; Gumussoy et al 2009; Chung et al 2010 and Lai et al 2005).

Many researchers have examined the relationships among perceived ease of use, perceived usefulness, attitude and usage of information systems (Ramayah et al 2009; Al-Somali et al 2009; Wei et al 2009; Adams et al 1992; Bagozzi et al 1992; Chau, 1996; Davis et al 1996; Gefen et al; 1997, Mathieson, 1991; Straub et al 1995; Szajna, 1996; Taylor and Todd, 1995; Yang and Mason, 1998; Leaderer et al 2000). Porter's (1980) model, Resourced Based Theory (RBT), is another theory to consider when predicting behavioural intentions (Parker 2009).

Gong (2009), Choi et al (2008), Lu et al (2005), Alsajjan and Dennis (2010), Maldifassi et al (2009) and Durkin (2008) stated that many other consumer and infrastructure characteristics, cultural and environmental influences need to be considered when determining user acceptance and adoption of information technology. There has also been limited research on factors contributing to technology acceptance in developing countries, previous research having focused mostly on western and developed countries. The following sections will examine the characteristics of each model in detail and explore and determine its impact on user acceptance of interactive applications.

4.3.1 Theory of Planned Behaviour (TPB)

TPB, Decomposed TPB and TAM are all extensions of the original model, the TRA proposed by Fishbein and Ajzen (1980). TRA indicates that an individual's performance is determined by his or her behavioural intentions. It describes four attributes: behavioural attitude, subjective norm, behavioural intention and actual usage, as shown in Figure 4.3. Shih (2004) and Shin and Fang (2004) are authors associated with these concepts. The TRA model implies that an individual's social behaviour is motivated by the person's attitude and subjective norm towards the behaviour (Suh et al 2002; Ma and Lui , 2004; Alsajjan and Dennis, 2010; Cheng et al 2006; and Li et al 2008).

Shih (2004) and Lopez-Nicolas et al (2008) defined Attitude as the positive and negative feelings of an individual, as influenced by the individual's belief concerning a specific behaviour.

Parker and Castleman (2009) described the TPB as composed of three external variables (attitude, subjective norm and perceived behavioural control). The theory explains a user's intention to adopt the technology. As Harrison et al (1997) analyse it, if no additional environmental events occur and the individual has control over the decision then the intention to adopt the technology can lead to actual adoption.

Subjective Norm describes an individual's perception of whether people important to them consider that the behaviour should be performed. It takes the person's normative beliefs into consideration (Shih and Fang, 2004; Lee 2009). Triandis (1971) stated that when the behaviour is new then Subjective Norm plays an important role as it has greater influence on actions. Thompson and Higgins (1994) argued that in the early stages of adoption, the beliefs of individuals having little or no experience of the new innovation are greatly influenced by the opinions and beliefs expressed by innovators and other reference groups such as family, friends, colleagues, managers, etc. Normative pressure applied by such groups diminishes the perceived risks of adoption.

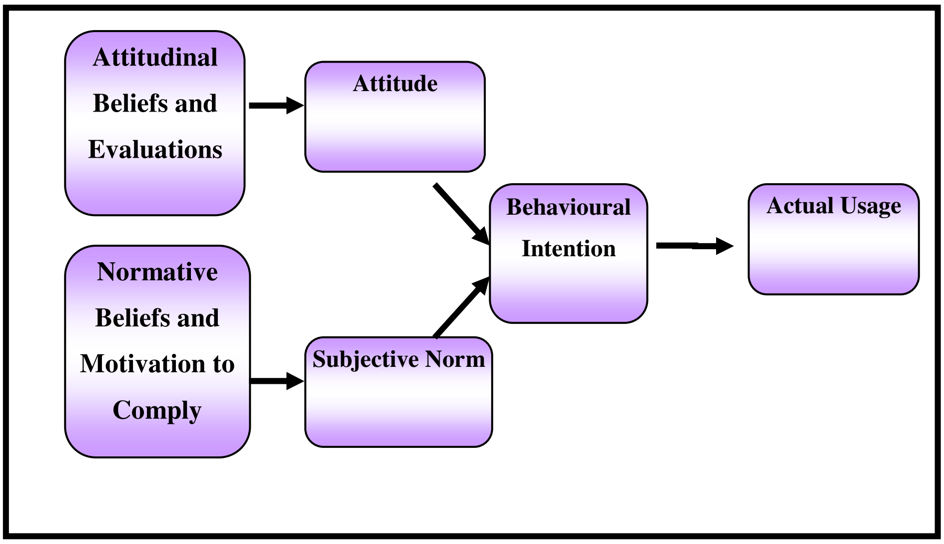


Figure 4.3 Theory of Reasoned Action (TRA)

Extracted from Ajzen, 1991, 'The Theory of Planned Behavior', Organizational Behavior and Human Decision Processes, vol. 50, no. 2, pp. 179-211.

Ajzen and Fishbein (1985, 1991) further extended the TRA model to include perceived behavioural control as a determinant of behaviour known as TPB. According to Ajzen (1991), Perceived Behavioural Control takes into consideration access to the resources and opportunities which may influence the individual's beliefs.

Shih and Fang (2004), Gefen et al (2003); Hsu and et al (2006); Wu and Chen, (2005) stated that in both the TPB and TRA models, behaviour is a direct function of behavioural intention, which is determined by attitude and subjective norm, although the addition of perceived behavioural control accounts for circumstances in which the individual has no control over his or her behaviour. The model of TPB is shown in Figure 4.4.

TPB is useful in understanding how to change people's behaviour, which Ajzen (1988, 1991) suggested can be planned. TPB helps to predict intentional behaviour, while recognising, as observed by Hung and Chang (2005), that under certain conditions behaviour contains non-volitional characteristics. Hung and Chang (2005) summarised some of the key features of TBP as follows:

- "TPB includes the possible influences of perceived behaviour control on behaviour intention and actual behaviour."
- "Behaviour intention and perceived behavioural control can directly affect behaviour."
- "Attitude and Perceived behavioural control both determine behavioural intention"
- "In the early IT implementation phase, the factor (subjective norm) is important for users with limited direct experience" as stated by Hartwick et al (1994)
- "Monolithic belief sets in TPB may be inconsistently related to the three determinants of intention and thus may be difficult to operationalise" as stated by Taylor and Todd (1995)

Behaviour can also be directly affected by behavioural intention and perceived behavioural control, an observation supported by a number of studies including Ajzen (1991), Madden et al (1992), Sparks et al (1992), Chen and Chao, (2011), Hsu et al (2006), Huh et al (2009) and Ajzen and Madden (1985). Behavioural intention is determined by attitude and perceived behavioural control.

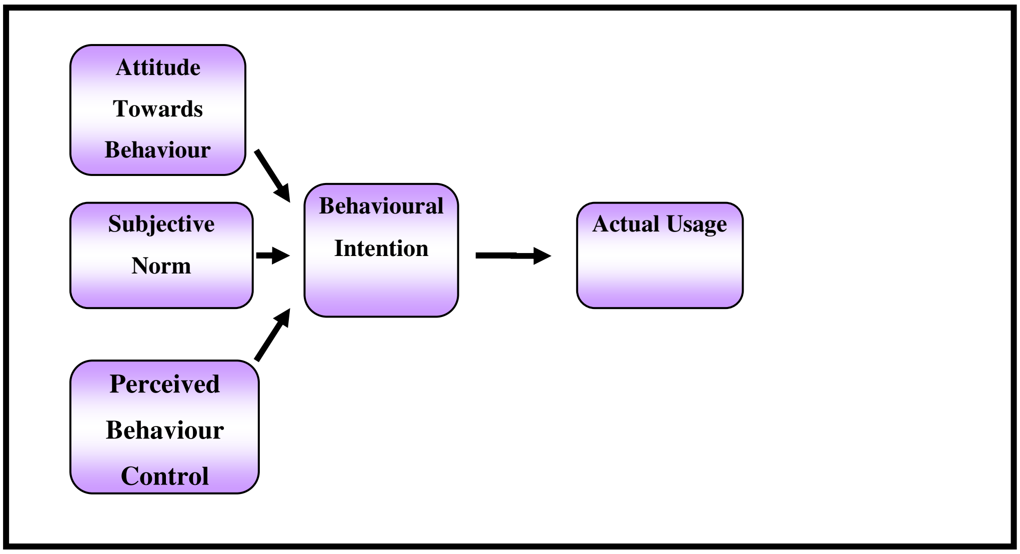


Figure 4.4 Theory of Planned Behaviour (TPB)

Extracted from Ajzen,1991, 'The Theory of Planned Behavior', Organizational Behavior and Human Decision Processes, vol. 50, no. 2, pp. 179-211.

Both TRA and TPB are widely used models in social psychology to explain and predict cognitive and affective behaviour by using the belief, attitude, intention and behaviour relationship model (Shih, 2004; Chen et al 2007). Davis (1989) adapted the Theory of Reasoned Action (TRA) model and proposed the Technology Acceptance Model (TAM) to assess and predict user acceptance of information systems (Suh et al 2002).

4.3.2 Technology Acceptance Model (TAM)

TAM was originally proposed by Davis et al (1989). Since then, TAM has gained popularity among many scholars and researchers. It is widely used to predict individuals' acceptance behaviour across various information technologies and their use; see for example Adams et al (1992), Chin and Todd (1995), Doll et al (1998), Mathieson (1991), Segars and Grover, (1993), Kim et al (2009), Davis (1996) and Straub et al (1997). A number of literatures, notably Adams et al (1992), Agarwal and Prasad (1997), Gefen and Straub (1997, 2000), Hendrickson et al (1993), Igbaria et al (1997), Szanja (1996), Gefen et al (2003) and Gefen and Keil (1998), Gefen et al (2003); Hsu and et al (2006); Wu and Chen, (2005) have demonstrated that the TAM model is applicable to a wide range of technologies.

TAM is believed to be robust, parsimonious and influential in explaining IT/IS adoption behaviour, and so is one of the major models used in determining the factors having an impact on user acceptance and use of information technology systems (Kim et al 2009 and Suh et al 2002). Davis et al (1996) developed the TAM to explain the effect of user perception of system characteristics on acceptance of the information technology systems. The original TAM explained the causal relationships between internal psychological variables such as beliefs, attitudes and behavioural intention and actual system use.

Davis's (1989) original TAM contained only two factors determining the use of an IT system: perceived ease of use and perceived usefulness (Suh, 2002; Davis, 1998; Grandon and Pearson, 2004). The TAM showed that an individual's perception of the usefulness and ease of use of IT are positively associated with the attitude towards employing the IT. This eventually leads to acceptance and use of the technology (Kim et al 2009), as shown in Figure 4.5.

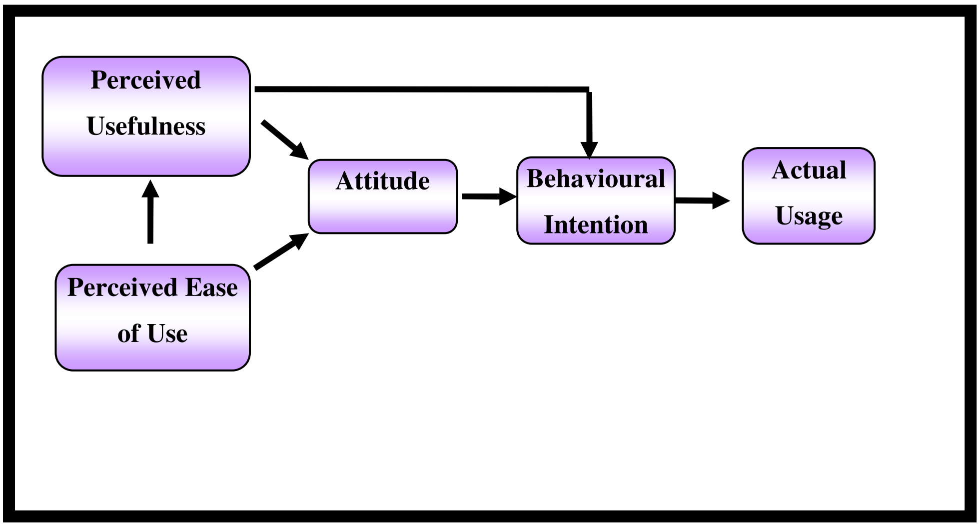


Figure 4.5 Technology Acceptance Model (TAM)

Extracted from Davis et al (1989) User acceptance of computer technology: a comparison of two. Manage Science Vol. 35 No.8 PP. 982–1002.

Davis (1989) defined perceived usefulness as the degree to which a person believes that using a particular system would enhance his or her job performance and perceived ease of use as the degree to which a person believes that using a particular system would be free of effort.

In the TAM, perceived usefulness is considered the primary factor compared to perceived ease of use in determining information system acceptance and usage (Shih, 2004), whereas Davis's findings showed that perceived ease of use is positively associated with perceived usefulness and has an indirect impact on the usage and acceptance of information systems (Davis, 1989 and Shih, 2004). Davis and Bagozzi (1989) also found that perceived usefulness has a positive although indirect effect on attitude. According to Hung and Chang (2004), the TAM excludes the influence of social norms and perceived behavioural control on behavioural intention.

Davis's (1989) model assumes that the usage of the technology can be determined by behavioural intentions to use it. These intentions are derived from the user's attitude towards the technology and by its perceived usefulness (see also Ahn et al, 2004).

Moon and Kim (2001) has stated that the factors which contribute to information technology updating may vary depending on the technology, the users and the context. Ahn et al (2003) contended that TAM is among the most significant and powerful models examining the acceptance and use of information technology, including the innovation diffusion theory and the theory of reasoned action.

Most research carried out in recent decades has focused on the perceived usefulness and perceived ease of use that allow the determination of individuals' acceptance of information technology systems. Examples are Agarwal and Karahanna (2000), Karahanna et al (1999), Straub et al (1997), Hossain et al (2009), Ramayah et al (2009), Lu and Su (2009), Al-Somali et al (2009), Wei et al (2009) and Venkatesh (2000). Davis (1989) considered perceived usefulness and perceived ease of use the most important underpinning constructs of TAM. There has been extensive research and discussion regarding the relationship between TAM and TRA (Davis et al 1989; Keil et al 1995; Mitchell et al 1993; Rogers, 2005). Karahanna et al (1999) and Taylor and Todd (1995) suggested that perceived usefulness and perceived ease of use are antecedents of use intentions, which facilitates predicting the adoption of a wide range of information systems for experienced and new users. It has been established that Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) have had a direct impact on the adoption of information systems, because of which TAM treats social norms as insignificant (Davis, 1989). Keil et al (1995), however, argued that social norms can affect technology adoption. Chen et al (2008) found in the TAM model an assumption that an individual's beliefs can have opposing effects on adopting new behaviour or technology.

Parker and Castleman (2009) considered both TAM and TPB powerful as they are designed to predict the immediate future regarding the technology's adoption. However, TAM fails to consider complex, significant and interconnected relationship factors, especially social factors, which may prevent technology acceptance, whereas TPB does take account of social factors to some extent through the social norm variable.

As found by Smarkola (2007), Davis (1993) argued that external factors such as self-efficacy, training, and compatibility influence Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). Igbaria et al (1995, 1996) and Karahanna et al (1999) demonstrated the impact of the above-mentioned external factors on PEOU and PU. They implied that there could be many other external factors that influence individual behavior intention and technology adoption. However, Mathieson (1991) pointed out that in previous research TAM has shown more potential than TRA and TPB for justifying attitudes towards using information technology. Chen et al (2002) stressed that TAM is one of the most significant and discussed theories in determining user acceptance and adoption of information systems. Venkatesh and Davis (2000) extended TAM to include variables relevant to social influences and cognitive instrumental processes; the resulting model was labeled TAM2.

Legris (2003) maintained that overall, TAM and TAM2 explained 40% of system adoption, although he also stated that results of the relevant empirical research are not consistent and clear, so significant factors may be absent from the model. TAM is an informative model, but it needs to integrate both human and social variables to increase its explanatory powers.

4.3.3 Decomposed Theory of Planned Behaviour

Taylor and Todd (1995) proposed the Decomposed Theory of Planned Behaviour (Decomposed TPB). This model has decomposed the existing three-belief structure in the TPB model and constructed in its place a multi-dimensional belief structure (Hung and Chang, 2005; Ramayah et al 2009, Ndubisi 2004). Taylor and Todd (1995) argue that profound knowledge of the relationship between the belief constructs and "antecedents of intention" requires that attitudinal belief be decomposed. Teo and Pok (2003) showed that Decomposed TPB analyses and explores the dimensions of attitude, subjective norm and perceived behavioural control by decomposing them and constructing explicit belief dimensions. Shimp and Kavas (1984) suggested that cognitive structures of belief cannot be organised as a singular concept or cognitive component.

Smarkola (2007) observed that the TPB utilises direct assessment of attitude, subjective norm and perceived behavioural control, taking into consideration individual and external constraints to predict the user's behavioural intention. Huang and Chuang (2007) found that the Decomposed TBP decomposes attitude while incorporating additional mediating variables such as compatibility, perceived usefulness and ease of use. Compatibility may act as an antecedent of perceived usefulness and ease of use (Huang and Chuang, 2007; Venkatesh and Davis, 2000; Taylor and Todd, 1995; Lin, 2007; Lu and Su, 2009).

Huang and Chuang (2007), Lee (2009) and Lin (2007) believed that attitude is included in the TBP and TAM models, since it is defined as a fundamental determinant of behavioural intention. Many studies reveal that perceived usefulness and ease of use have a significant effect on attitude; for example, Cheng et al (2006); Lopez-Nicolas et al (2008); Castaneda et al (2007); Yuanquan et al (2008); Keil et al (1995), Mathieson (1991), Szajna (1996) and Taylor and Todd (1995).

Subjective norm is explained by peer influence and superior influence, whereas perceived behavioural control is explained by self-efficacy and facilitating conditions, according to Lu et al (2005); Smarkola (2007) and Lee (2009).

Taylor and Todd (1995) explained that the predictive power of Decomposed TPB for behaviour resembles that of TAM and TPB, increasing it by only 2%. However, the Decomposed TPB is a more complex model. Taylor and Todd suggested that as the TAM model consists of a "parsimonious" construct, it is superior if the aim of the research is to predict information system usage. Conversely, according to Smarkola (2007) and Ramayah et al (2009), if the researchers are seeking broader insight into intentions, they should consider using the Decomposed TPB.

The Decomposed TPB consists of various belief dimensions such as attitude, subjective norm and perceived behavioural control, as shown in Figure 4.6. Taylor and Todd (1995) argued that, based on the Diffusion of Innovation theory proposed by Rogers (1983), attitudinal belief recognises three significant attributes of innovation that influence technology adoption: relative advantage, complexity and compatibility.

Relative advantage refers to the degree to which adopting an innovation will bring economic and social benefits, as well as offering technological improvements that cause the innovation to supersede a precursor. Kim et al (2007) and Tan and Teo (2000) found that relative advantage is positively correlated to the innovation's rate of adoption. As Shin and Fang (2004) demonstrated, the relative advantage of internet banking is that customers can administer their bank accounts from any location and at any time, saving them much time and inconvenience, thus leading to more uptake. Teo and Pok (2003) and Lopez-Nicolas et al (2008) showed that WAP mobile phones also offer advantages over existing laptops and personal computers and can provide internet access through a portable device. Here, too, time and location constraints are removed from internet access so that uptake is facilitated.

Complexity refers to the extent to which an innovation is perceived to be difficult to understand and use (Hernández et al, 2008 and Lu et al 2003). Complexity can be determined from the ease of use. Innovative technologies that are less complex and easier to use are more likely to be adopted by potential users. Davis (1989) suggested that complexity is a significant factor in the technology adoption process. Shih and Fang (2004) commented that the internet comprises "Click and Point" interfaces which are considered to be less complex and highly user-friendly; therefore it is more likely to be adopted by potential users, whereas the majority of WAP-enabled mobile phones consist of small screens and miniaturised keypads which cause problems during internet surfing.

Compatibility refers to the degree to which the innovation will fit the potential user's current needs, existing values and previous experience and skills (see Mallat et al 2009; Wu and Wang, 2005; Lin, 2007; and Lu and Su, 2009). As Tornatzkey and Klein (1982) argued, an innovation is more likely to be adopted if it is compatible with the potential adopter's work and lifestyle. Shih and Fang (2004) emphasized that adoption of an innovation is likely as long as it does not violate the existing cultural and social norms. Individuals who pursue an active lifestyle will be more attracted to wireless technology innovations than individuals with a sedentary lifestyle. Teo and Pok (2003) and Lopez-Nicolas et al (2008) agreed that the adoption of WAP-enabled mobile phones is strongly influenced by an individual's lifestyle, with those whose lives revolve around the internet most likely to adopt such phones.

Shih and Fang (2004), Mallat et al (2009) and Schierz et al (2010) pointed out that individuals who refrain from using the internet will be unlikely to adopt services such as internet banking and Mobile commerce services. Thus compatibility is a highly important factor to consider when assessing technology adoption.

The perceived behaviour control concept is further expanded in the Decomposed TPB to include the following two components: Facilitating conditions and Efficacy. Triandis (1979) observed that "facilitating conditions" refers to the availability of resources required to perform a specific behaviour, for example support for new technological infrastructures to ensure that the technology is easily available. Shin and Fang (2004), Wang and Shih (2009), Cheng et al (2002), Al-Gahtani et al (2007), Au and Kauffman (2008) and Teo and Pok (2003) suggested that the government can play an important educational and leadership role in promoting the diffusion of innovation. It can foster and implement new strategies to ensure that the innovation is adopted nationally. Operators of the innovation can also facilitate diffusion by increasing awareness of it through extensive advertising and promotion.

Bandura (1982) viewed efficacy as the perceived capabilities of an individual to organise and execute a particular action or manage a situation. The concept takes the individual's skills and confidence into consideration. Shih and Fang (2004) considered that confident individuals possessing assured skills in the use of information technology, e.g. the internet, are more likely to adopt services such as internet banking. Compeau (1995) stated that an individual with high self-efficacy is more likely to adopt technology innovation than one with low self-efficacy.

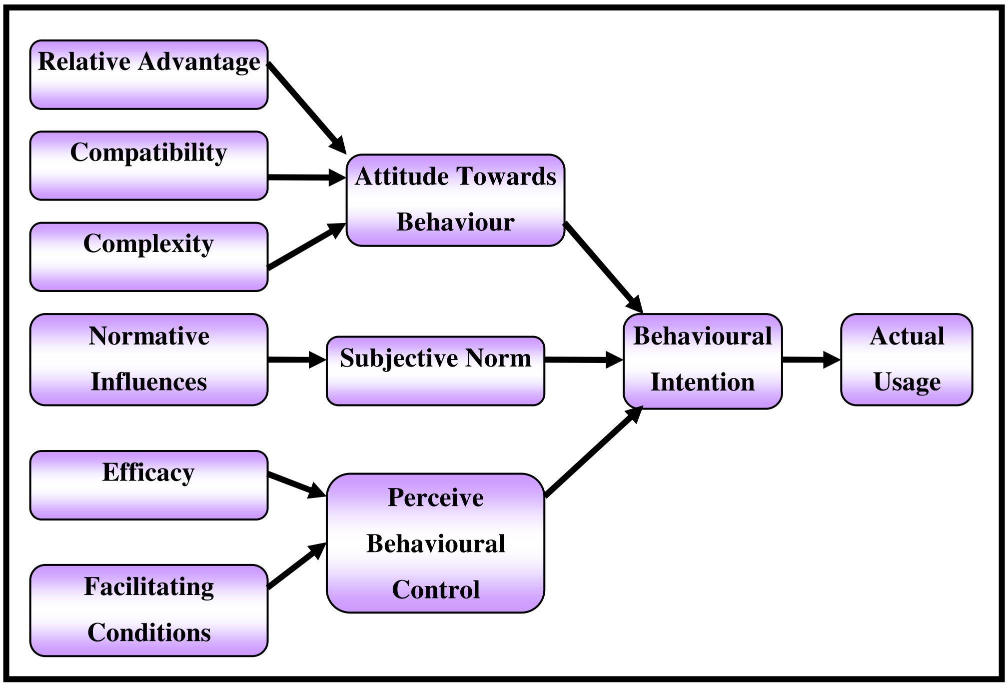


Figure 4.6 Decomposed Theory of Perceived Behaviour

Extracted from Taylor, S., & Todd, P. A. (1996). Understanding information technology usage: a test of competing models. Information Systems Research, 6(2), 144–176.

These features give the Decomposed TPB model substantial advantages, such as increased predictive powers, when compared to TAM and TPB. Hung and Chang (2005), Lin, (2007), Ramayah et al (2009) and Teo and Pok (2003) summarised a number of benefits of the Decomposed TPB as listed below. Decomposed TPB can characterise a number of dimensions for the belief structure which can be related to and give a better understanding of the antecedents of intention, unlike the Monolithic belief structure as proposed in TPB; it can also outline a stable and more precise set of beliefs (Taylor and Todd, 1995). Consideration of a number of belief dimensions can produce a clearer understanding of the stable set of belief structures. Decomposed TPB is less complex and more easily made operational than other models, allowing belief structures to be applied to a wide variety of settings. Compared to TAM, Decomposed TPB provides greater understanding of behaviour and intentions, and so can guide management more effectively by identifying the issues that influence technology adoption and usage (Matheison, 1991 and Smarkola, 2007).

The sections above have examined the leading models developed to explore and understand factors affecting technology adoption. These models examine user acceptance, adoption and usage behaviour. They will now be further studied to understand their applicability to interactive applications, and to ascertain their utilisation and success in predicting the acceptance and usage behaviour of interactive applications.

4.4. Theoretical Models applied to Interactive Technology

Davis (1989) and Taylor and Todd (1995) argued that user acceptance is important in ensuring that the return on the investment is higher than the productivity cost. It is therefore important to determine user acceptance of interactive applications. TAM, TPB and decomposed TPB models can help to discover and understand the acceptance of the technology and have already been applied to interactive applications such as the internet and WAP. Various factors have been identified which contribute to users' adoption of interactive applications. In Table 4.1 earlier research carried out to identify the acceptance of interactive applications and services, and the models applied, are listed. The sections which follow will justify the applicability of these models to interactive applications. For this purpose an extensive review of journals was carried out in order to analyse previous research on interactive applications.

Table 4.1 Previous Research Acceptance of Interactive Applications and Services

Year	Author	Application	Model	Variables
2009	Ramayah et al	Online Trading	Decomposed TBP	Attitude, Subjective Norm, Perceived Usefulness, Perceived Ease of Use, Descriptive Norm, Injunctive Norm
2009	Lu and Su	M-Commerce	TAM	Mobile Skilfulness, Anxiety, Enjoyment, Ease of Access, Usefulness, Compatibility, Mobile Shopping Intention
2009	Al-Somali et al.	Online Banking	TAM	PU, PEOU, BI, Attitude, Quality of Internet Connect, Awareness of Service and its Benefits, Trust, Social Influences, Resistance to Change, Computer Self-efficacy
2009	Lee	Online Trading	TAM,TPB	PU, PEOU, Attitude, Subjective Norm, Perceived Behavioural Control Intention, Trust, Perceived Benefits, Perceived Risk
2009	Wei et al	M-Commerce	TAM	Intention of Use, PU, PEOU, Social Influences, Perceived Financial Cost, Trust
2008	Chen et al.	Online News Services	TAM	PU, Perceived Core service Quality, Perceived Supplementary Service Quality (PSSQ), Trust, Networking, Interface and Subjective Norm
2007	Lin	Shop Online (B2C)	TAM TPB Decomposed TPB	Actual Usage, Behavioural Intention, PU, PEOU, Compatibility, Attitude, Subjective Norms, PBC, Interpersonal Influences, External Influences, Self- efficacy, Facilitation Conditions
2007	Shin	Mobile Internet	TAM	PU, Perceived Enjoyment, Perceived Quality, Perceived Availability, Social Pressure
2006	Porter et al.	WWW	TAM	Age, Education, Income, Race, PEOU, PU, Access Barrier, Attitude and Usage
2005	Wu et al	M-commerce	TAM	Perceived Risk, Cost, Compatibility, Perceived Usefulness, Perceived Ease of Use, BI, Actual Use
2005	Luran et al.	Mobile Banking	TAM	PU, PEOU, Perceived Credibility, Perceived Self- efficacy, Perceived Financial Cost
2005	Hung and Chang	WAP Services	TAM TPB DTPB	User Satisfaction, Personal Innovations, Ease of Use, Usefulness, Peer Influences, External Influences, Self Efficacy, Facilitating Conditions, Attitude, Subjective Norm, BI

Year	Author	Application	Model	Variables
2004	Ahn et al	Internet Shopping Malls (Online and Offline Features) (B2C)	TAM	System Quality, Information Quality, Service Quality, Product Quality, Delivery Service, PEOU, PU, Attitude, BI
2004	Shih	E- Shopping (B2C)	TAM	PEOU, PU, Attitude, User Satisfaction, Web Security, Access Cost, Perceived Information Quality, Perceived Service Quality, Perceived System Quality
2004	Shih and Fang	Internet Banking	TRA TPB DTPB	BI, Actual Usage, Attitude, Subjective Norms, PBC, Relative Advantage, Compatibility, Complexity, Normative Influences, Efficacy, Facilitating
2004	Ndubisi	E-Learning	DTPB	Usage Intention, Attitude, Subjective Norm, Perceived Behavioural Control, Usefulness Perception, Ease of Use Perception, Systems Security, Course Leaders Influence, Computer Anxiety, Training, Computer Self-efficacy, Technological Facilities, Prior Computing Experience
2003	Teo and Pok	WAP Mobile	DTPB	Relative Advantage, Ease of Use, Image, Compatibility, Risk, Significant Others, Self- efficacy, Government, Mobile Operator, Attitude, Subjective Norm, Perceived Behavioural Control
2002	Shu and Han	Internet Banking	TAM	PU, PEOU, Attitude, BI, Actual Use, Trust
2000	Leaderer et al	WWW	TAM	Usefulness Antecedents, Ease of Use Antecedents, Perceived Usefulness , PEOU, System Usage

Early studies examining WAP service acceptance mostly explored the influence of critical factors on user acceptance; for example, Teo and Pok (2003), Lopez-Nicolas et al (2008), Au and Kauffman, (2008), Wu and Wang, (2005), Mallat et al (2009) and Hung et al (2005). Teo and Pok (2003) utilised the Decomposed TPB to determine the acceptance of the WAP mobile. Their research indicated that attitude and social factors rather than perceived behavioural control factors play a significant role in influencing intentions to adopt a WAP-enabled mobile phone. Hung and Chang (2005) conducted a similar study to establish the acceptance of the WAP services. The research showed that TPB and Decomposed TPB are superior to TAM in terms of their ability to explain user acceptance of

WAP services. They also found that the Decomposed TBP model provided more easily understood and managerially significant factors. It was further suggested that TPB was more "parsimonious" and had similar explanatory power to that of the Decomposed TPB model. In studying the acceptance of the WAP mobile phone, Lu et al (2003), Schierz et al (2010) and Shin (2007) utilised the TAM, expanding the existing TAM to include other significant factors which could affect user acceptance of WAP.

Similarly Porter et al (2006) employed the TAM to determine acceptance of the internet. They identified many other significant factors affecting its acceptance, for example, cultural and social status differences, and found that TAM was a useful model. Lederer et al (2000), Cheng et al (2006), Castaneda et al (2007), Chen et al (2008), Lee, (2009) carried out research to establish the technology acceptance of the WWW for undertaking work-related tasks. Their findings supported the TAM model and illustrated that usefulness had a stronger effect than ease of use.

Shih and Fang (2004), Lin (2007) and Ramayah et al (2009) used the Decomposed TPB, TPB and TRA to study user acceptance of internet services such as internet banking. Their findings indicated that, compared to TRA and TPB, the Decomposed TPB model had greater power to explain behavioural intention, attitude and subjective norm than other models. Their results also showed that attitude is the main factor in the Decomposed TPB and TPB models which can explain the intention to adopt internet banking. However, this research also demonstrated that in the Decomposed TPB, only relative advantage and complexity are related to attitude, whereas compatibility is not. Ndubisi and Sinti (2006) only adopted the Decomposed TPB to analyse consumer attitudes towards the system's characteristics regarding internet banking adoption in Malaysia. The results showed that attitudinal factors play a significant role in the adoption of internet banking. Jaruwachirathanakul and Fink (2005) also adopted the Decomposed TPB to study internet banking adoption strategies for a developing country. According to his findings, the attitudinal factors that appear to encourage the adoption of internet banking in Thailand are “Features of the web” and PU, while the most significant impediment to adoption is perceived behavioural control in the form of “External environment”.

Al-Somali et al (2009) further expanded the TAM model to include social influences, computer self-efficacy and many other important factors, his findings clearly suggesting that social influences and computer self-efficacy have marked effects on the PU and PEOU of online banking acceptance. Shu and Han (2002) and Alsajjan and Dennis (2010), again utilising the TAM model, also identified significant factors affecting the acceptance of online banking. Luran et al (2005) used a TAM acceptance model to establish the adoption of mobile banking. Their results strongly supported the extended TAM in predicting users’ intentions to adopt it.

Many studies have been carried out to establish a suitable model for determining the acceptance of e-commerce. Ahn et al (2004) used the TAM model with extended factors to analyse the Online and Offline features of e-commerce. The study showed that online quality has a positive correlation with PEOU and usefulness, while offline quality is positively correlated with usefulness. Shih (2004) and Chen et al (2002) also utilised TAM to analyse the factors promoting user acceptance of e-commerce. Wei et al (2009) used the same model to identify the factors which affect user acceptance of m-commerce in Malaysia. They found that perceived usefulness, social influences, perceived financial cost and trust are positively associated with consumers’ intentions to use m-commerce, but that PEOU and trust had an insignificant effect.

Chang (2008) applied the TAM to determine user acceptance of intelligent agent technology for the automation of auction websites. The study revealed PU as most influential in promoting the intention to use the website. King and He (2006), using 88 published studies, conducted meta-analysis of TAM as applied in numerous areas, the results demonstrating that TAM was a powerful, highly reliable and robust predictive model.

Limited research has been performed on the acceptance of iTV. Choi and Choi, 2003 expanded the TAM model to include TPB variables and many other meaningful factors. However there has been no research on the validity of other models such as TPB and Decomposed TPB.

From the extensive review of the three models (TAM, TPB and Decomposed TPB), it is clear that all are valid means of predicting the relevant intentions and acceptance of interactive applications. In particular, the use of Decomposed TPB can help to understand better the impact of other significant factors. Initially, therefore, each model will be individually analysed and then an integrated research model, applicable to any interactive technology, will be constructed to predict the acceptance of these technologies.

Chapter 5 Research Model

5.1. Introduction

The previous chapters explored the literature on forecasting the future of interactive technologies. The literature review gave an extensive introduction to interactive technology applications and discussed various theoretical models and techniques. This has permitted the development of an underlying theoretical framework for this thesis and provided assistance in forecasting the future of interactive technologies.

New technology introduced into the market requires the establishment of its market position. However, for every technology there will be a variety of drivers and inhibitors impeding its acceptance. This chapter will underline the research model adopted to forecast the future of interactive technologies and examine the factors that influence interactive technology's adoption. The acceptance of technology is influenced by factors such as demographic characteristics, perceived quality, attitude, social influences and many more. These significant factors will be examined and testable hypotheses will be proposed.

5.2. Demographic and Social Economic Factors

Various studies have been carried out to identify the impact of demographic factors on the adoption of information technology. Examples are Porter et al (2006), Lai and Li (2005) and Lassar et al (2005). Agarwal and Prasad (1999), Maldifassi et al (2009), Hsu and Lin, (2008) Lopez- Nicolas et al (2008), Kuo and Yen (2009) and Sun et al (2006) suggested that individual differences have an impact on interactive technology acceptance. Individual difference takes account of demographic variables and other important factors such as education, experience and enjoyment. Previous studies have often neglected such individual differences when establishing technology acceptance. Karjaluoto et al (2002), Zhu and He (2002), Arning and Ziefle (2007), Ong and Lai (2006), Lu et al (2005), Yan and Lihua (2008) and Sathye (1999) stated that potential users can be classified as highly educated, young, wealthy individuals with sound knowledge of the technology and its applications such as computers and the internet.

5.2.1 Culture

Culture is comprised of a common set of values which determine socially acceptable behaviour (Slowikowski, 1997). According to Shiu and Dawson, (2004) and Gong (2009) it is important to understand cultural differences in order to formulate a profitable marketing strategy, as globalization plays an important role in today's world. Maintaining a competitive strategy is imperative for the success of new innovation products. Park and Jun's (2003); Teo et al (2009) and Li and Kirkup, (2008) findings showed that cultural differences have an impact on the adoption and use of ICT. Therefore it is important to understand and take account of cultural differences when establishing the acceptance of interactive technology in different countries. Individuals are deeply influenced by the cultural values of the country. Yalcinkaya (2008) further observed that social interaction plays an important role in technology adoption, although the strength of the social interaction affects the culture, as it varies across a range of different countries.

Baligh (1994) and Gong (2007) maintain that culture is one of the most fundamental components affecting human behaviour. It plays a significant role in every individual's life, as well as in the adoption of innovation and technology. Innovation is successfully accepted by information-seeking cultures.

Singh et al (2003) and Al-Gahtani et al (2007) argues that despite the global reach, information technology adoption across different countries is uneven. Many studies have shown that different cultures adopt new products and technological innovations at different rates even when they are situated in the same continent (Dwyer et al 2005; Kumar and Krishnan, 2002; Le Ferle et al 2002; Mahajan and Muller, 1994; Yeniyurt and Takada, 2003). For example, when comparing Pakistan and China (Hong Kong) which are neighbouring countries, it is notable that only 2.12% of the population in Pakistan use internet, whereas in Hong Kong, internet usage is 68.7%. Technological innovation in some cultures is accepted rapidly whereas it takes longer to penetrate others.

There are two well-known theories of national culture, firstly Hall's (1976) "The cultural classification", secondly Hofstede's (2001) cultural framework. In many recent studies Hofstede's framework has been successfully employed to define national culture and determine the impact of culture on interactive technologies; see, for example, Kumar and Krishnan (2002), La Ferle et al (2002) and Yeniyurt and Townsend (2003). Hofstede (1991) described national culture as the collective programming of the mind which distinguishes the members of one group or category of people from another. Even though Hofstede's framework has received criticism from many scholars such as Fernandez et al (1997), Huang (1995) and Myers and Tan (2002) as the data collected to develop the framework is out of date. Hofstede (1991) identified five dimensions that defined national culture. These were high power distance vs low power distance , high uncertainty avoidance vs low uncertainty avoidance, individualism vs. collectivism, femininity vs. masculinity and long-term vs. short-term orientation. Each of these dimensions is rated in order to determine the culture of the country. There has been many previous studies where Hofstede's framework has been adopted such as by Porter et al (2006), Yalcinkaya (2008), Shih (2004) and Gong (2007) and (2009). However in this study Culture will be determined by the Country. As a result the following hypothesis has been proposed:

- *H1(a): **Culture** differences significantly influence the intention to use interactive technology.*

5.2.2 Gender

Gender plays an important role in the adoption of interactive technology. According to Gefen and Straub (1997), gender interrelates with social presence and information richness. Studies by Venkatesh and Morris (2000); Ong and Lai (2006); have suggested that the decision-making process varies between males and females. Further studies by Eastin (2002) and Alagheband (2006) have also found that gender has a significant impact on an individual's attitude towards adopting information technology. Varied research has shown that males are more dominant than females in its adoption (Venkatesh and Kumar, 2002). According to Gefen and Straub (1997), gender differences also occur across different cultures. Thus males might be more positively associated with concern for the perceived usefulness of the innovation. Females have higher computer anxiety and lower computer self- efficacy than males. These characteristics have an impact on perceived ease of use Sun, (2006); Venkatesh and Morris (2000) also observed that higher computer self-efficacy indicates a better ease of use perception. Females are greatly influenced by others (Venkatesh and Morris, 2000). The same study indicated that males are more influenced by perceived usefulness, whereas females are more motivated by perceived ease of use and subjective norms.

- *H1(b): **Gender** is significantly associated with Intention to use interactive technology.*

5.2.3 Age

The older the generation, the less readily it adapts to new technological advances. Age is a significant factor affecting the technological adoption rate, especially in the case of interactive technology, as older people have less experience of information technologies such as computers and mobiles. Hertzog and Hultsch (2000), Sun et al (2006) and Venkatesh et al (2003) ascertained that younger individuals are more attracted to extrinsic rewards, a characteristic with some relevance to perceived usefulness.

Individual differences have always been a significant factor in explaining and understanding drivers or inhibitors of technology. Porter et al (2006), Chua et al (1999), Gefen and Straub (1997), Harrison and Rainer (1992) and Ziefle et.al. (2004) have all emphasised that individual differences constitute a key factor in technology acceptance and user behaviour. Further to this Venkatesh et al (2003), Arning and Ziefle (2007) and Agarwal and Prasad (1999) found that age significantly affects technology acceptance. Chaffin and Harlow (2005), Czaja et al (1998), Jung et al 2010 and Saunders (2004) all suggest that older adults are reluctant to use technology such as computers because of anxiety and lack of confidence. According to Hertzog and Hultsch (2000), older people perceive that their learning abilities diminish as they age. Zajicek and Hall (2000) and Goodman et al (2003) suggest that older people find it difficult to use and handle the technology devices, so that the devices' perceived usefulness is lower than it would be for younger people. So, when older people consider the low perceived usefulness along with the time and cost required to learn the technology, they are inhibited from adopting it. Further to this Van de Watering (2007) showed that physical changes related to the ageing process **–** for example, weakening of sensory and motor skills **–** can cause delays in the process of learning new technology. Older people will face more usability issues than younger people (Chadwick-Dias et al 2003). Thus the following hypothesis has been proposed:

H1(c): Increasing ***Age*** *is negatively associated with Intention to use interactive technology*

5.2.4. Education

Education plays a significant role in the adoption of interactive technology. As Rogers (1995) argued, most early adopters of technology have higher education, the ability to understand complex technologies, and knowledge of how to. Further studies also suggest that individuals with less knowledge avoid learning and using new information technologies such as the internet. Agarwal and Prasad (1999), Burton-Jones et al (2006) and Chen, (2011) have established a significant positive association between education level and perceived ease of use. This indicates that the perceived ease of use of interactive technologies will be lower for less educated than for better educated individuals. Lai and Li (2005) maintained that education is positively associated with the potential user's attitude.

- *H1(d)* ***Educational*** *attainment is positively associated with Intention to use interactive technology.*

5.2.5. Income

Income has an important impact on the attitude towards adopting interactive technology. Rogers (1995) observed that innovation enters through homophilous groups, especially influencing higher socio-economic status groups first. It is very unlikely that these groups will influence lower social groups regarding the usefulness of interactive technologies, since communication between high and low socio-economic groups is infrequent. This suggests that the perceived usefulness of interactive technology is lower for individuals with a lower income. Driskell and Wang (2009) carried out a study to establish the relationship between adoption of Wi-Fi access and social demographic factors. Income was one the significant factors which influences the adoption of Wi-Fi. Thus the following hypothesis has been proposed:

- *H1(e)* ***Income*** *will be positively associated with the Intention to use interactive technology.*

5.2.6. Employment Status

Professional individuals tend to watch less TV, but because they try to make their lives more efficient and convenient, they will be more attracted to applications such as home shopping and banking. Duernecker (2007) and Tong (2009) recent analysed the impact of unemployment on technology adoption. His finding so that unemployment does influence technology acceptance. Mawhinney & Lederer, (1990); Tillquist, (1996); Hubona & Geitz, (1997) found mixed results on the effect of employment on technology adoption. However Weitzel & Hallahan (2003) and Masrek et al (2007) found that employment is influential in determining intranet adoption.

- *H1(f)* ***Employment Status*** *will be positively associated with the Intention to use interactive technology.*

5.2.7. Household Occupants Status

Individuals in households with a higher number of occupants tend to watch more TV than those in households with fewer occupants. Driskell and Wang (2009) findings show that number of household occupants influence technology adoption. Wilson et al (2007) demonstrate through her research that household occupants influences the decision making process to adopt innovation.

- *H1(g) A growing number of **Household Occupants** will be positively associated with the Intention to use interactive technology.*

5.2.8. Marriage Status

Married couples tend to watch more television than single people, who are more inclined to use other interactive technologies such as mobile phones and the internet. Also, as the society attaches less importance to marriage, an increasing number of individuals are enjoying their independence and living in their own home, rather than in a family home with family commitments. As these circumstances will encourage them to adopt technology, the following hypothesis is proposed. Zhang and Maruping (2008) and Wang and Driskell (2009) identified that Marriage status a significant factor which influences technology adoption.

- *H1(h) **Marriage Status** will be positively associated with the Intention to use interactive technology.*

5.2.9. Decrease in Physically Active Population

In the information era, society is becoming less active, the number of people involved in hard physical work having markedly declined in the last decade. Employment currently being offered is likely to consist of service jobs rather than manufacturing jobs. Therefore society is generally more sedentary, with a resulting impact on people's lifestyle at home. People are becoming more laid back and like to relax more; therefore they prefer to stay home rather than going to a gym or social club. Roger (1995) describes these individuals are Laggards according to the Individual Innovativeness Theory which are described to be less active individuals.

- *H1(i) – Decrease in the **Physically Active Population** is negatively associated with the Intention to use interactive technology.*

5.2.10. Increase in Hedonistic Lifestyle

Society is moving towards a more hedonistic lifestyle characterised by lavish spending, no savings, no regard for others, lack of empathy and no thoughts about the future. Limited research has been carried out to understand the relationship between technology uptake and hedonistic lifestyle, although Pohjanheimo et al (2009) investigated food choice motives for hedonistic and traditional-values individuals. It was found that mood and price correlated positively with hedonistic values whereas traditional consumers were more cautious when making choices. A similar concept can be applied to technology uptake. The increasingly hedonistic lifestyle indicates that individuals will adopt take the technology depending on their mood. So the following hypothesis is proposed.

- *H1(j)– Increase in* ***Hedonistic Lifestyle*** *is positively associated with the Intention to use interactive technology.*

5.3. Attitudinal Beliefs

5.3.1 Attitude

Rogers (1995) argued that the attitude towards an innovation is a significant variable in determining the adoption decision. Attitude has many dimensions. An individual's attitude towards interactive technology usage is positively associated with that person's use of it. Lederer et al (2000) and Venkatesh and Davis (2000) stated that an individual's perceived ease of use is positively associated with actual ease of use. Lai and Li (2005); Lin, (2007) and Chen et al (2002) pointed out that individuals' attitudes towards using interactive technology such as online banking or virtual stores have a positive impact on their intentions to use it. Therefore the following hypothesis can be proposed:

- *H2(a) : Individuals'* ***Attitude*** *towards interactive technology is positively associated with their use of the technology.*

5.3.2 Perceived Usefulness

Davis (1989) defined usefulness as the degree to which a person believes that using a particular technology will enhance his performance. Sun and Zhang (2006) noted that perceived usefulness has been confirmed as an important factor in affecting users' acceptance of technology. This factor has received a marked amount of attention from other scholars and researchers. Porter et al (2006) and Rogers (1995) maintained that characteristics of new technology such as relative advantage and complexity are important elements in the formation of an individual's attitude to new technology.

In many earlier TAM studies such as Porter et al (2006), Lee (2009), Ahn et al (2004) and Moon and Kin (2001) it is argued that perceived usefulness has a stronger influence on attitude compared to perceived ease of use. Porter et al (2006) suggested that normally users overcome the complexity of using new technology when the benefits of using it seem advantageous. At the same time, the more an individual perceives the interactive technology as easy to use, the more that individual will perceive it as useful.

A study conducted by Teo and Pok (2003) demonstrated that perception of relative advantage influences the intention to adopt WAP-enabled mobile telephones. Other studies carried out by Porter et al (2006) and Al-Somali et al (2009) confirmed that individuals' perception of usefulness also had a positive impact on the intention to use online banking. Chen et al (2002) conducted a different study which indicated that perceived usefulness had a positive impact on an individual's attitude towards using virtual stores. The following hypothesis is therefore proposed.

- *H2(b): **Perceived Usefulness** is positively associated with attitude.*

5.3.3 Perceived Ease of Use

Users will be more attracted to a technology which is less complex to use. Ease of use is a significant factor in technology adoption (Davis, 1986; Davis et al 1989; Park, 2010; Park et al 2007, 2009; Wu and Wang (2005). Empirical research has established that ease of use is directly linked to intention to use (Horton et al 2001; Clegg, 2001; and Venkatesh and Davis, 1996, 2000).

Complexity is similar to perceived ease of use (PEOU) in the TAM model (Davis, 1989). According to Davis et al (1989) and Agarwal and Karahanna (2000) the PEOU and PU both influence an individual's attitude towards adopting new technology. The more an individual perceives the interactive technologies as easy to use, the more the perception reflects the individual's attitude towards use of the technology (Chen et al, 2002). Porter et al (2006) argued that the more the individual perceives the internet as easy to use, the more positive an attitude the individual has towards using it. But prior studies have indicated that perceived usefulness has a stronger direct effect on attitude than perceived ease of use. Therefore the following hypothesis are purposed:

- *H2(c):* ***Perceived Ease of Use*** *towards interactive technology is positively associated with attitude and use of the technology.*

- *H2(d)* ***Perceived Usefulness*** *is positively associated with* ***Perceived Ease of Use***

5.3.4 Compatibility

Lin (2007), Lu and Su (2009), Wu and Wang (2005) and Moore and Benbasat (1991) defined compatibility as the degree to which the individual finds the innovation consistent with the existing values and needs and past experience of potential adopters. The findings of Chen et al (2002), Schierz et al (2010) and Hardgrave (2003) showed that compatibility has a positive effect on an individual's attitude towards using a technology. Further to this Yang (2005) emphasises that compatibility is a critical factor in consumer adoption decision. Wu and Wang (2005) suggest that high compatibility will lead to preferable technology adoption. Therefore the following hypothesis is purposed:

- *H2(e):* ***Compatibility*** *of interactive technology is positively associated with attitude.*

5.3.5 Knowledge

Knowledge plays an important role in the individual's innovation-related characteristics. It helps the individual to gain confidence in the technology which in turn promotes its use. Huang et al (2011) states that knowledge is the expertise and skills acquired through experience and education. Maldifassi et al (2009) states that people with no knowledge of ICT may find it difficult to grasp some basic IT concepts. Rogers (1995) and Hsu and Lin (2008) suggested that the decision to adopt new technology is strongly associated with the quantity of knowledge the individual possesses as to how to use innovative technology. The greater the technology's complexity, the more knowledge is required to understand and use it.

- *H2(e): Increasing **Knowledge** of interactive technology is positively associated with Intention to use interactive technology.*

5.3.6 Confidence

If individuals have confidence in their abilities, it will most likely be significantly associated with the attitude towards adopting interactive technology. Sanchez and Hueros, (2010) state that self-efficacy demonstrates the confidence shown by users in their own ability to utilize information technology. Arning and Ziefle, (2007); Ong and Lai, (2006); Gong et al (2004); Lin (2007); Luran et al (2005) further suggests that confidence and self-efficiency possibly influences the acceptance and usage of technology.

- *H2(f): Increasing **Confidence** in one's ability to use interactive technology is positively associated with Intention to use interactive technology.*

5.3.7 Usage

By using the technology, the individual gains knowledge and experience (Davis, 1989) and can also be helped to gain confidence in using other interactive technologies. Prior usage and experience of the technology has been investigated in many studies (e.g. Arning and Ziefle, 2007; Dowing et al 2005;

Leaderer et al 2000; and Ziefle, 2002). The more the individual uses the technology, the less complex and easier to use it seems.

- *H2(g): Increasing **Usage** of interactive technology is positively associated with Intention to use interactive technology.*

5.3.8 Enjoyment

Interactive technology such as WAP and the internet is not used entirely for educational or work purposes, but also for entertainment and pleasure. Users who enjoy using a technology and perceive any activity involving the technology is more likely to adopt the technology and use it more extensively than other as Kim et al (2007) suggest. Shin, (2007), Agarwal and Karahanna (2000), Moon and Kin (2001); Lu and Su (2009), and Teo et al (1999) have found that perceived enjoyment is significantly associated with attitude and behavioral intention towards using the technology. Technology is even more enjoyable if it is easy to use. Therefore enjoyment can also be positively associated with the perceived ease of use.

- *H2(h): **Enjoyment** of interactive technology is positively associated with Intention to use interactive technology.*

5.3.9 Experience and Ownership of ICT

Ownership of ICT determines the individual's experience of using other information communication technology. The greater the extent of the individual's ownership of other information technology, the greater the experience he/she is likely to have of using interactive technologies. Experience and ownership of ICT helps in the adoption of technological innovation. (Im et al 2008). According to Webster and Martocchio (1992), Castaneda et al (2007) and Hackbarth et al (2003), Ndubisi, (2004), Kim et al (2007) experience helps to enhance the enjoyment of using the technology, as well as to develop the skills necessary for using the technology easily. According to Hackbarth et al (2003) and Igbaria et al (1995), Castaneda et al (2007) experience of technology is positively associated with perceived ease of use. Venkatesh and Morris (2000), Venkatesh et al (2003) and Davis (1989) used various measurements of experience. Generally experience is measured by the number of years an individual has used the interactive technology.

- *H2(i): **Experience and Ownership of Technology** is positively associated with Intention to use interactive technology.*

5.4. Social Influences and Interaction

Social interaction plays a highly important role in technology adoption. Socially interactive pursuits determine individuals' habits, which makes it possible to ascertain their acceptance of innovation. Social influence has a marked effect on the acceptance and usage of new technology. Several studies have identified the importance of social influences in understanding technology adoption; for example, Shin, (2007), Ndubisi, (2004), Wei et al (2009), Hung and Chang, (2005), Abdullah et al (2009), Lin, (2007), and Lee, (2009). According to Hassanein and Head, (2007) and Gefen and Straub, (2003) social influences are equivalent to subjective norms, and are defined as other people's opinions, superior influences and peer influence. Potential users are usually optimistic or pessimistic towards the use of interactive technology on the basis of the impressions received from friends and families. Davis et al (1989) argued that in some situations individuals utilise the technology to comply with others' beliefs rather than their own beliefs and feelings. Hence it seems that social information influences an individual's attitudes and usage of technology.

5.4.1 Social Influences

Subjective normative factors considerably influences technology adoption. Lin (2007) and Hsu and Lu (2004) argued that normative influences have a significant influence on social influences. Lopes-Nicolas et al (2008) suggests that social influences are related to a individuals attitude towards technology innovation and is based on the concept of personal innovations. People's attitude, behavior and perception are affected by the information the individual receives from the social environment. (Kim et al, 2009). Social influences may shape individuals confidence to use the technology. (Hassanein and Head, 2007) Therefore the following hypothesis are proposed.

- *H3(a): **Social Influences** is positively associated with Intention to use interactive technology.*

External factors to take into consideration are political and economic issues. Politics and the economy play an extremely important role in the individual's lifestyle. Such external factors are strongly associated with a person's attitude.

5.4.2 Political Stability

The level of political stability can be a significant inhibitor of iTV uptake. Political issues can prevent interactive technology adoption, since many political policies may apply to the technology, thus affecting the individual's attitude towards adopting it. (Au and Kauffman, 2008). To achieve and maintain high economic growth, a country requires a stable and efficient legal and economic environment, closely monitored and controlled by the government, and involving the reform of rules and regulations in order to achieve political stability. The need to maintain political stability helps to determine security and privacy policies when new technology is adopted, Rodrik (2002). The government needs to be sure that they are presiding over a secure environment and promoting competition so as to reduce cost. A decrease in political stability may produce changes in monetary policies, which may affect the individual's cost of living. This in turn will prevent them from taking up interactive TV because of the additional cost of using the technology (Gwartney and Lawson, 2003).

- *H3(b): **Political Stability** is positively associated with the Intention to use interactive technology.*

5.4.3 Decrease in Economic Growth

Economic growth plays a significant role in the uptake of interactive TV. A decrease in growth will prevent competition with the result that interactive TV, being a small player in the interactive technology industry, will have fewer opportunities to offer and promote itself to potential users as it cannot provide incentives and special offers. In addition, a decrease in economic growth will considerably affect users in that they will be seeking to reduce their outgoings, so that the luxury of taking up interactive TV may no longer be an option. When the economy declines, there is less disposable capital, and people have less money to spend on innovative interactive technology. (Au and Kauffman, 2008).

- *H3(c):* ***Economic Growth*** *is negatively associated with Intention to use interactive technology.*

5.4.4 Mass Media Influences

Bhattacherjee (2000) and Agarwal and Prasad (1998) identified that the potential technology adopters are significantly influenced by the mass media. Mass media influences individuals intentions. Social influence can be divided into two groups, external and interpersonal influences. (Hang and Chang, 2005) External influences include mass media reports, experts opinion and other non-personal information while interpersonal influences include word of mouth from friends, colleagues and superiors. Mass media influences involves non personal influences. (Lopez-Nicolas et 2008). Generally people gain information from mass media and this information influences individuals perception and beliefs. (Lin, 2007). Therefore the following hypothesis is proposed.

- *H3(d):* ***Mass Media*** *is significantly associated with Intention to use interactive technology.*

5.5. Perceived Behaviour Control

Ajzen (1991), Shih and Fang (2004) referred to perceived behaviour control as the perceived ease or difficulty of performing a particular behaviour. Perceived behaviour control is comprised of two factors: efficacy, and facilitation such as government and technology providers.

5.5.1 Self-Efficacy

Self-Efficacy can be defined as an individual’s ability to perform tasks across multiple environments such as WWW, WAP and iTV. Several studies have examined the relationship between self-efficacy with respect to technology use; for example, Eastin (2002) and Monsuwe et al (2004). Various studies such as those of Davis et al (1989) and Wang et al (2003) show that computer self-efficacy and perceived ease of use are related. Polatogul and Ekin (2001) illustrated the fact that individuals who are familiar with internet and email are most likely to find other internet services, such as internet banking, less complex to use.

Eastin (2002), Wang et al (2003) and Pituch and Lee (2006) suggested that higher self-efficacy will have a positive impact on customer's perceived ease of use. This indicates that an individual who has positive self-efficacy beliefs for interactive technology are more likely to accept the technology.

- *H4(a): **Self-Efficacy** is significantly associated with Intention to use interactive technology.*

5.5.2 Government Facilitation

Government plays a important role in technology adoption. (Gordon et al 1997). Government promotion of digital switchover and increased broadband and mobile coverage is positively associated with the individual's attitude towards accepting the technology. Government facilitation appears to be significantly associated with perceived behavioural control (Teo and Pok, 2003).

- *H4(b): **Government Facilitation** is significantly associated Intention to use interactive technology.*

5.5.3 Technology Operators

Technology operators play an important role, as they are in charge of promoting the new innovation as well as supporting it once adopted. Increasing the awareness of the product can indirectly increase the likelihood of adoption. Technology operators support is considered to be directly related to system usage. (Kim et al 2009). Lack of technology operators support is considered as a critical barrier to the acceptance and usage of the technology. (Igbaria, 1990). Interactive technology operators are significantly associated with perceived behavior control (Teo and Pok, 2003).

- *H4(c): **Technology Operators** are positively associated with Intention to use interactive technology.*

5.6. Technological Factors

5.6.1 Technology Rivals

The increase in technology rivals is a significant inhibitor of interactive technology uptake. Rivals such as the internet and mobile may provide a better and cheaper service, as well as greater technology convergence, than interactive TV. Technology adopters enjoy using a device which provides more services and greater functionality than its rivals.

- *H5(a): An increase in **Technology Rivals** is significantly associated with the Intention to use interactive technology.*

5.6.2 Technology Commerce

Television commerce makes it possible to carry out electronically mediated commerce via television. Its concept is similar to that of e-commerce, in which electronic commerce is conducted through the internet (Yu et al 2005). T-commerce allows goods and services to be purchased while the buyer is watching TV and transactions to be performed by means of a remote control or wireless keyboard and mouse. Services currently available include booking cinema tickets and ordering pizzas. T-Commerce also offers a range of betting and gaming services. The increase in T-commerce will change an individual's purchasing style, which will also create new business opportunities for the provider. As the growth of T-commerce will encourage users to take up interactive TV, the following hypothesis can be proposed.

- *H5(b): The increase in **Technology Commerce** is significantly associated with the Intention to use interactive technology.*

5.6.3 Accessibility

Accessibility plays an important role in an individual's inclination to accept interactive technology. Shin (2007) suggested that the availability of the technology affects the individual's attitude towards it. Convenience is another significant factor in an individual's lifestyle, besides which, accessibility affects the technology's perceived usefulness. According to Mathieson (1991) and Venkatesh and Brown (2001), accessibility and cost are important determinants of technology adoption.

- *H5(c): **Accessibility** is significantly associated with Intention to use interactive technology.*

5.6.4 Access Cost

Bradner (2001), LaRose and Atkin (1991) and Choi and Choi (2003) emphasised that potential users assess a technology in terms of its technical and functional capabilities. The price of technology is perceived by users in relation to the new benefits and features it provides (Wu et al, 2005). LaRose and Atkin (1991) was able to demonstrate that users' intentions to adopt pay-per-view service were associated with price and perceived benefits, as limited service was available on conventional television channels. However, Shin (2009) and Shim et al (2006) suggested that consumers perceive high price as an adoption barrier. It was also found that younger people are more willing than older ones to pay the cost associated with perceived benefits.

The Triandis (1979) model indicated that facilitating conditions determine information system usage behaviour. Shin (2004) maintained that the Web environment is a fundamental facilitating factor in the adoption of e-technologies such as e-shopping. According to this view, the mobile and TV are also facilitating factors for m and t commerce. Potential users will initially evaluate the environment before conducting any commerce-related business. Therefore access cost can be seen as an environmental construct, to be measured by an individual's perception.

Access cost is the cost involved in accessing the interactive technology. Therefore it will be the cost associated with the WAP, WWW and iTV environment. High access cost can be one of the main inhibitors of technology adoption. Wei et al (2009) and Strader (1997) both stressed the importance of access cost for interactive technologies. Therefore the following hypotheses are tested: access costs are negatively associated with PEOU of interactive technologies; access costs are negatively associated with PU of interactive technologies; access costs are also negatively associated with individual attitudes towards interactive technology. Hence, altogether, access costs are negatively associated with user acceptance of interactive technology.

- *H5(d): **Access cost is negatively** associated with Intention to use interactive technology.*

5.6.5 Technological Convergence

The concept of convergence has a considerable impact on the digital economy and the industrial structure since it was introduced over two decades ago. (Chang, 2007). Technology convergence explorers the users perception and behavior while using a converged technology. However, despite of social communication, it is unknown how consumers will respond to the changes as Technological convergence will affect the individual's attitude towards acceptance of a new innovation. (Choi and Choi 2003; Shin, 2009). Individuals will be inhibited from using standalone interactive technology if it is already integrated with a different system. For example, why would an individual use the internet via a PC, if it is available on the WAP-enabled mobile phone?

- *H5(e): **Technological Convergence** is positively associated with Intention to use interactive technology.*

5.7. Quality Characteristics

Information and service and system quality can all contribute to the overall quality of interactive TV. These three elements of quality have a significant impact on interactive TV uptake. DeLone and McLean (1992) argue that information quality is an important factor in the development of intriguing information systems. Shin, (2007), Beyah (2003) and Cheong and Park (2005) carried out various studies which established that the factor of quality is significant in determining the acceptance of a technology. An improvement in quality will result in higher user satisfaction. The quality of information is usually measured by dimensions such as accuracy, completeness and understand ability (Huizingh, 2000 and Ranganathan et al 2002). Ahn et al (2007), Lin (2008) and Ha et al (2009) have all emphasised that quality influences a user's intention to take up a technology. Barnes and Vidgen (2003), Belanger et al (2006) and Kim (2000) maintain that websites which offer system reliability, user-friendly interfaces and ease of navigation considerably increase the frequency of visits. Morris and Venkatesh (2000) and Morris et al (2005) emphasised that the customer's age significantly influences the perception of quality. Younger people appreciate the quality characteristics of an application such as design, site features and functions more than do older people, who, because they take longer to learn the application, may not easily recognise and value its overall quality.

Quality is an important asset for interactive technologies, as they provide a dynamic portal for a range of services and business. Shin (2004) comments that when pursuing commercial business on different interactive applications such as the web, it is crucial that accurate information be available, accompanied by exceptional system and service quality. Liu (2000) argued that the perceived quality of information, system and service are determinants of the success of websites. This approach can be generally applied to other interactive technologies.

5.7.1 System Quality

The interactive technology market is becoming a highly competitive and challenging one in which to thrive. Therefore it is important to ensure that the technology overcomes the system quality barriers. System quality is measured by the following features: design, navigation, response time, system security, system availability, functionality and error-free transaction. Ahn et al (2004) and Shih, (2004) showed that system quality is positively associated with PEOF, PU and attitude regarding user acceptance of internet shopping malls. Pagani (2006) stressed that speed is a critical factor in technology adoption. High-speed data service is more likely to attract users to adopt the technology. Information quality is an important aspect of interactive technologies, as an increase in information quality will increase users' trust and improve their perception of the technology. Lin et al (2000) stated that information quality can be measured by accuracy, currency, completeness, timelessness and understandability. During the use of interactive technology services, it is important that consumers and information providers communicate and cooperate by exchanging and sharing information through different services. Ahn et al (2004) suggested that information quality helps service users to compare shopping products, enhance their shopping experience, and make better choices. They are also given information which is considered consistent and reliable. Much previous research, for example that of Aladwani et al (2002), Barnes et al (2001), Palmer et al (2002) and Ranganathan et al (2002), has underlined the importance of the information quality of web applications for its effect on acceptance of the web service. Perceived information quality is assumed to affect PEOU, PU and attitude. Information quality and quantity are positively associated with PEOU of interactive technologies, with PU of interactive technologies, and with attitude towards interactive technologies.

- *H6(a): **System Quality** is positively associated with intention to use the interactive technology.*

5.7.2 Service Quality

Service quality is another important aspect of interactive technology. According to Ahn et al (2004), and Chen et al (2008); service quality is vital because the technology offers a service without any face-to-face interaction. Their findings illustrate that service quality is a determinant of information systems' success. It follows that for companies to provide a better service it is necessary to ensure that the quality of service is adequate. Poor service results in loss of revenue and reputation. Service quality can, as Shih, (2004) observed, be measured by many factors such as the above-mentioned reliability, responsiveness, assurance and empathy.

- *H6(b): **Service Quality** is positively associated with intention to use interactive technology.*

5.8. Perceived Risk

5.8.1 Security Risk

Risk is considered an important element of interactive technology use and thus has a marked effect on an individual's attitude towards using the interactive technology. Security risk usually relates to potential loss owing to fraud or breaches of security measures such as the data protection act. Such risks can lead to financial loss (Kuisma et al 2007). Improved security is thus a notable factor in expanding the uptake of interactive TV. Security and privacy when performing transactions or handling personal information by means of interactive TV are crucial drivers of the technology (Paine et al 2007). According to Lee et al (2003) and Phang et al (2006), users' perception that their personal data is stored in a secure location when they are online significantly influences the decision to take up the online system. Lwin et al (2007) stress that security risks and the danger of privacy invasion are major concerns among consumers.

- *H7(a)* ***Security*** *is positively associated with Intention to use interactive technology.*

5.8.2 Trust Risk

If an individual is to adopt an interactive technology and use it to its full potential, it is very important for providers of the service to win the consumers' trust (Kolsaker, 2002). Gefen et al (2003) argued that trust in an e-commerce vendor increased a user's intention to use the vendor's website and was the most efficient factor in reducing uncertainty. Grazioli and Jarvenpaa (2000) and Wei et al (2009) further found that the customer's attitude was determined by trust.

- *H7(b):* ***Trust*** *is positively associated with Intention to use interactive technology.*

This chapter has identified diverse factors which influence the adoption of interactive technology. Most were selected from previous studies concerning the adoption of interactive technologies such as the internet and WAP technologies.

Individual difference takes account of demographic variables and other important factors such as education, experience and enjoyment. Previous studies have often neglected such individual differences when establishing technology acceptance. The hypothesis will demonstrate the effect of demographic and social economical factors on the intention to use interactive technologies.

The hypothesis purpose that Attitude attributes such as Perceived Ease of Use and Perceived usefulness are positively associated with the intention to use interactive technologies.

Social influences and interactions influence the intention to use interactive technology. Social influences consists of External and Normative influences. Mass media, Government and Political influences are considered to influence the intention to use interactive technologies.

Technology Factors such as Availability, Risk, Quality, Access Cost, Technology rivals, convergence and technology commerce influence the use of technology. These technology factors can influence the use of interactive technologies if the quality of these technology factors is insufficient.

These factors will be evaluated throughout this thesis by adopting various different evaluation methods such as Delphi and the Technology Acceptance Model. Figure 5.1 illustrates the overall research model for this thesis. In the following chapter the methods used to test each of the hypotheses are outlined.

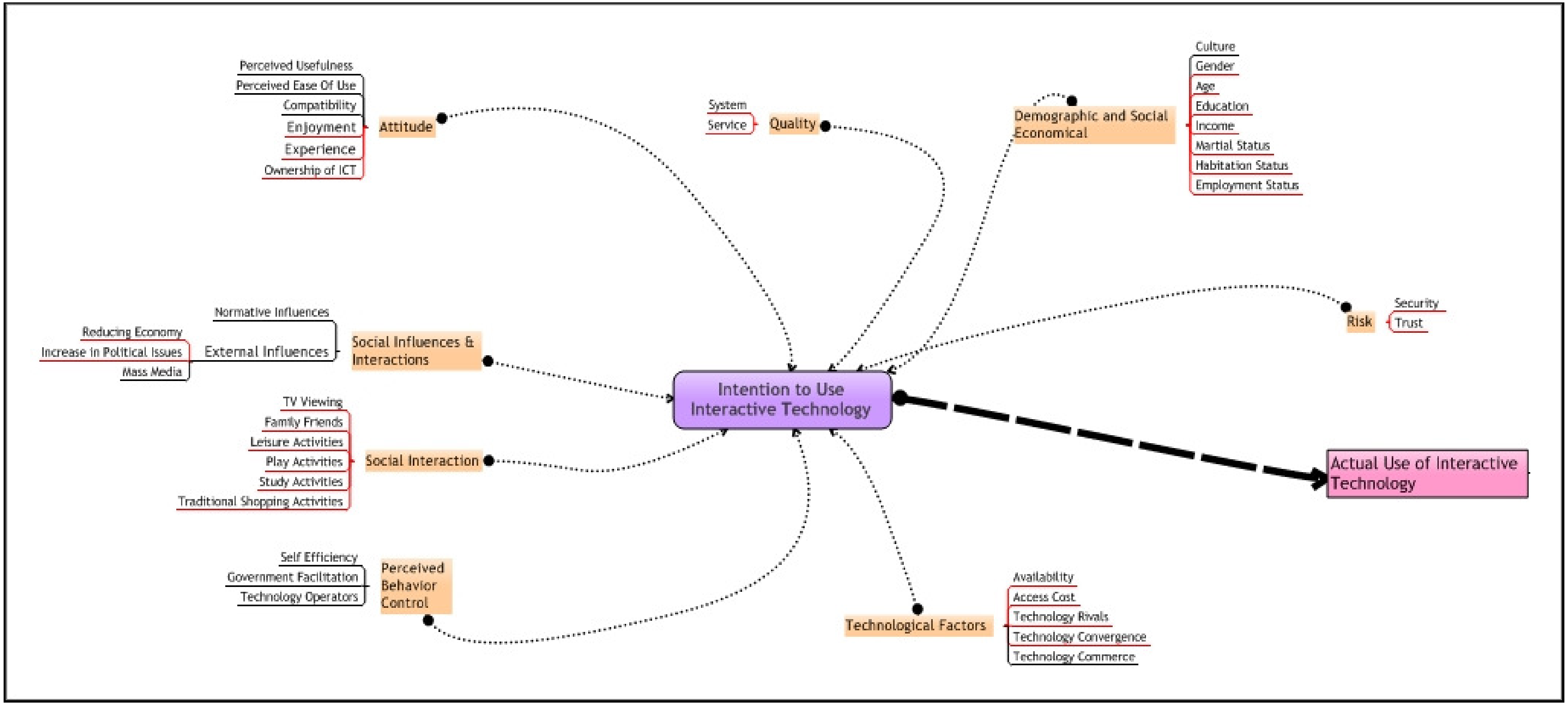


Figure 5.1 Overall Research Model to Forecast the Future of Interactive Technologies

Chapter 6 Methodology

6.1. Introduction

In Chapter 1 the objectives of the thesis were stated and supported by an overall research design model. Specifically, the research has four main objectives. Firstly, it seeks to evaluate technological forecasting models in order to find a suitable one for forecasting the future growth of interactive TV. The second objective is to apply the Delphi judgemental forecasting method to determine the future of interactive technologies as well as key promoters and inhibitors. The third objective is to understand the cross-cultural adoption of interactive technologies and evaluate the factors that influence their acceptance. Evaluation of existing technology adoption theories will further assist in constructing a technology adoption model for interactive technologies.

In this chapter, the research methods and models used in the study and the sample selection procedures are discussed to satisfy the proposed objectives. The remainder of the chapter will evaluate the methodology adopted for the first three objectives, while the fourth objective will be achieved through a conclusion based on findings obtained from the pursuit of the previous three objectives.

6.2. Justification of Research Methodology Adopted

This thesis has employed primary and secondary research. For the different objectives, different types of research were adopted. This research focuses on four main areas in order to fulfil the objectives of the thesis. A range of research methodologies has been adopted, including Technological, Judgemental, Cross- Cultural and Technology Acceptance modelling. Such diversity in the research methodologies will make it possible to prove the consistency of the results when forecasting the future of interactive technologies. For example, the Judgemental approach is based on human experience and judgement whereas Technology Acceptance modelling is based purely on statistical analysis; while Technological forecasting focuses on historical data to identify the most appropriate forecasting models. The combination of methods makes findings which have been checked for consistency all the more secure, and thus will assist in validating predictions of the future of interactive technologies.

The ideal forecast methodology will thus incorporate both the qualitative and quantitative approaches. In applying quantitative analysis sufficient data are required, so that, if there are not enough, it will be more reasonable to mix quantitative and qualitative techniques. Many scholars have combined forecasting techniques when faced with limited data, or when they wanted to improve the quality of the forecast (Christodoulos et al 2010; Wang and Lan , 2007; Chen, 2011; Tseng et al 2009. Kumar et al (2002), arguing the need to integrate forecasting methods, emphasised that technologies no longer have a stable relationship with the historical data, with the result that forecasts may become less accurate. Anderson et al (2008) and Yoo and Moon (2006) found that forecasts from different quantitative methods significantly increase accuracy, help to reduce errors in data and prevent incorrect assumptions. Wang and Lan (2007) also used a combined forecasting process, particularly scenario and substitution models, to improve the quality of the forecast.

Different models, such as the Logistic Model (Gruber and Verboven, 2001), the Bass Model (Sundqvist et al 2005), and the Gompertz Model (Rouvinen, 2006), have been used in various studies of the diffusion of advanced technologies, e.g. mobile phones, in several countries. According to Chu et al (2009), research has indicated that the application of growth models is the first step towards understanding and analysing the diffusion of technology. They concluded that certain characteristics of the Logistic, Gompertz and Bass models have made them very useful for understanding the accelerated growth and the determinants of the diffusion rate.

Thus it seems clear that to improve the quality of interactive technology forecasts, a mixture of forecasting techniques will offer superior validity. In the quantitative sphere, the following methods will be utilised in forecasting the future of interactive technologies: the Growth curve, the Diffusion model and the Substitution model. At the same time, the qualitative method will be employed in order to understand the drivers and inhibitors of interactive technology, and to assimilate scholarly opinion regarding its future. Delphi methods will be used here because they permit the assessment of many scholars' views unaffected by personal conflicts.

The following research methodologies have been adopted from various scholars: Technological forecasting (Chu and Pan, 2008; Evens et al 2010; Funk, 2005; Anderson et al 2008), the Judgemental approach (Dransfield et al 2000; Jacobs et al 1998), Cross-Cultural enquiry (Lasser et al 2004), and Technology Acceptance Model (Baker et al 2007; Davis, 1989; Shih, 2004; Choi and Choi 2003; Lederer et al 2000; Driskell et al 2009; Burton Jones et al 2006; Lin, 2007; Min, 2003). These studies reached significant conclusions which may have assisted in marketing and designing products so as to attract potential adopters. Since the present research also aims at forecasting the future of interactive technologies and understanding their growth prospects in order to identify prospective adopters' characteristics, use of the above methodologies will help to achieve the objectives of this thesis.

It should be borne in mind that such methodological diversity can have disadvantages, in that it might produce inconsistent and conflicting results. But overall, adopting the full range of techniques may provide a clearer understanding and vision for the future of interactive technologies.

6.3. Evaluation of Technological Forecasting Models

Technological forecasting models assist in forecasting the future growth of iTV. Evaluating and comparing their forecasting performance helps to identify a suitable model for predicting the future of interactive technologies, especially iTV where the future is unknown. Meade and Islam (1995) and Kucharavy et al (2011) have constructed various empirical comparison studies with the use of growth curves, and have established that they can identify suitable models with which to forecast the future performance of a technology. Choosing suitable models helps to improve the accuracy and validity of the forecast (Christodoulos et al 2010). The aim is to find which model best suits the interactive technologies market for the following three countries: the United Kingdom, Hong Kong and Pakistan. In assessing the models for this purpose, data for different information technology communication products have been adopted.

Research in the literature has discerned many models such as Bass Model, Gompertz Model, Simple Logistics and others which can help to model the diffusion of innovation. Similar approaches will be taken up to forecast the future of interactive technologies. Kauffman et al (2009) adopted this type of approach in order to understand the early diffusion of digital wireless phones. He further evaluated factors affecting adoption decisions in some of the Rogers (1995) adopter categories. In addition, Wu and Chu (2009) utilised the diffusion models to determine whether the best of them can be applied to the full life cycle of mobile telephony. There have also been a number of cross-national studies to determine the most effective models for different countries or establish an overall best model, such as research performed by Sundqvist et al (2005), Rouvinen (2006) and Meade and Islam (2006). The methodology adopted was determined by previous research. The objective of this evaluation of technological forecasting is to ascertain a suitable model which can assist in forecasting the future of iTV. This model will also be a candidate for future technological forecasting of interactive technologies. In the early chapters, the literature has emphasised the intensity of various technological forecasting models.

6.3.1 Data Selection

This study uses secondary data adopted from two different sources. The majority are extracted from Euromonitor International (http://www.euromonitor.com, 2007/), one of the world's leading independent providers of business intelligence and international market statistics for a variety of industries and consumers. Data for the number of users of personal computers, internet users, and mobile telephone users across the United Kingdom, Hong Kong and Pakistan are derived from Euromonitor. The data points covered the period from 1990 to 2009. These products were selected because of their connection to interactive TV either as enablers or as competitors. Of additional interest here will be the direct forecasting of the use of interactive TV. Danaher et al (2001), Islam and Meade (1997) and Norton and Bass (1987) point out that theoretical and empirical evidence shows the diffusion of a new generation of technology to be influenced by the older generation technology. Therefore they suggest it is preferable to consider an older, rival technology when evaluating technological forecasting models. As limited data are available on the usage of iTV, therefore these data were obtained from Wakefield Council, who recorded statistics on the frequency of use of their services on iTV. Data points extended from 2007 to 2010 (http://www.wakefield.gov.uk/).

6.3.2 Data Analysis

The literature review identified six diffusion models which can be adopted to evaluate forecasting performance. A summary of the models is given in Table 6.1. Data points were fitted in the diffusion models and the following criteria for selecting the best model are utilised.

Table 6.1 Technological Forecasting Models Adopted

Models	**Formula**
Bass Model	$Y_t = (P + \frac{q}{m} Y_t - 1)(m - Y_t - 1) + e_t$
Modified Exponential Curve	$Y_t = m - ce^{(-bt)} + \varepsilon_t$
Simple Logistic Curve	$Y_t = \frac{m}{1 + ce^{(-bt)}} + \varepsilon_t$
Gompertz Curve	$Y_t = me^{(-c(e^{(-bt)}))} + \varepsilon_t$
Local Logistic Model	$Y_t = \frac{mY_{t-1}}{Y_{t-1} + e^{-q}(m - Y_{t-1)})} + \varepsilon_t$
Log Logistic Model	$Y_t = \frac{m}{1 + ce^{-b\ln(t)}} + \varepsilon_t$

Once the models have been composed, then the fit and forecasting performance among the six models is examined. In testing the fit of the forecasting model, residuals between the actual and forecasted values are checked to determine the model's forecasting performance. Many different approaches can be adopted to select the best forecasting performance model. However, it seems that measuring forecasting error to identify the accuracy of the model is the most common method (Meade and Islam, 2006). The idea is that high accuracy means a low error rate. There are a number of methods to measure error, such as Mean Absolute Deviation (MAD), Mean Square Error (MSE), Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE). Carbon and Armstrong (1982) found that RMSE was the preferred measure of accuracy. Kurawarwala et al (1996) and Meade and Islam (1998, 1996) all recommend RMSE as valid for measuring the fit of the forecasting model. Therefore RMSE is adopted to assess each forecasting model's fit.

$$RMSE = \sqrt{\frac{\sum_{t=1}^{T} (y_t - \hat{y}_y)^2}{n}} \qquad \textit{Equation 1}$$

where y_t is the actual value at time t, $\hat{y}_t$ is the estimated value at time t and n is the number of observations. These measurements are based on the residuals, which represent the distance between actual data and forecasted predictive data. Therefore if the values of these measures are small, then the fit and prediction performance is adequate.

To check further the forecast performance and measure the model's accuracy and performance, the models are used to predict the last three data points of the dataset.

$$MAPE = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{y_t - \hat{y}_t}{y_t}\right| \text{ x } 100 \qquad \textit{Equation 2}$$

where y_t is the actual value and $\hat{y}_t$ is the forecast value. The difference between y_t and $\hat{y}_t$ is divided by the actual value y_t again.

The absolute value for each fitting is summed and divided again by the number of observation points. This determines the percentage error. Young (1993) suggested that MAPE is more appropriate than MSE.

The criteria used in this section to select the best model for forecasting the future of ITV are listed below:

- The fit between actual and forecast curves
- Low RMSE and MAPE values

- Analysis of future points along with actual
- Comparison with Euromonitor forecast

6.3.3 Forecasting Procedures

The steps used in this dissertation for carrying out the growth curves performance comparisons are as follows:

1. Microsoft Excel spreadsheet was used for each growth curve model. Each spreadsheet contained time, actual growth, forecast growth and other parameters depending on the model, error (difference between actual and forecast) and root mean square error.
2. The growth curve model and error measure formulation were computed, followed by application of the model to the data.
3. The tool "Solver" was used to minimise the RMSE by iteratively changing the coefficients until a convergence criterion was reached. The aim of this procedure is to obtain the minimum RMSE value by changing/estimating the values of the model parameters and measuring the accuracy of the model.
4. For each model, a chart of actual and forecast values against time was plotted.
5. For chosen models, their RMSE and MAPE values were compared.
6. The prediction intervals were calculated for the models which obtained the three smallest RMSE and MAPE values.
7. Finally, conclusions are drawn on the performance of each model and the difference in results among the three countries: the United Kingdom, Hong Kong and Pakistan. The best forecasting performance model will be further utilised to forecast the future growth performance of iTV.

6.4. Judgmental Delphi Approach

The literature review has presented an overview of the Delphi method and highlighted the success it has had in forecasting the future of information communication technologies. (Tseng et al 2009; Gallego et al 2008). It also underlined the importance of forecasting the future of iTV and evaluating its potential drivers and inhibitors. The following methodology has been adopted for these purposes; this section will review the proposed method.

6.4.1 Delphi Study to Predict the Future of iTV

The previous chapters highlighted the use of Delphi Forecasting and its application in forecasts in regard to information communication technology and interactive technology. This section will identify the methodology adopted for use during Delphi forecasting. The aim of Delphi forecasting is to establish the potential growth of interactive technologies, to determine the key drivers and inhibitors of interactive TV and to evaluate their impact on the growth of interactive technologies. It has also identified various drivers and inhibitors of interactive TV. The Delphi study focused on the growth of interactive TV instead of the mobile and internet because, although interactive TV has been on the market for a decade now, the technology's growth is still described as being in its infancy. The research process included six steps in three stages, as summarised in Figure 6.1

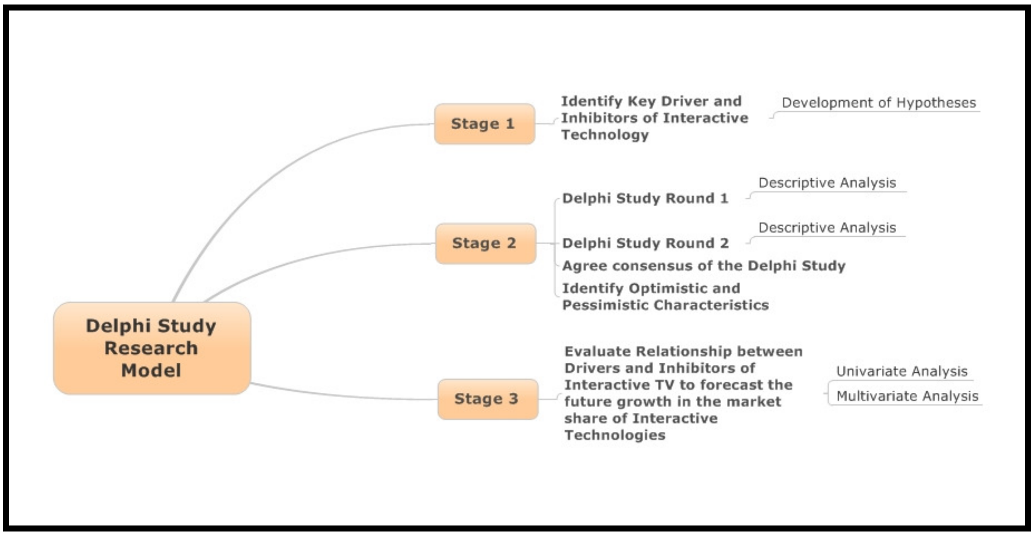


Figure 6.1 Delphi Study Research Model Adopted

From the literature review it can be concluded that the Delphi method has been successful in forecasting the future of information communication technology. Adler and Ziglio (1996) described the Delphi method as "an exercise in group communication among a panel of geographically dispersed experts". Harrison and Sullivan (2000) observed that qualitative measures, being judgement-based, are often used as they do not require a precise and accurate quantifiable measurement. Quantitative measures allow the researchers to determine “where we have been, where we are going and where we are today in a physical sense”. Harrison and Sullivan (2000) further notes that while “quantitative measures tell us what has happened, qualitative measures tell us what is happening”. Bozburn (2004) called attention to Sieber’s (1973) suggestion that qualitative research methods develop the foundations for quantitative analysis.

Bradley and Stewart (2002, 2003) and Gunter (2003) have all adapted Delphi qualitative research methods to perform further quantitative analysis for determining the future of interactive technologies.

However, there are three commonly raised issues surrounding the Delphi Method: selection of the expert panel, the size of the panel and the number of rounds required to complete the Delphi study (see Witkin and Altschuld, 1995 and Skulmoski et al 2007). According to Delbecq et al (1975) and Powell (2003), it is crucial that all the participants clearly understand the Delphi process.

6.4.2 Selection of the Expert Panel

Selecting the expert panel is the most important step in the Delphi study. Linstone and Turoff (2010), Mitchell and McGoldrick (1994), Fischer (1978), Reid (1988) and Sackman (1975) all observed that there is much disagreement as to how to identify an “expert”. They ask how an expert can be defined and his expertise in the research field be known. Selecting an expert should not be a random process; Deitz (1987) and Linstone (1978) suggested that an expert is usually either professionally or scientifically qualified. The selection should be based on the person’s knowledge and expertise. An expert can also be referred to as someone with high status in a particular field. Pill (1971) suggests that an expert can be regarded as anyone who can offer relevant input; Cantril et al (1996) similarly noted that, according to many critics, the expert should be any individual with relevant knowledge and experience of the research topic. Deitz (1987) cautions that panellists’ self-rating is a very inequitable process; while Delbecq et al

(1986), Rowe et al (1991) and Keeney et al (2001) all contended that selecting panellists from various backgrounds is more suitable than selecting them from one background.

Beech (1999) argued that, as the experts of the panel are either selected or nominated, the procedure is deficient in normal sampling techniques. In keeping with this view, Reid (1988) suggested that some basic sampling techniques added to the Delphi study will improve the Delphi process. However, Beretta (1996) argued that sampling techniques may be inappropriate when an expert's opinion is fundamental.

In this research into forecasting the future of interactive TV and identifying the relationship between key drivers and inhibitors, respondents from various backgrounds were invited to participate, for, as Bradley and Stewart (2003) emphasise, no individual can be an expert on all new technologies. Therefore, experts from different industries and geographical locations were invited to take part, in the expectation that they could complement each other. The participants were found through various academic journals and consultancy reports. Some were involved in retailing of iTV, others were iTV providers in software and technology, consultants, or academics engaged in researching the iTV industry. All participants were invited by email to take part in a web-based Delphi study. Nikolopoulos et al (2003) stressed the importance of e-forecasting as it permits easy access from anywhere and provides real-time Delphi (Steinert, 2009). Zipfinger (2007) and Gordon and Pease (2006) have emphasised the benefits of the real-time Delphi method. The advantage of computer-based Delphi is that the expert panel can be drawn from multiple cultures and countries without heavy financial travel costs. Anonymity of the respondents is one of the key strengths of Delphi, as it removes the effects of status, powerful personalities and group pressure which can arise in a meeting. Use of the web-based Delphi method eliminated these concerns.

6.4.3 Expert Panel Size

According to Linstone (1978), Day and Aaker (1990) and Prendergast and Marr (1994) and Mitchell and McGoldrick (1994), Skulmoski et al (2007), Hang et al (2008) and Von der Gracht (2010) they argue that the most effective Delphi studies have used small panels. Panel sizes can vary from seven to thousands of people. Powell (2003) argues that the number of experts depends on the nature of the problem. Williams and Webb (1994) argued that there is no established rule for sample size. However, Linstone (1978) and Fowles (1978) have suggested that a suitable minimum number is seven as a panel size below seven diminishes the quality of the study. Prendergast and Marr (1994) maintain that increasing the panel size to between eight and twelve members reduces the error significantly. Cavalli-Sforza and Ortolano (1984) and Phillips (2000) claimed that the Delphi panel should have about seven to twelve members, while Day and Aaker (1990) and Mitchell and McGoldrick (1994) argued that the panel size should not be below ten or above forty. It was suggested by Turoff (1970), van Zolingen and Klaassen (2003), Gordon (2004) and Wild and Torgersen (2000) that for a Policy Delphi the number of panellists should be higher than for the Classic Delphi. Cantril et al (1996) as well as Delbecq et al (1986) maintained that there should be no set number of panellists required, but rather that there should be enough to facilitate the pooling of judgments.

6.4.4 Number of Delphi Rounds

Feedback to the respondents creates an opportunity for the panellists to review and modify their responses on the research topic. Skulmosku et al (2007), Linstone and Turoff (2010) and Custer et al (1998) all noted that opinions vary regarding the number of rounds required for a successful Delphi study. They suggested that a minimum of two rounds are adequate. Others thought that at least three to six rounds were necessary, while Brockhoff (1979), Johnson and King (1988) and Lang (1994) all contended that as many as ten rounds might be required to achieve the research outcome. Deitz (1987) and Mitchell (1992) both suggested that an increased number of rounds decreases the error rate of the results, whereas Walker and Selfe (1996) argued that repeated rounds could result in loss of interest on the part of the panellists, leading to an increased attrition rate. Therefore they suggested that two or three rounds are sufficient.

The Delphi study was developed and conducted during the months from July 2009 to December 2009. A pilot study was undertaken with a group of 15 IT specialists who were confident in the use and knowledge of leading ICT technologies. The pilot study permitted identification of any issues with the questionnaire. Also a document was attached to the email explaining the definition of iTV and the current market for iTV.

Two rounds of the Delphi study took place during this time period. The initial intention was to allow two or three weeks for responses, but in reality the first Delphi round took eight weeks because of a slow response. Three reminders were sent to the participants to complete the Delphi questionnaire.

The first round of the Delphi study consisted of 12 questions, and a further consolidated 18 statements were assessed by the panellists during the second round. Likert scales were adopted during the second round rather than other question types such as multiple choice or open-ended questions, as it was important that a consensus be reached at the end of the study. 34 panellists who contributed to the first round of Delphi were invited to take part in the second round and 22 panellists responded. Two of the responses were disregarded as they were incomplete. The remaining 20 responses were reviewed to conclude the Delphi study. The following section will review the conclusion derived from the first and second rounds of the Delphi study. The two Delphi questionnaires and the panellists who participated in this Delphi study can be reviewed in Appendix 1.

Descriptive analysis was carried out to learn the panellists' views on the future of iTV and model the relationship between the drivers and inhibitors of interactive TV. Methodological decisions and issues having been outlined, analysis of the data and findings will be discussed in Chapter 8.

6.5. Cross Cultural Study

6.5.1 Introduction

In this section the methodology used in a cross-cultural study to ascertain the adoption of interactive technology across three different countries – the UK, Hong Kong (China SAR) and Pakistan – is discussed. Figure 6.2 illustrates the research model employed to discern the cross-cultural variation in interactive technology adoption.

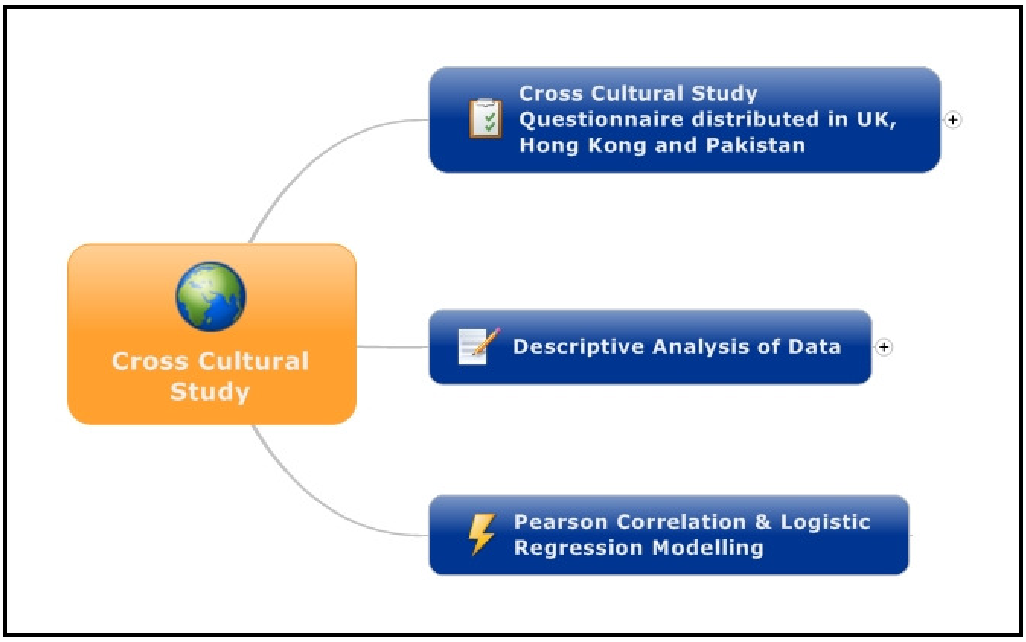


Figure 6.2 Research Model Adopted to Determine Cross-Cultural Acceptance.

To understand the factors which will encourage users in different cultures to accept an innovative technology, initially it is important to identify these factors. If the product is meant to reach the global market, the cultural influences which can either hold back or promote the product must be recognised. The aim of this thesis is to identify and understand the factors which promote the acceptance of interactive technology. In order to accomplish this, a cross-cultural study was carried out across the UK, Hong Kong and Pakistan. Very few cross-cultural studies of interactive technology acceptance have been conducted. However, some studies have explored cultural differences affecting the adoption of high technology products, including the internet and WAP: for example, research done by Slowikowski and Jarratt (1997), Gong (2007, 2009), Park and Jun (2003) and Yalcinkaya (2008). A number of cross-cultural studies are listed in Table 6.2.

Table 6.2 Cross-Cultural Studies to Determine Technology Acceptance

Author	Title
Slowikowski and Jarratt (1997)	The Impact of culture on the adoption of high technology products
Gong, Li and Stump (2007)	Global internet use and access: cultural consideration
Park and Jun (2003)	A cross cultural comparison of Internet buying behavior
Yalcinkaya (2008)	A culture based approach to understanding the adoption and diffusion of new products across countries.
Alsajjan and Dennis (2010)	Internet banking acceptance model: Cross-market examination.

The previous chapter clearly identified the importance of significant variables which have an impact on adoption of interactive technologies. It is important to discover these elements and understand the relationships among them. Various models have been derived from the literature review for evaluating the relationships among different models. To analyse interactive technology acceptance across different cultures, many factors were considered, and particularly those attributes that diverge in different cultures: for example, demographic, social economic and social interaction factors. Additional characteristics were taken account of as influencing the acceptance of interactive technology, such as interactive technology quality attributes and other interactive technology commerce-promoting characteristics such as speed, reliability, security, uniqueness and cheapness. Other factors, including knowledge, confidence, technology usage and ease of use, were also considered.

Fusilier and Durlabhi (2005) point out that limited research has been carried out to assess technology acceptance in less developed and less industrialised countries. Veiga et al (2001) emphasised the importance of cultural influence on the acceptance and use of technology. Further, Moon and Kim (2001) recommend that more research be conducted to understand technology acceptance models for less developed counties.

6.5.2 Data Collection

The current study employs a multicultural research framework consisting of consumers living in the UK, Hong Kong and Pakistan. These three countries contain a wide range of cultural differences, values and adoption behaviour. The sample was comprised exclusively of undergraduates, graduates and professionals from various backgrounds. Selecting subjects from different backgrounds increases the variance of several individual variables such as age, salary and education level. Increasing the variance when selecting individuals and evaluating these variables will help in understanding cultural differences that affect technology adoption. (Alsajjan and Dennis, 2010; Lee, 2010; Terzis and Economides, 2011; Luarn and Lin, 2005; Lee, 2009; and Lee et al 2009)

Paper questionnaires were distributed to students and academic professionals in three different academic institutions, one in each country: Edinburgh Napier University in the UK, Informatics University in Pakistan and Hong Kong University in Hong Kong. Six hundred questionnaires were distributed among the three countries, containing 38 questions of mixed question types. A small pilot study, undertaken with only 20 people, made it possible to identify any issues with the questionnaire. Also, before distributing the questionnaire, a presentation on the purpose of the research was given to a group of people to encourage them to ask as many questions as they wished about the survey, thus ensuring that they all understood the questions that were being asked.

6.5.3 Descriptive Statistics Analysis

Descriptive analysis of the data was carried out to identify the data's characteristics and determine the general tendency of the principal findings. The results were coded in SPSS for Windows for analysis.

6.5.4 Reliability – Cronbach's Alpha

Churchill (1979) suggests that this calculation should be the first measure one uses to assess the quality of the instrument. Cronbach's alpha can be considered an adequate index of the inter-item consistency reliability of independent and dependent variables (Sekaran, 1992). According to Nunnally (1978), constructs have values of 0.7 or greater. There were no cases where a loading value was less than 0.7. If the value for the loading is less than 0.7 it is usually removed from further analysis, as only constructs with alpha values above this are deemed to be reliable. The reliability of each construct was calculated by using the Cronbach's alpha measure. Each construct has a Cronbach's alpha value of greater then 0.7, which means that respondents can answer these items over and over again with a high probability of receiving similar scores for the underlying construct (see Bontis et al 2002; Shin, 2004).

6.5.5 Construction of scale values

The variables that remain after the reliability analysis are further scaled in order to make interpretation of the regression analysis easier (Bontis, 1998). The Factor Analysis method is used to create scale values, in accordance with the practice of Bontis (1998, 2000, and 2007). Factor analysis is a multivariate statistical method for reducing the number of variables and detecting structure in the relationship between variables. It was first introduced by Thurstone (1931). The Kaiser–Meyer–Olkin measure of sampling adequacy and Bartlett's test of sphericity were also referred to. The KMO statistic varies between 0 and 1. A value of 0 means that the sum of partial correlations is larger than the sum of correlations, indicating diffusion in the pattern of correlation; hence, factor analysis is likely to be inappropriate. A value close to 1 indicates that patterns of correlations are relatively stable and so factor analysis should yield distinct and reliable factors. Kaiser (1974) recommends accepting values greater than 0.5.

6.5.6 Bivariate and Multivariate Analysis

In bivariate analysis, the Pearson correlation coefficient makes it possible to measure the degree of association between variables. Pearson correlation coefficients (r) can only take on values from -1 to +1. This value will indicate the strength of the relationship between two variables. A correlation of 0 indicates no relationship at all, a correlation of 1.0 indicates a positive correlation and a value of -1.0 indicates a negative correlation. A coefficient value (p-value) of less than 0.05 suggests that the variables are significant.

Logistic regression is a type of predictive model which is used in the analysis because of the presence of dichotomous variables (Use Interactive Technology/ No Use Interactive Technologies) (Thomas et al 2006); and, as Press and Wilson (1978) have suggested, the probability of usage must lie between 0 and 1 (Lasser et al 2005). In general, the logistic regression model has the form

$$\log\left[\frac{p}{1-p}\right] = \beta_0 + \beta_1\chi_1 + \beta_2\chi_2 + \dots\dots\dots + \varepsilon_t \qquad \textit{Equation 1}$$

– where p is the probability of the outcome of interest, β_0 is an intercept term, β_0 is an intercept term, β_i is the coefficient associated with the corresponding explanatory variable Xi. (Thomas et al 2006; Bienstock et al 2008; Shin, 2007).

Three measures of the model's performance were reviewed, using the chi-square goodness-of-fit test, coefficients and the significance of all the independent variables. To reject the null model, the significance needs to be below 0.05. The Hosmer and Lemeshow Goodness of Fit test divides subjects into deciles based on predicted probabilities. Then it computes a chi-square from observed and expected frequencies. If the Hosmer and Lemeshow Goodness of Fit test statistic is ($p<0.05$) or less, then the null hypothesis, that there is no difference between the observed and predicted values of the dependent, can be rejected. If it is greater, the implications are that the model's estimates fit the data at an acceptable level, the model does explain some variance and the variables are significant to some degree. The variables in the model are assessed and if they are significant then the significance level will be below ($p < 0.05$). Logistic modelling to determine the relationship between variables for technology adoption has been used by many researchers such as Lassar (2005), Autry et al (2010) Shin (2007), Deng et al (2004), Gerpott (2011), Cerpa et al (2010), Lee et al (2009), and Yu and Tao (2009). Figure 6.3 shows the research model for the Cross-Cultural study.

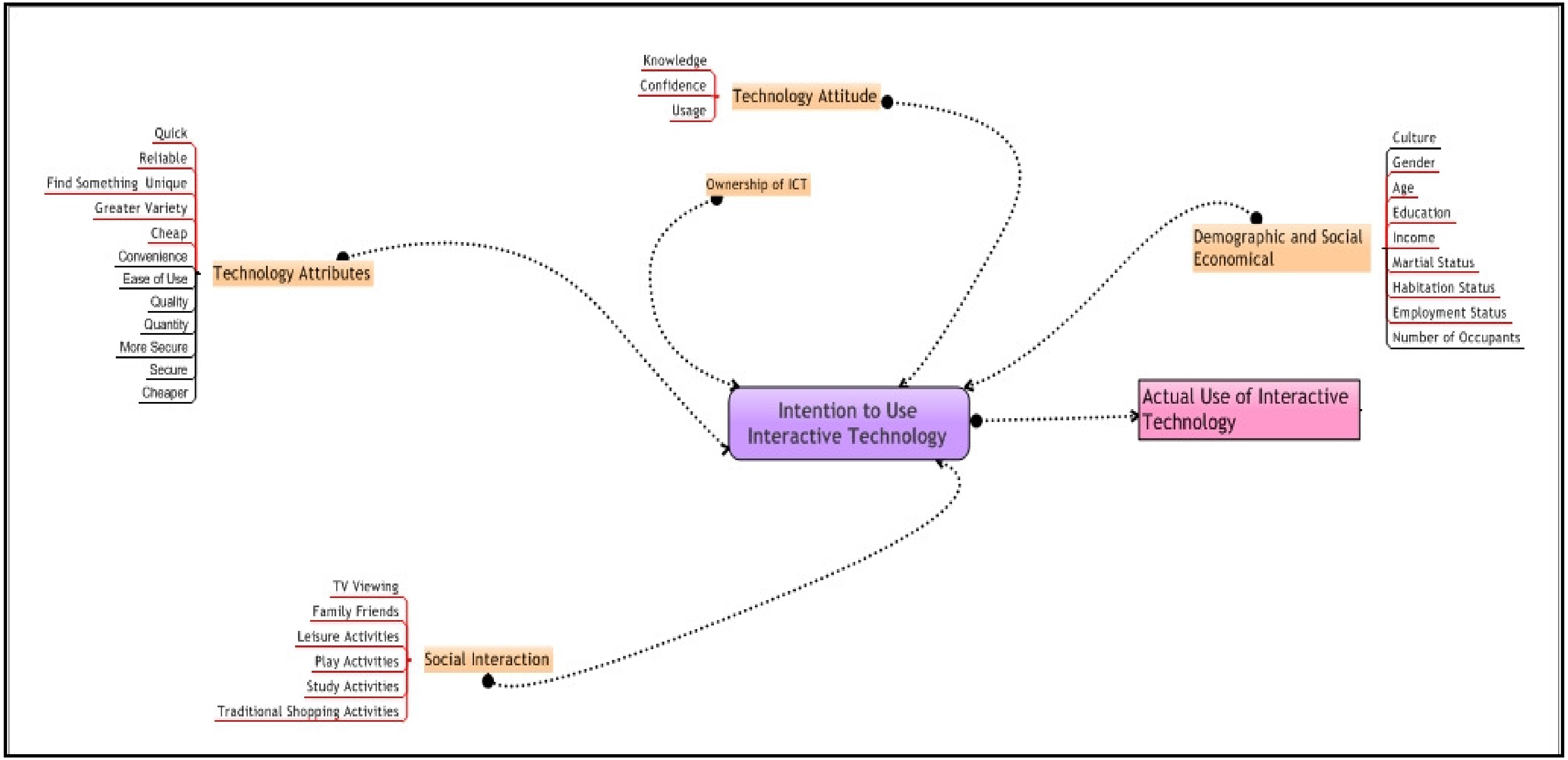


Figure 6.3 Cross-Cultural Technology Acceptance Model Variables

6.6. UK Technology Acceptance Study

In this section the methodology with which to determine a technology acceptance model of interactive technologies is established. To find an overall technology acceptance model, additional factors were considered such as Risk, Technological Quality, Demographic and Socio-Economic factors, Enjoyment, Experience and External Influences. Illustrated in Figure 6.4 is the research model adopted to establish a Technology Acceptance model for interactive technologies.

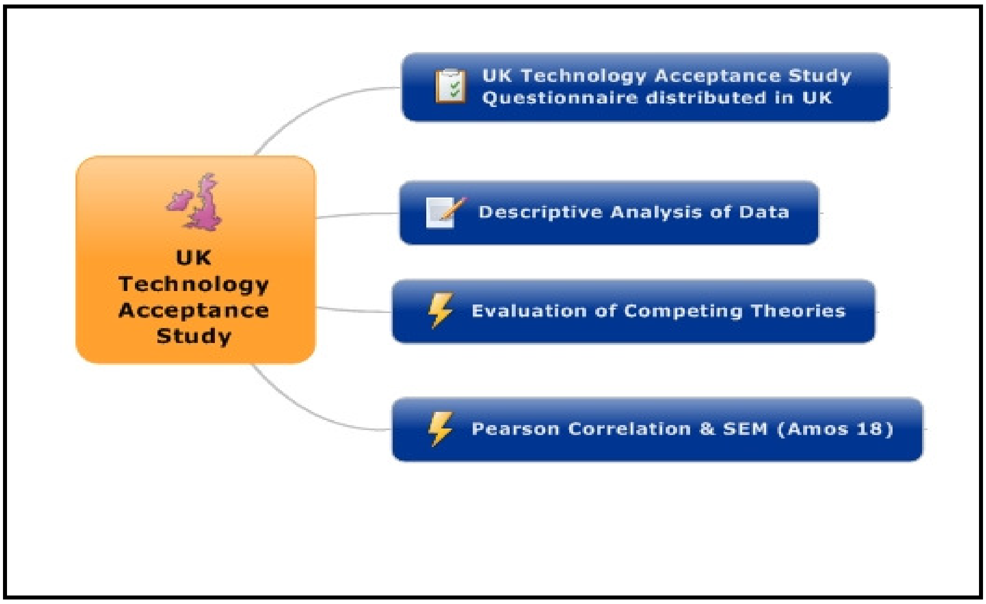


Figure 6.4 Research Model Adopted to Determine Technology Acceptance Model.

6.6.1. Data Collection

The literature review highlighted the importance of those variables which influence the future usage and adoption of interactive technologies. One of the objectives of this study was to evaluate the variables in order to predict the elements which can influence the growth and adoption of interactive technologies. The questionnaire measured different aspects of Attitude, Social Influences, Perceived Behaviour Control, Technological Factors, Demographics, Risk and Quality. It contained 42 questions designed to measure various factors influencing the growth and adoption of interactive technologies; most of the questions employed a 5-point scale ranging from 1 to 5 (Strongly Agree to Strongly Disagree). Participants in the survey were asked to evaluate the factors which might promote their interest in using and adopting interactive technology. The questionnaire was distributed to 200 people. To ensure the selection of a broader sample, the questionnaire was also posted on Facebook and a paper version was distributed and collected in some residential areas. 117 participants responded to it: a response rate of 58%. Unfortunately, 38 questionnaires were only partially completed and so were removed for further analysis. In total there were 78 completed questionnaires which were analysed. 51% of the respondents were female and 49% were male. 56% of the respondents were within the 20–29-year-old age group. The results were statistically analysed to assist in determining the elements likely to influence the growth and adoption of interactive technologies. The questionnaire can be reviewed in Appendix 3.

This study analyses the results in three parts: firstly, a descriptive analysis of the data; secondly, evaluation of the existing three competing theories of technology acceptance; and thirdly, construction of an overall interactive technology acceptance model for the UK. Illustrated in Figure 6.5 is the overall research model adopted for determining an Interactive Technology Acceptance Model.

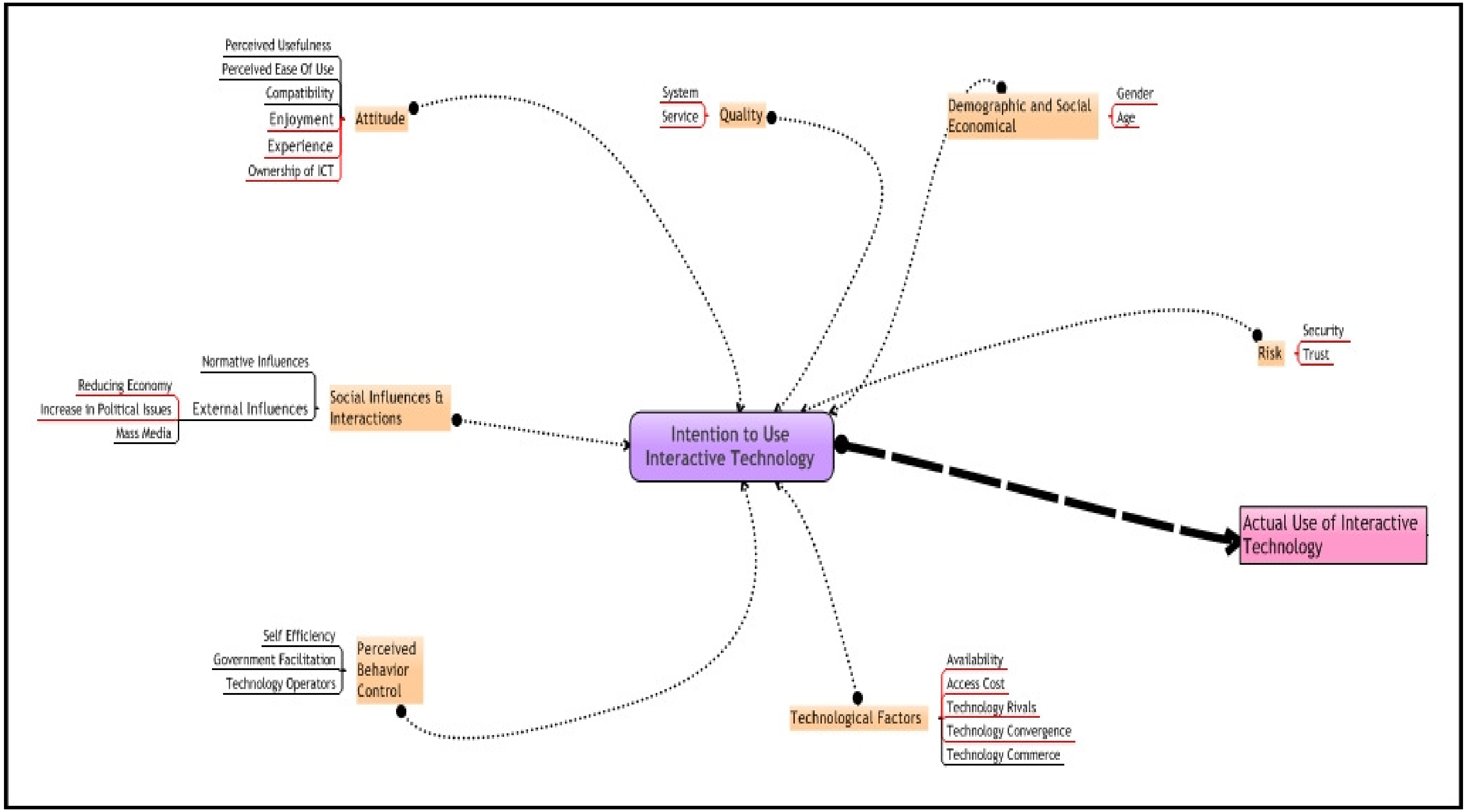


Figure 6.5 Research Model for UK Adoption of Interactive Technologies

6.6.2. Testing Complementary Theories

The aim of this study is to evaluate three complementary theories, the Technology Acceptance Model (TAM), The Theory of Planned Behaviour (TPB) and the Decomposed Theory of Planned Behaviour (DTPB), to establish the best model for determining the acceptance of interactive technology. There have been some attempts to refine the TAM/TPB/DTBP so as to predict and explain intention behaviour more effectively. For example, Taylor and Todd (1995) found that the DTPB is superior to the TPB and TAM in understanding behavioural intention to use IT. Additionally, Chau and Hu (2001) proposed that the TAM is superior to the TPB in explaining behavioural intention of professional workers. Many previous empirical comparisons of complementary theories have been constructed, as summarised in Table 6.3.

Table 6.3 Previous Empirical Studies on Testing Competing Theories (TAM, TPB, DTPB)

Author (s)	**Context**
Taylor and Todd (1995)	IT
Chau and Hu (2001)	Telemedicine Technology
Hung and Chang (2005)	WAP Service
Lin (2007)	Online Shopping
Huh , Kim and Law (2009)	IT in hotels

However, only limited empirical study has been carried out to examine and compare the validity and explanatory utility of the prevalent intention-based complementary theories in the interactive technology context. Although there have been many studies of individual technologies such as WAP and the internet, little investigation has been undertaken concerning the acceptance of these interactive technologies.

6.6.3. Descriptive Analysis

In order to assess the influence of various elements on the adoption of interactive technologies, descriptive analysis of the elements will first be carried out to identify the various characteristics of the elements and trends in their influence on interactive technology acceptance. The results were coded in SPSS for Windows for analysis.

6.6.4. Reliability – Cronbach's Alpha

First, a reliability test was applied to the elements to ensure that the variables were reliable and valid. As discussed in an earlier section, Nunnally (1978) suggests that this calculation should be the first measure one uses to assess the quality of an instrument. Bontis et al (2002), Shin (2004) and Nunnally (1978) all have advised that the acceptable value for constructs is 0.7 or greater. Any variable with a value below 0.7 should be excluded from further analysis.

6.6.5. Construction of scale values

The variables that remain after the reliability analysis are further scaled in order to make correlation and modelling much easier. The method used to create scale values has been previously used by Bollen (2005). To create the scale values, the mean of each independent variable and dependent variable for usage of technology is calculated. Usually factor analysis is adopted to construct scale values. Items of similar scale which refer to likely future use of the technologies will be summed to create variables for measuring each "*future use*" of the technologies. However, in this instance factor analysis is not used to create an independent variable as only two to three variables were combined to create independent variables.

6.6.6. Bi-variant Analysis

Further to this, Pearson's correlation was carried out to discover any underlying relationships between variables. A coefficient value (p-value) of less than 0.05 suggests that the variables are significant. Variables which were not significant were removed from any later analysis. The significant variables were additionally analysed by applying structural equation modelling.

6.6.7. Structural Equation Modelling

The hypotheses are operationalised using structural equation modelling (SEM). This technique adopts Multivariate analysis and Regression analysis to investigate the relationship between variables. In the process of analysing the data, the significance of the estimated relationship, plus the degree of confidence that the true relationship is close to the estimated relationship, are also assessed. The goodness of fit statistics were used to determine the goodness of fit of the model. In particular, path models are employed to model the interlinked nature of the models. AMOS 17.0 will be used as software to facilitate this (Hung et al 2005; Ha and Stoel, 2009; Im et al 2008).

6.7. Summary and Conclusion

This chapter has discussed the methodology adopted to achieve the objectives of the thesis. Selection of methods has been drawn from analysis of primary and secondary data. To achieve a better understanding of the future of interactive technologies, technological forecasting models are initially adopted to determine a valid model which can be applied to iTV. To understand further the acceptance of interactive technologies, a cross-cultural study is conducted and an adoption model for the UK is established. In addition, the validity of complementary theories is assessed before determining an overall technology acceptance model for interactive technologies. The following four chapters focus on the analyses of the data collected. The table below summarises the hypotheses to be assessed in this thesis and the methodology adopted for evaluating them.

Table 6.4 Summary of the Hypotheses and Research Methods

ID	Hypothesis	
	Demographic and Social Economic Factors	**Research Method**
H1	Demographic and Social Economic differences significantly influence technology adoption.	Cross Cultural Study
H1(a)	Culture differences significantly influence technology adoption.	Cross Cultural Study
H1(b)	Gender is significantly associated with Intention to use interactive technology.	Cross Cultural Study
H1(c)	Increasing Age is negatively associated with the future growth of interactive technologies	Cross Cultural Study / Delphi Study
H1(d)	Educational attainment is significantly associated with the adoption of interactive technology.	Cross Cultural Study
H1(e)	Income will be significantly associated with the acceptance of interactive technology adoption.	Cross Cultural Study
H1(f)	Employment Status will be significantly associated with the adoption of interactive technology.	Cross Cultural Study
H1(g)	A growing number of Household Occupants will be positively associated with the adoption of interactive technology	Cross Cultural Study
H1(h)	Marriage Status will be significantly associated with the acceptance of interactive technology adoption.	Cross Cultural Study / Delphi Study
H1(i)	Decrease in the Physically Active Population is positively associated with the future growth of interactive TV	Delphi Study
H1(j)	Increase in Hedonistic Lifestyle is significantly associated with the future growth of interactive TV	Delphi Study
	Attitude Factors	**Research Method**
H2	Individuals' Attitude towards interactive technology is positively associated with their use of the technology.	Competing Theories /TAM Study
H2(a)	Perceived Usefulness is significantly associated with attitude.	Competing Theories /TAM Study
H2(b)	Perceived Ease of Use towards interactive technology is significantly associated with attitude and use of the technology.	Competing Theories /TAM Study/ Delphi study
H2(c)	Perceived Usefulness is significantly associated with Perceived Ease of Use	Competing Theories /TAM Study
H2(d)	Compatibility of interactive technology is positively associated with attitude.	Competing Theories /TAM Study
H2(e)	Increasing Knowledge of interactive technology is positively associated with its use.	Cross Cultural Study
H2(f)	Increasing Confidence in one's ability to use interactive technology is positively associated with its adoption.	Cross Cultural Study
H2(g)	Increasing Usage of interactive technology is positively associated with its Future Use.	Cross Cultural Study
H2(h)	Enjoyment of interactive technology is significantly associated with attitude.	Competing Theories /TAM Study
H2(i)	Experience and Ownership of Technology is positively associated with individuals' use of interactive technology.	Cross Cultural Study
	Social Influences and Interaction	**Research Method**
H3	Social Influences and Interaction are significantly associated with individuals' use of interactive technology.	Cross Cultural Study / TAM Study
H3(a)	Normative Influences is significantly associated with individuals social influences.	TAM Study
H3(b)	A decrease in Political Stability is significantly assoicated with Social Influences.	Delphi Study
H3(c)	A decrease in Economic Growth is significantly associated with Social Infleunces	Delphi Study
H3(d)	Mass Media is significantly associated with Social Influences.	TAM/Delphi Study
	Perceived Behaviour Control Factors	**Research Method**
H4	Perceived Behaviour Control is positively associated with Intention to use interactive technology.	TAM Study
H4(a)	Self-Efficacy is significantly associated with perceived behaviour control.	TAM Study
H4(b)	Government Facilitation is significantly associated with perceived behaviour control.	TAM Study
H4(c)	Technology Operators are positively associated with perceived behaviour control.	TAM Study
	Technological Factors	**Research Method**
H5(a)	An increase in Technology Rivals is significantly associated with the future growth of Interactive Technology.	Delphi Study
H5(b)	The increase in Technology Commerce is significantly associated with the future growth of interactive technology.	Delphi Study
H5(c)	Accessibility is significantly associated with Intention to use interactive technology.	TAM Study
H5(d)	Decreased price is significantly associated with Intention to use interactive technology.	Delphi Study
H5(e)	Technological Convergence is significantly associated with Intention to use interactive technology.	Delphi Study
	Quality Factors	**Research Method**
H6	Quality is significantly associated with Intention to use interactive technology.	Delphi Study
H6(a)	System Quality is positively associated with quality of the interactive technology.	Delphi Study
H6(b)	Service Quality is positively associated with quality of interactive technology.	Delphi Study
	Risk Factors	**Research Method**
H7 (a)	Security is positively associated with Intention to use interactive technology.	TAM Study / Delphi Study
H7(b)	Trust is positively associated with Intention to use interactive technology.	TAM Study / Delphi Study

Chapter 7 Technological Forecasting

7.1. Introduction

This chapter presents the results of analysing secondary data from Euromonitor (an international marketing database), BARB – Broadcast Audience Research Board, and Wakefield Council. Data for various technologies of internet and mobile services, considered as predecessors of interactive technologies, were analysed. This analysis the data will help to determine a suitable technological forecasting model which can be applied to forecast the future growth of interactive technologies, especially that of iTV. Chapter 3 contained a comprehensive review of the different technological forecasting models and, further to this, Chapter 6 provided the methodology employed in analysing the secondary data.

The research model identified the following key stages of the research, the following objectives of which were all successfully met.

Objective 1: *Identify and apply suitable technological forecasting approach to identify the best models for the UK, Hong Kong and Pakistan.*

To achieve this objective, extensive literature research was carried out. The literature research also assisted in developing the methodology approach. secondary data, concerning predecessors of interactive technologies, were identified from Euromonitor. Secondary data were analysed for three different nations, the UK, Hong Kong and Pakistan, which have distinct cultures and levels of disposable income. Forecasting models applied to these secondary data made it possible to identify the best models for forecasting the future of interactive technologies, by applying the following selection criteria:

- The observed fitness between actual and forecast curves
- Low RMSE and MAPE value
- Analysis of future points with actual data
- Comparison of Best Model future forecast with Euromonitor forecast.

The following data sets were used to establish an appropriate technological forecasting model:

- PCs in use
- Mobiles in use
- Internet in use
- Satellite TV households.

Analysing the above data permitted the establishment of an appropriate model for forecasting the future of interactive technologies such as interactive TV. Obtaining valid data for this purpose was difficult, since interactive TV data are mostly protected by BSKYB and gaining access to them proved impossible. Therefore to forecast the future of interactive TV only UK data were analysed, there being none available for Pakistan and Hong Kong, since digital TV infrastructure has not been fully implemented in those countries.

Objective 2: *Apply to secondary data for interactive technologies the technological forecasting model identified as best, in order to forecast the future growth of these technologies, especially iTV.*

To achieve this objective, secondary data were obtained from three different sources: Euromonitor, BARB and Wakefield Council. Data were obtained for Digital Satellite Pay TV, Digital TV Households, Interactive TV red button users and Users of Interactive TV Wakefield Council pages. The reason different data were collected from different sources was the aforementioned restricted access to data currently protected by Sky TV, the main providers of this service.

Objective 3: *Forecast the future of interactive technologies and iTV*

This research permitted the assessment of various technological forecasting models in order to identify the best model for predicting the future of interactive technologies, in particular that of iTV. This chapter will further discuss the findings so as to reach conclusions about the future of interactive technologies.

7.2. Technological Forecasting Results for PCs in Use

7.2.1 Forecasting PCs in Use in the UK

In this section, the results of applying various diffusion models to different technologies in order to forecast their growth are presented. Firstly, the diffusion models were used to forecast the future growth of PCs in use. This takes account of portable and non-portable personal computers in business and residential use. The data were displayed in terms of millions of users, so to gain a more accurate picture of growth the millions-of-users figures were divided by the estimated population. The results are shown in Figure 7.1.

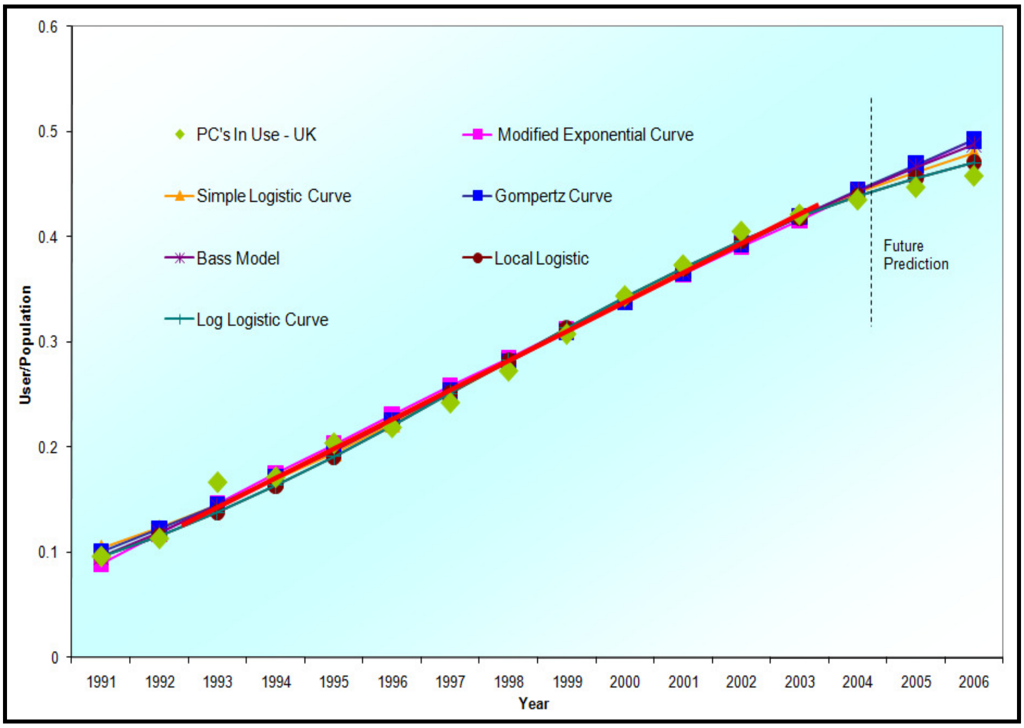


Figure 7.1 Forecasting PCs in Use in the UK

Examination of these results helped to establish the best forecasting model for PCs in use in the UK. All of the forecasting models produced a linear prediction. Using the UK data, the forecasting results show that the Simple Logistic model (1.10×10^{-3}) has the lowest RMSE value while the Log Logistic Curve (3.15×10^{-3}) had the highest. From these values it can be discerned that

the Simple Logistic Model had a better fit between the actual and predicated data, as its RMSE was lower than that of the rest of the models.
Examining future prediction compared to actual results, it can be seen that the Local Logistic Curve (2.42%) had the smallest MAPE value for the future prediction points. The Bass Model (5.23%) and Gompertz Curve (5.88%) showed high MAPE values, but the Modified Exponential Curve (5.94) had the highest.

The results suggest that the Simple Logistic model is more accurate when comparing predicted values against actual values. However, the results also show that the Local Logistic model is better at predicting future values, since it had the smallest MAPE value. The Simple Logistic and Local Logistic models were further analysed to determine how accurate their forecasts were in comparison with the Euromonitor prediction.

7.2.2 Forecasting PCs in Use in Hong Kong

Shown in Figure 7.2 are the forecasting results for PCs in use in Hong Kong. Evaluation of these results will determine the best forecasting model for this category. After the data set was fitted into the chosen models and the actual and forecast values were presented, the results showed that the Simple Logistic model ($2.07X10^{-4}$) had the smallest RMSE compared to other models but the Bass Model ($2.70X10^{3}$) had the largest RMSE.

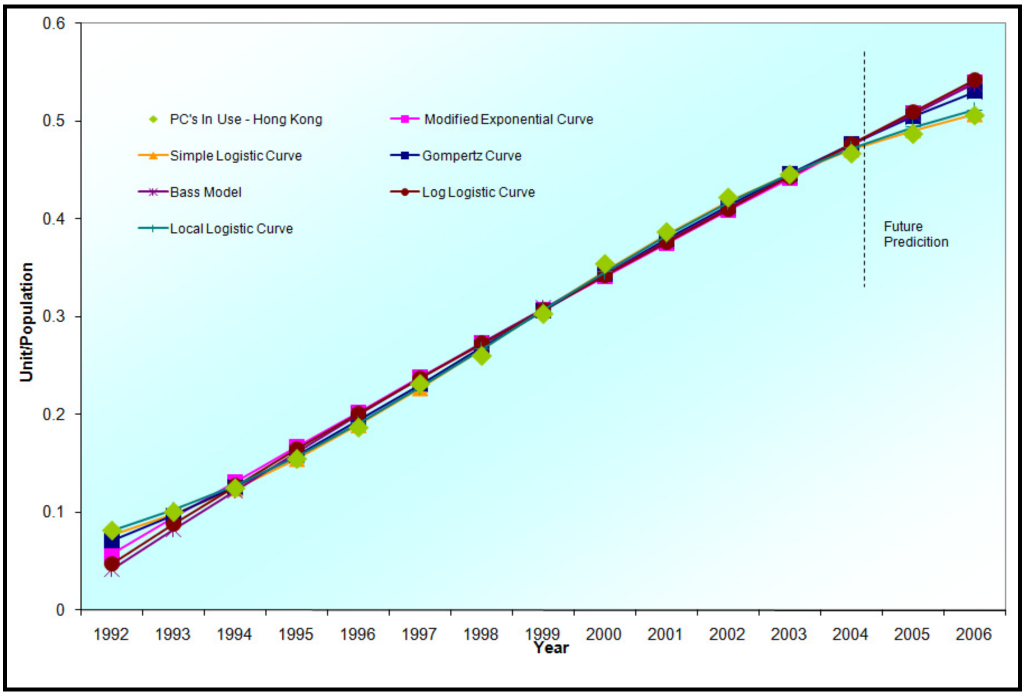


Figure 7.2 Forecasting PCs in Use in Hong Kong

Analysis of the future prediction values for the different growth forecasting models reveals that the Simple Logistic Curve (0.52%) had the lowest MAPE error compared to the rest of the models. Modified Exponential Curve (5.20%) all had relatively high MAPE errors, but the Log Logistic Curve (5.60%) had the highest.

These results demonstrate that the Simple Logistic Model has a smaller RMSE and MAPE than the Local Logistic Curve, Gompertz Curve and other models. Thus, for further analysis the Simple Logistic Curve will be selected and compared to Euromonitor's future predicated values. This procedure will help to determine if the Simple Logistic Curve is a suitable model to utilise in forecasting the future of interactive technologies for Hong Kong.

7.2.3 Forecasting PCs in Use in Pakistan

The forecasting results for PCs in use in Pakistan are presented in Figure 7.3. Analysing these results will determine the best forecasting model for this category. However, this market is less mature, occupying the infant part of the growth curves, so the ability to forecast its future is expected to be poor. Using the data for Pakistan the forecasting results show that the Bass Model ($2.36X10^{-6}$) had the lowest RMSE value. While the Local Logistic Curve ($4.15X10^{-5}$), which produced a logistical predication, resulted in a higher RMSE compared to the rest of the models.

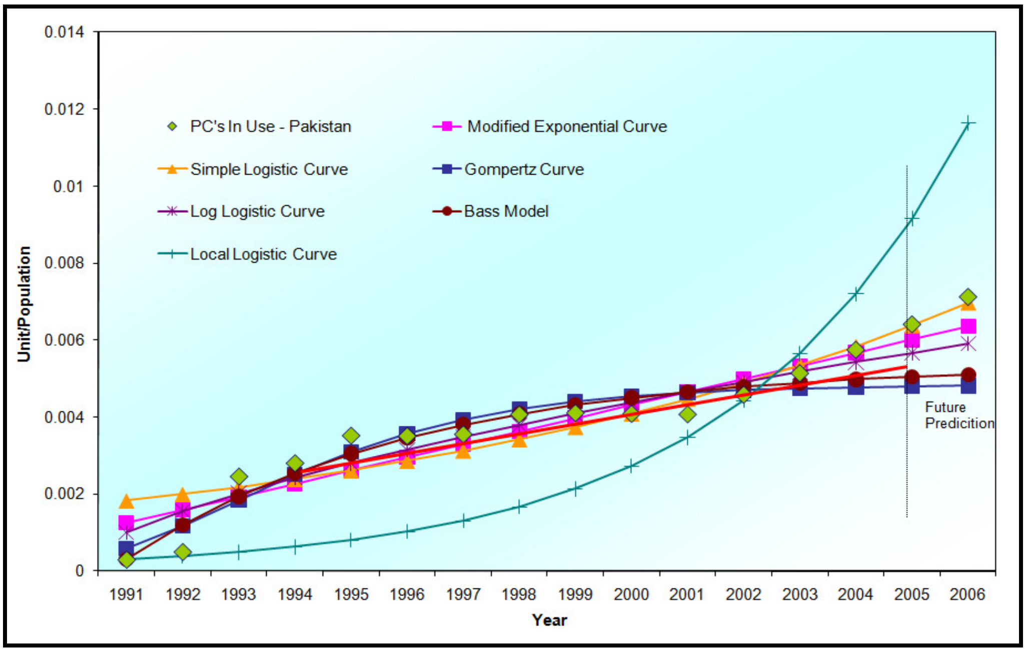


Figure 7.3 Forecasting PCs in Use in Pakistan

Analysis of future predictions compared to actual results shows that the Simple Logistic Curve (1.17%) had the smallest MAPE compared to the rest of the forecasting models. The highest MAPE was produced by the Local Logistic Curve.

The results illustrate that the Bass Model and Simple Logistic model are prospective candidates for predicting the future of PC's in use in Pakistan, inasmuch as the Bass Model had the smallest RMSE value and Simple Logistic Model the smallest MAPE value. These models will be further compared with the Euromonitor forecast for PCs in use in Pakistan.

7.2.4 Cross-Cultural Comparison of PCs in Use

The forecasting results determined from the models were further compared cross-culturally, the lowest MAPE determined for the overall data set being presented in Figure 7.4.

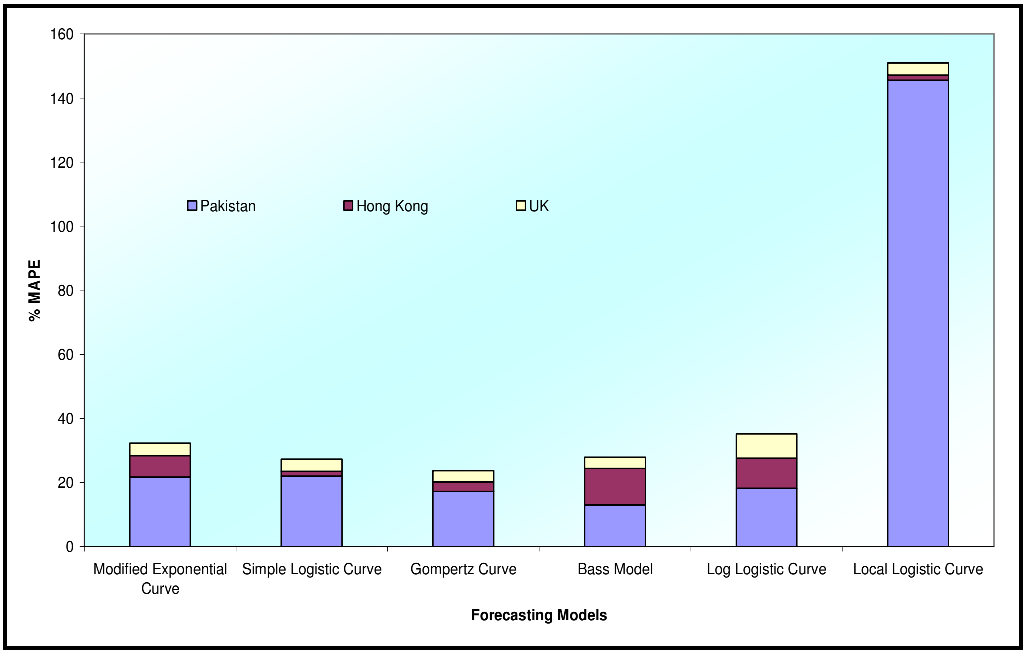


Figure 7.4 Cross-Cultural Comparisons of Model Fitting for PC Use

Overall, Pakistan has produced the highest MAPE compared to the other countries, perhaps because the growth of PCs in use in Pakistan is still at a low level in an immature market.

When comparing the model across different countries it can be clearly seen that overall the Simple Logistic Curve for Hong Kong (1.46%) has produced the lowest MAPE compared to the rest of the models across the three different countries. For the UK and Pakistan, the Bass Model produced the smallest MAPE compared to the other models. Table 7.1 summarises the models identified as best for each country for predicting the future of PCs in use. These models were further selected and their forecasts compared with that of Euromonitor, in order to determine the best model with which to forecast the future of PCs in use for each country.

Table 7.1 Best Models for Forecasting the Future of PCs in Use

Country	Smallest RMSE	Smallest Future MAPE
UK	Local Logistic	Simple Logistic model
Hong Kong	Bass model	Simple Logistic Model
Pakistan	Simple Logistic Model	Simple Logistic Model

7.2.5 Comparing Future Forecast with Euromonitor

Comparing the selected models' future predictions with those of Euromonitor will help to validate each model. This in turn will serve to confirm the results and soundness of the forecasts.

In Figure 7.5 the best models are compared with the Euromonitor future forecast. Comparing the future forecasting models with the future Euromonitor forecast has permitted confirmation of the reliability of these models as regards predicting the future of the products. In addition, the comparison can help in comparing the forecasting results with other predicated results.

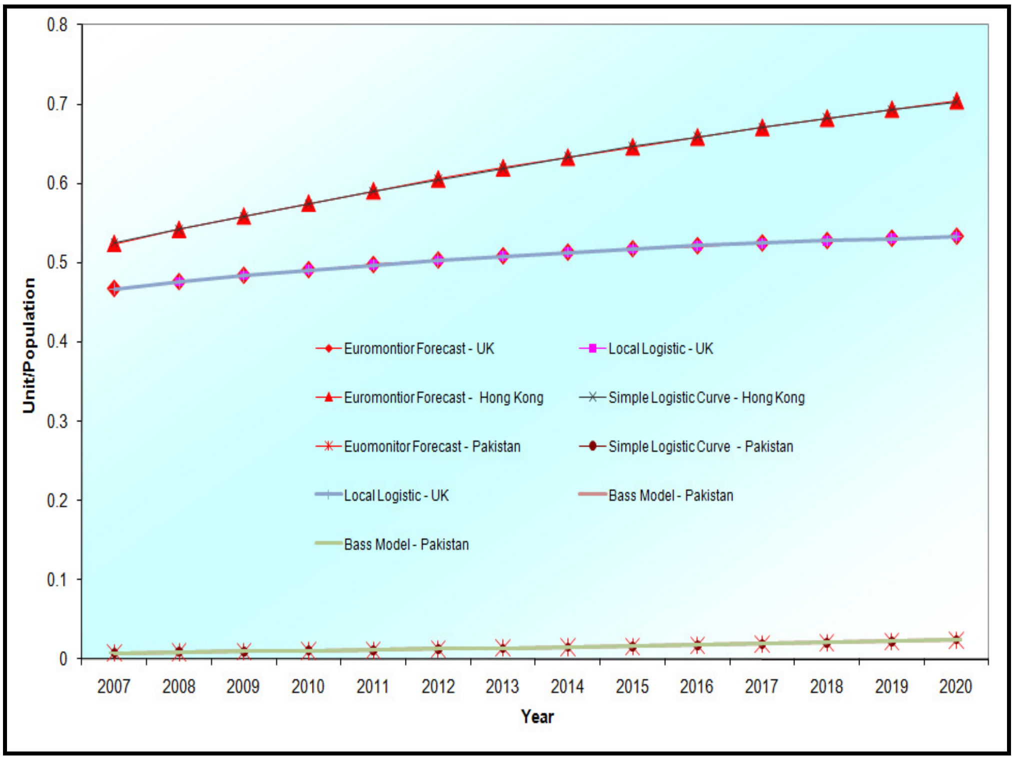


Figure 7.5 Cross-Cultural Forecast Euromonitor vs Best Fit Models PCs in Use.

All the best fit models for the UK, Pakistan, and Hong Kong have shown the same trend as the Euromonitor forecast. Further to this, Table 7.2 displays a summary of the RMSE and MAPE results obtained from each model.

Table 7.2 Comparison of Best Models for Forecasting Future PCs in Use

Pc's In Use	UK		Hong Kong	Pakistan	
Technological Forecasting Model	Local Logistic Model	Simple Logistic Model	Simple Logistic Model	Bass Model	Simple Logistic Model
Expression	$Y_t = \frac{mY_{t-1}}{Y_{t-1}+e^{-q}(m-Y_{t-1})}+\varepsilon_t$	$Y_t = \frac{m}{1+ce^{(-bt)}}+\varepsilon_t$	$Y_t = \frac{m}{1+ce^{(-bt)}}+\varepsilon_t$	$Y_t=(P+\frac{q}{m}Y_{t-1})(m-Y_{t-1})+\varepsilon_t$	$Y_t = \frac{m}{1+ce^{(-bt)}}+\varepsilon_t$
RMSE	2.174E-07	1.549E-07	3.323E-06	1.190E-08	6.039E-07
MAPE (%)	0.02	0.02	0.07	0.19	1.38
m	0.5515	0.5519	0.8384	1.2260	0.6148
b		0.2206	0.2310		0.0020
c		0.1246	0.0872		0.0854
p				0.0628	
q	0.1259			0.0003	

Analysis of the results and comparison of the forecast with Euromonitor shows that the Simple Logistic model is the best for the UK as it has the smallest RMSE ($1.55X10^{-7}$) compared to the Local Logistic Model ($2.174X10^{-7}$), although both models have the same MAPE value of 0.02%. The best model identified for Pakistan was the Bass Model, as it has a smaller RMSE of ($1.19X10^{-8}$) than the Simple Logistic Model ($6.04X10^{-7}$). In addition, the Simple Logistic Model has a higher MAPE (1.38%) than the rest of the models. The best model for Hong Kong was the Simple Logistic Model ($3.23X10^{-6}$), with a small MAPE value of 0.07%.

Comparison of the cross-cultural Euromonitor forecast with the selected models has revealed significant findings. It seems that the Euromonitor organisation has used the same or similar technological forecasting models to predict the future of PCs in use in the UK, Hong Kong and Pakistan. The forecast between the best fit models and Euromonitor were the same. This validates the selection of models for predicting the future of PCs. The summary of the technological forecasting results for PCs in use is displayed in Table 7.3.

Table 7.3 Growth Model Analysis for PCs in Use

PC's in Use		Modified Exponential Model	Simple Logistic Model	Gompertz Model	Bass Model	Log Logistic Model	Local Logistic Model
Expression		$Y_t = m - ce^{(-bt)} + \varepsilon_t$	$Y_t = \frac{m}{1+ce^{(-bt)}} + \varepsilon_t$	$Y_t = me^{(-c(e^{(-bt)}))} + \varepsilon_t$	$Y_t = (P + \frac{q}{m} Y_t - 1)(m - Y_t - 1) + \varepsilon_t$	$Y_t = \frac{m}{1+ce^{-b\ln(t)}} + \varepsilon_t$	$Y_t = \frac{mY_{t-1}}{Y_{t-1} + e^{-q}(m - Y_{t-1})} + \varepsilon_t$
Pakistan	**RMSE**	4.661E-06	7.102E-06	3.071E-06	2.358E-06	3.292E-06	4.149E-05
	MAPE (%)	21.66	22.02	17.17	13.06	18.16	143.53
	Future Forecasting MAPE%	*8.46*	*1.17*	*28.75*	*24.66*	*14.18*	*53.23*
	m	*1.0076*	*0.6149*	*0.0048*	*1.2282*	*9023.5731*	*0.4763*
	b	*0.0003*	*0.0017*	*3.0873*		*0.0010*	
	c	*1.0067*	*0.0898*	*0.3859*		*0.6419*	
	q				*-0.1769*		*0.2452*
	P				*0.0008*		
Hong Kong	**RMSE**	1.788E-03	2.073E-04	5.908E-04	2.700E-03	2.347E-03	2.633E-04
	MAPE (%)	6.75	1.46	2.97	11.31	9.37	1.60
	Future Forecasting MAPE%	5.20	0.52	4.05	5.07	5.60	1.25
	m	*3.7512*	*0.5624*	*0.7392*	*3.2445*	*9023.5731*	*0.5761*
	b	*0.0100*	*0.0461*	*3.0905*		*0.0471*	
	c	*3.7679*	*0.2895*	*0.1394*		*0.9023*	
	q				*-0.0102*		*0.2772*
	P				*0.0129*		
UK	**RMSE**	1.407E-03	1.100E-03	1.106E-03	1.122E-03	3.148E-03	1.359E-03
	MAPE (%)	3.91	3.84	3.55	3.46	7.65	3.74
	Future Forecasting MAPE%	5.94	3.93	5.88	5.23	3.18	2.42
	m	*2.9884*	*0.5727*	*0.7732*	*0.6558*	*9023.5731*	*0.5361*
	b	*0.0100*	*0.0877*	*2.2584*		*0.7182*	
	c	*2.9280*	*0.2092*	*0.1005*		*0.0653*	
	q				*0.1246*		*0.2332*
	P				*0.0233*		

7.3. Forecasting Mobile Telephones in Use

Mobile Telephones in Use data, extracted from Euromonitor, accounts for all the mobile telephones using digital (Global System for Mobile Communications-GSM or Code-Division Multiple Access-CDMA) or analogue narrowband networks. The forecasting models were fitted against the data on mobile telephones in use for the UK, Hong Kong and Pakistan.

The summarised results in Table 7.4 showed that the Simple Logistic Model ($2.49X10^{-2}$) has yielded the lowest RMSE value compared to the rest of the models for UK. So far the results show that for forecasting the future of mobile telephone use in the UK, the Simple Logistic Curve is the best model. However it is also important to determine how reliable this model is for predicting the future growth of the product. Therefore the future prediction is compared to actual results for the years 2005 and 2006. Analysis of the future prediction compared to actual results shows that the Gompertz Curve (0.55%) had the smallest MAPE compared to the remaining forecasting models. It can be concluded that the best models for forecasting mobile telephones in use in the UK are the Simple Logistic Model, which produced the smallest RMSE, and the Gompertz Model, which gave a smaller MAPE in forecasting future values.

Forecasting Mobile Telephone Use in Hong Kong the results showed that the Gompertz Model ($1.08X10^{-2}$) had the lowest RMSE value compared to the rest of the models. Analysis of the future prediction compared to actual results shows that the Gompertz Curve (1.34%) had the smallest MAPE compared to the rest of the forecasting models. As a result the Gompertz model can be identified as the best model for forecasting mobile telephone use in Hong Kong, since it produced the smallest RMSE and MAPE values compared to the rest of the models.

Forecasting Mobile Telephone Use in Pakistan the results showed that the Simple Logistic Curve ($8.94X10^{-6}$) produced the lowest value of RMSE compared to other models. Analysis of the future prediction compared to actual results reveals that the Gompertz Curve (33.46%) had the smallest MAPE. As a result, it seems that the best models for predicting mobile telephones in use in Pakistan are the Simple Logistic Curve and the Gompertz Curve, since these models produced the smallest RMSE and MAPE values. The Simple Logistic Curve produced a low RMSE and there was very little difference between the MAPE values of the Gompertz Curve and of the Simple Logistic Curve.

Cross-Cultural comparison of Mobile Telephones in Use was analysed and the results are shown in figure 7.6.

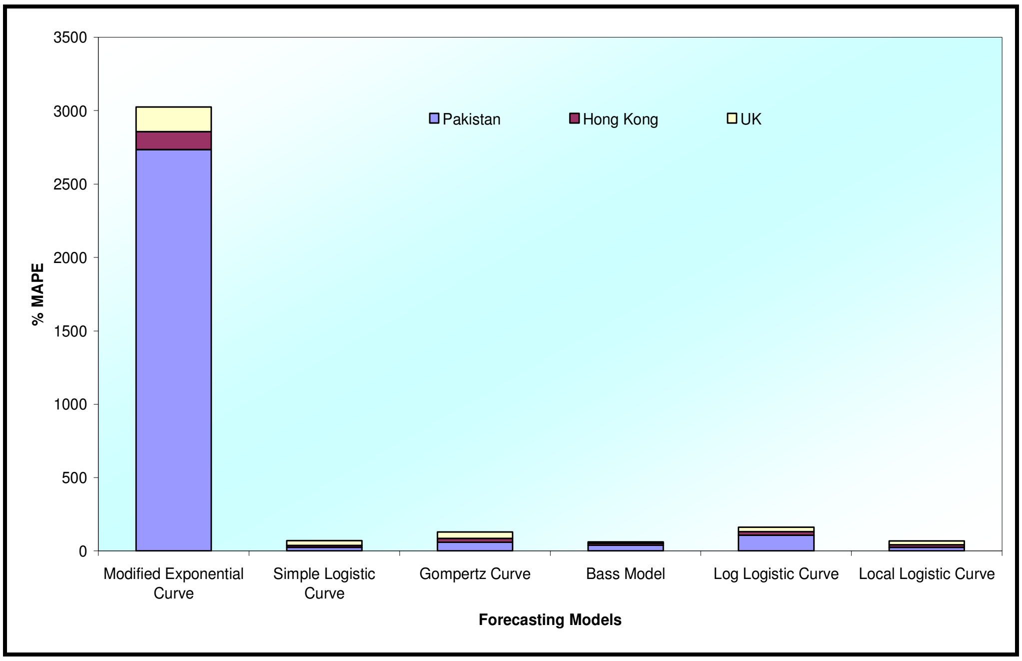


Figure 7.6 Cross-Cultural Comparison of Model Fitting For Mobile Use

When comparing the model across different countries it can be clearly seen that, overall, the Bass Model for the UK (9.97%) has the lowest MAPE compared to the rest of the countries and forecasting models. The Simple Logistic Curve for Hong Kong (11.75%) had the second lowest MAPE. In addition, the Simple Logistic Curve for Pakistan produced the lowest MAPE compared to the rest of the forecasting models for that country. The Modified Exponential Curve resulted in an exceedingly high MAPE for all three countries, which indicates that the Modified Exponential Curve is not a suitable model with which to forecast the future of mobile telephones in use for any of the three countries. The growth models are further analysed alongside the Euromonitor forecast to check whether similar models were used to forecast the future of the products, and to identify the best model for forecasting the future of mobiles in use for each country. In Figure 7.7 the best models are compared with the Euromonitor future forecast. All three best fit models for the UK, Pakistan and Hong Kong have shown the same trend as the Euromonitor forecast.

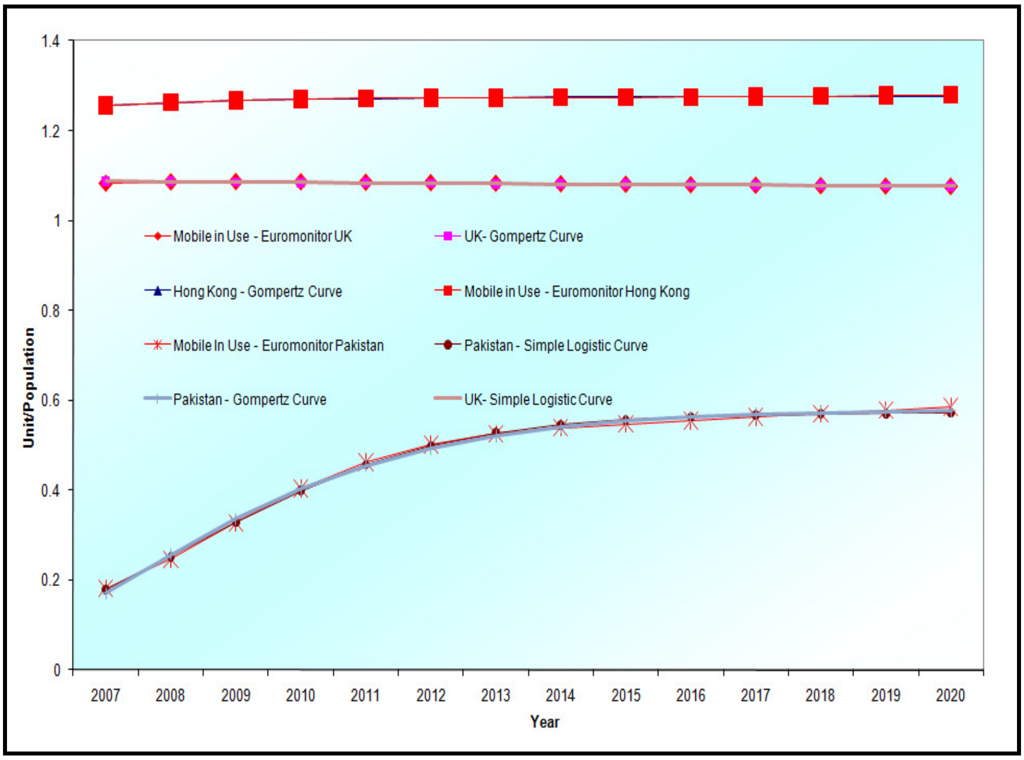


Figure 7.7 Cross-Cultural Forecast Euromonitor vs Best Fit Models Mobiles in Use

All the best fit models for the UK, Pakistan and Hong Kong have shown the same trend as the Euromonitor forecast. The results show that the best model identified for forecasting the future of mobiles in use for the UK, Hong Kong and Pakistan was the Simple Logistic Model, as it reported the smallest RMSE compared to the Gompertz Model. Comparing the future forecasting models with the Euromonitor future forecast has permitted confirmation of the reliability of these models in forecasting the future of technological products. A summary of the technological forecasting results for mobiles in use is displayed in Table 7.2.

Table 7.4 Growth Model Analysis for Mobiles in Use

Mobile In Use		**Modified Exponential Model**	**Simple Logistic Model**	**Gompertz Model**	**Bass Model**	**Log Logistic Model**	**Local Logistic Model**
Expression		$Y_t = m - ce^{(-bt)} + \varepsilon_t$	$Y_t = \frac{m}{1+ce^{(-bt)}} + \varepsilon_t$	$Y_t = me^{(-c(e^{(-bt)}))} + \varepsilon_t$	$Y_t = (P + \frac{q}{m}Y_t - 1)(m - Y_t - 1) + \varepsilon_t$	$Y_t = \frac{m}{1+ce^{-b\ln(t)}} + \varepsilon_t$	$Y_t = \frac{mY_{t-1}}{Y_{t-1} + e^{-q}(m - Y_{t-1})} + \varepsilon_t$
Pakistan	**RMSE**	5.230E-04	8.938E-06	1.06E-05	3.729E-05	1.790E-04	1.316E-05
	MAPE (%)	2734.32	44.97	60.38	39.75	107.51	25.86
	Future Forecasting MAPE%	82.79	33.81	33.46	45.20	67.99	34.04
	m	9.9972	0.2593	0.7678	1.1687	9023.5731	1.3006
	b	0.0001	0.0000	0.1014		0.0000	
	c	10.0026	0.6251	2.2555		3.2761	
	q				0.5599		0.5347
	P				0.0000		
Hong Kong	**RMSE**	1.630E-01	1.257E-02	1.082E-02	1.846E-02	4.469E-02	1.724E-02
	MAPE (%)	123.01	11.75	24.53	13.45	25.73	16.03
	Future Forecasting MAPE%	2.82	5.29	1.34	3.37	20.05	1.60
	m	19.3889	1.2136	1.4619	1.1648	9023.5731	1.3006
	b	0.0048	0.0137	8.4552		0.0126	
	c	19.5717	0.5027	0.2557		1.7389	
	q				0.5289		0.4309
	P				-0.0010		
UK	**RMSE**	2.493E-01	2.490E-02	3.551E-02	2.568E-02	8.433E-02	5.631E-02
	MAPE (%)	169.05	33.71	45.75	9.97	28.70	28.21
	Future Forecasting MAPE%	2.98	6.12	0.55	10.73	28.07	6.53
	m	*18.5170*	*1.0141*	*1.1464*	*0.9515*	*9023.5731*	*1.2818*
	b	*0.0044*	*0.0019*	*25.4696*		*0.0048*	
	c	*18.7051*	*0.6867*	*0.3766*		*2.0584*	
	q				*0.8047*		*0.4022*
	P				*-0.0137*		

7.4. Forecasting Internet Use

Internet user data were retrieved from Euromonitor. Internet users are defined as people with access to the world-wide network via home, work internet-enabled computers or internet cafés. These data were further analysed by applying the growth models for the three different countries.

The results in Table 7.5 show that For UK, the Gompertz Model ($2.89X10^{-3}$) curve fitted the data well and displayed the lowest RMSE value compared to the other models. Analysis of the future prediction compared to actual results shows that the Bass Model (2.37%) had the smallest MAPE compared to the rest of the forecasting models.

Forecasting Internet Use in Hong Kong the Bass Model ($8.71X10^{-4}$) gave the lowest RMSE value. Analysis of the future prediction compared to actual results shows that the Gompertz Curve (1.81%) had the smallest MAPE compared to the rest of the forecasting models. These results indicate that the best model for forecasting Internet in Use in Hong Kong is the Bass Model as it produced the lowest RMSE value; but for future prediction the Gompertz Curve gave the lowest MAPE value.

The results of applying the forecasting models to forecast Internet Use in Pakistan the results showed that the Local Logistic Curve ($4.52X10^{-7}$) produced the lowest RMSE value and the Gompertz Curve (11.79%) had the smallest MAPE compared to the other forecasting models. From these results it is evident that the best models for forecasting Internet in Use in Pakistan are the Local Logistic Curve, as it had the lowest RMSE value, and the Gompertz Curve, as it produced the smallest MAPE value for predicting the future.

The forecasting models are compared cross-culturally by determining the lowest MAPE. Figure 7.8 illustrates the cross-cultural comparison of MAPE for Internet in Use.

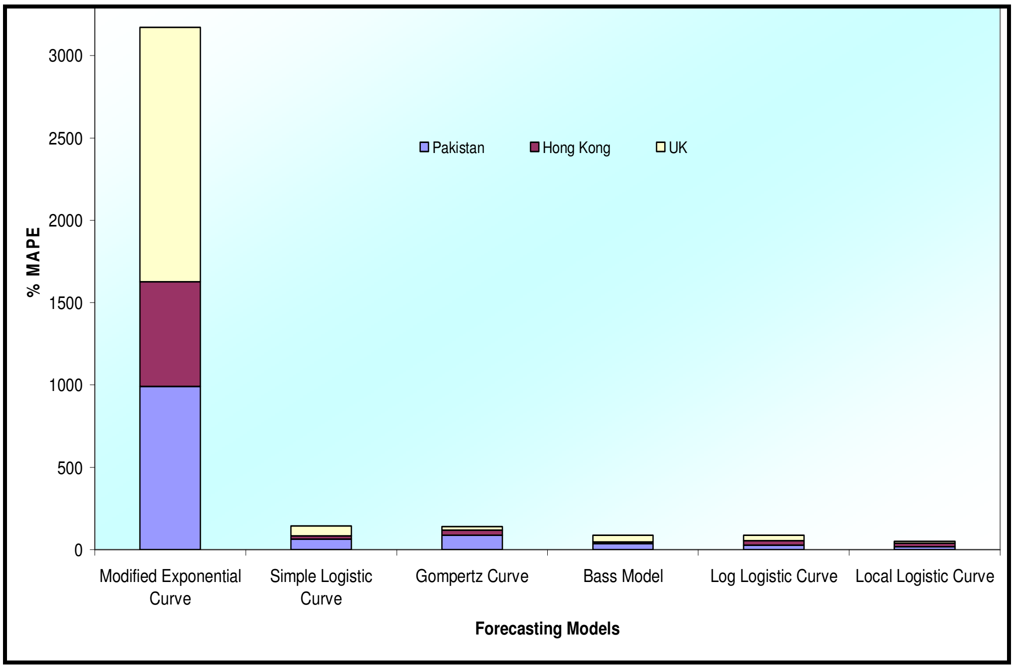


Figure 7.8 Cross-Cultural Forecast Euromonitor vs. Best Fit Models Internet in Use

Comparison of the Modified Exponential Curve across the three different countries reveals that this forecasting model had the highest MAPE for Hong Kong (634.69%), Pakistan (992.51%) and the UK (1543.09%). This clearly shows that the Modified Exponential Curve is not a suitable growth model with which to forecast the future of Internet in Use. When comparing the models across different countries it can be clearly seen that, overall, the Local Logistic Curve produced the lowest MAPE values for the UK (10.47%) and Pakistan (17.71%) compared to the rest of the models across the three different countries. For Hong Kong, the Bass Model (10.63%) gave the smallest MAPE compared to the rest of the models. The best models selected for each country for predicting the future of Internet in Use were further utilised in making those forecasts and the results were compared with Euromonitor's forecast to determine the best model with which to predict the future of Internet in Use for each country.

In Figure 7.9 the best models are compared with the Euromonitor future forecast.

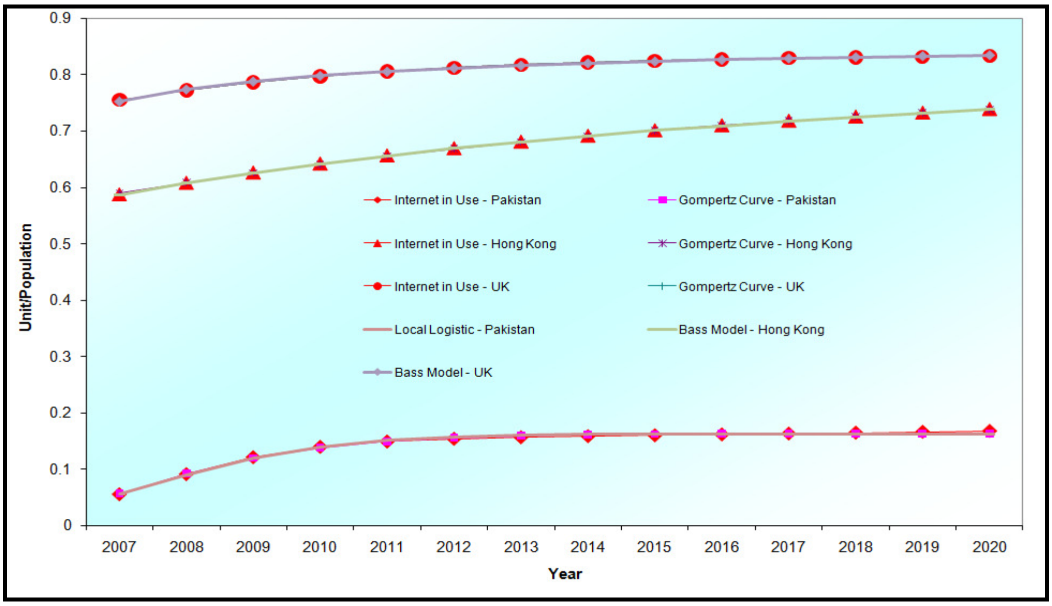


Figure 7.9 Cross-Cultural Forecast Euromonitor vs Best Fit Models Internet in Use.

All three best fit models for the UK, Pakistan and Hong Kong have shown the same trend as the Euromonitor forecast. Analysis of the results and comparison of the forecast with Euromonitor's shows that the Bass Model is the best for the UK, as it had the smallest RMSE ($9.59X10^{-6}$) compared to the Gompertz Model ($4.34X10^{-5}$). The Bass Model also had a smaller MAPE value than the Gompertz Model. The best model identified for Pakistan was the Gompertz Model as it gave a smaller RMSE ($5.71X10^{-5}$) than the Local Logistic Model ($1.10X10^{-4}$). The best model for Hong Kong was the Bass Model ($3.56X10^{-5}$), with a small MAPE value of 0.19%.

A summary of the technological forecasting results for Internet in Use is displayed in Table 7.9.

Table 7.5 Growth Model Analysis for Internet in Use

Internet In Use		Modified Exponential Model	Simple Logistic Model	Gompertz Model	Bass Model	Log Logistic Model	Local Logistic Model
Expression		$Y_t = m - ce^{(-bt)} + \varepsilon_t$	$Y_t = \frac{m}{1+ce^{(-bt)}} + \varepsilon_t$	$Y_t = me^{(-c(e^{(-bt)}))} + \varepsilon_t$	$Y_t = (P + \frac{q}{m} Y_t - 1)(m - Y_t - 1) + \varepsilon_t$	$Y_t = \frac{m}{1+ce^{-b\ln(t)}} + \varepsilon_t$	$Y_t = \frac{mY_{t-1}}{Y_{t-1} + e^{-q}(m - Y_{t-1})} + \varepsilon_t$
Pakistan	**RMSE**	2.828E-05	1.251E-05	3.185E-06	4.158E-06	2.001E-06	4.52009E-07
	MAPE (%)	992.51	63.15	86.67	37.55	28.12	17.71
	Future Forecasting MAPE%	38.88	56.26	11.79	12.18	12.87	31.54
	m	*11.6490*	*0.5416*	*0.5843*	*0.5280*	*9023.5731*	*0.0150*
	b	*0.0001*	*0.0000*	*14.3518*		*0.0001*	
	c	*11.6611*	*0.5766*	*0.0957*		*2.5944*	
	q				*0.4618*		*1.0020*
	P				*0.0006*		
Hong Kong	**RMSE**	3.960E-02	9.533E-04	2.365E-03	8.711E-04	1.084E-02	2.41E-03
	MAPE (%)	634.69	21.97	31.52	10.63	25.85	21.60
	Future Forecasting MAPE%	3.89	4.70	1.81	8.02	24.83	8.77
	m	*11.5869*	*0.5421*	*0.6632*	*0.5088*	*9023.5731*	*0.5083*
	b	*0.0038*	*0.0019*	*14.3505*		*0.0018*	
	c	*11.7218*	*0.5825*	*0.2867*		*2.1726*	
	q				*0.6283*		*0.7123*
	P				*0.0057*		
UK	**RMSE**	*1.077E-01*	*3.870E-03*	*2.891E-03*	*3.689E-03*	*4.619E-03*	*7.09E-03*
	MAPE (%)	*1543.09*	*58.60*	*21.22*	*39.22*	*32.63*	*10.47*
	Future Forecasting MAPE%	*21.05*	*3.57*	*11.17*	*2.37*	*24.79*	*4.78*
	m	*11.3298*	*0.8590*	*1.5629*	*0.7907*	*9023.5731*	*0.7145*
	b	*0.0040*	*0.0034*	*9.7659*		*0.0004*	
	c	*11.4613*	*0.4696*	*0.1710*		*2.7918*	
	q				*0.5089*		*0.6053*
	P				*0.0042*		

7.5. Satellite TV Households Forecasting

Satellite TV provided TV viewers with a new experience by allowing access to multiple channels across the world. This was a phenomenal event in the history of television because of the viewing choices it offered users. Prior to Satellite TV, television service providers in the UK were only able to service four channels: BBC 1, BBC 2, ITV and Channel 4. Satellite TV Households indicates the number of households subscribed to systems which use a broadband network intended for the distribution of television, sound and data signals received directly from one or more satellites per analogue, as well as digital colour television households. The reason Satellite TV Households are to be analysed with technological forecasting models is that the majority of Satellite TV viewers moved on to experience Digital Satellite TV once the analogue switchover had occurred in the UK. Forecasting the future of Satellite TV will provide some indication of a valid forecasting model with which to forecast the future of interactive TV.

Forecasting Satellite TV Households in the UK, Hong Kong and Pakistan the results are shown in Table 7.6. Analysis of the results obtained from technological forecasting models show that for UK most of the forecasting models produced a linear prediction except for the Local Logistic model which gave an exponential growth prediction. When the data were analysed, the results showed that the Modified Exponential Model ($3.73X10^{-4}$) gave the smallest RMSE value, but the Local Logistic Curve ($3.93X10^{-3}$) yielded the highest. Analysis of the future prediction values for the different forecasting growth models reveals that the Gompertz Curve (0.81%) had the lowest MAPE error compared to the rest of the models but the Local Logistic Curve produced the highest (24.45%).

The results suggest that the best model for forecasting the future of Satellite TV Households in the UK is either the Modified Exponential Model or the Gompertz Curve. The Modified Exponential Model was more accurate in predicting the forecasted values as against the actual values. However, it appears that the Gompertz Curve would predict the future more accurately than the Modified Exponential Model because it produced a smaller MAPE value. Forecasting Satellite TV Households in Hong Kong the results showed that most of the forecasting models produced a linear prediction except for the Local Logistic and Bass models, which produced exponential growth predictions. Results of analysing the data revealed that the Bass Model ($4.07X10^{-9}$) gave the smallest RMSE value followed by the Local Logistic Curve ($8.06X10^{-9}$), while the Simple Logistic Curve ($4.07X10^{-8}$) had the highest. Analysis of the future prediction values for the different growth forecasting models shows that the Local Logistic Curve (6.76%) had the lowest MAPE error compared to the rest of the models and but the Log Logistic Curve produced the highest MAPE error value of 37.99%. These results suggest that the best model with which to forecast the future of Satellite TV Households for Hong Kong is the Local Logistic Curve, since it produced the lowest RMSE and MAPE values.

Analysing the results obtained from technological forecasting models for Forecasting Satellite TV Households in Pakistan the Simple Logistic Curve ($1.75X10^{-6}$) gave the smallest RMSE value while the Modified Exponential Curve ($2.35X10^{-5}$) had the highest. Results of analysing the future prediction values for the different forecasting growth models show that the Local Logistic Curve (5.15%) had the lowest MAPE error compared to the rest of the models. These results suggest that the best models with which to forecast the future of Satellite TV Households for Pakistan are the Simple Logistic Model, as it reported the smallest RMSE value, and the Local Logistic Curve, which had the smallest MAPE value.

The forecasting models are compared cross-culturally by determining the lowest MAPE. Illustrated in Figure 7.10 are the cross-cultural comparisons of MAPE for Satellite in Use.

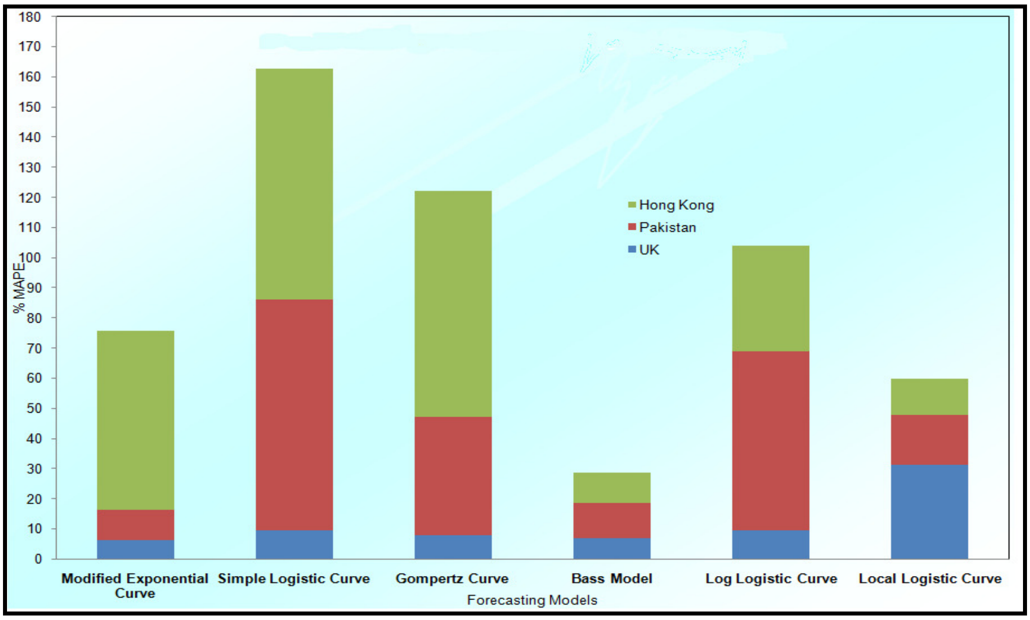


Figure 7.10 Cross-Cultural Forecast Euromonitor vs Best Fit Models Satellite Households

Comparison of the Modified Exponential Curve across the three different countries shows that this forecasting model had the lowest MAPE for the UK (6.38%) compared to Pakistan (9.95%) and Hong Kong (59.45%). However, when the Modified Exponential Curve was compared to other forecasting models, others were found to have lower MAPE values; therefore it is clear that the Modified Exponential Curve is not a suitable growth model for forecasting the future of Satellite households.

The best models are compared with the Euromonitor future forecast. All three best fit models for the UK, Pakistan, and Hong Kong have shown the same trend as the Euromonitor forecast. All the best fit models for the UK, Pakistan, and Hong Kong have shown the same trend as the Euromonitor forecast. Analysis of the results and comparison of the forecast with Euromonitor shows that the Modified Exponential is the best model for the UK, as it had the smallest RMSE ($1.33X10^{-7}$) compared to the Gompertz Model ($8.48X10^{-5}$). In addition, the Modified Exponential Model had a much smaller MAPE value of 0.04% compared to that of the Gompertz Model. The best model identified for Pakistan was the Simple Logistic Model as it had a smaller RMSE ($2.53X10^{-7}$) than the Local Logistic Model ($6.06X10^{-7}$), as well as a smaller MAPE (0.89%) than the rest of the models. For Hong Kong, the best models were the Local Logistic Model ($1.87X10^{-10}$) and the Bass Model ($1.91X10^{-10}$), the difference between the RMSE and MAPE values for these models being very small. The summary of the technological forecasting results for Satellite in Use are displayed in Table 7.12.

Table 7.6 Growth Model Analysis for Satellite Households

Satellite In Use		Modified Exponential Model	Simple Logistic Model	Gompertz Model	Bass Model	Log Logistic Model	Local Logistic Model
Expression		$Y_t = m - ce^{(-bt)} + \varepsilon_t$	$Y_t = \frac{m}{1+ce^{(-bt)}} + \varepsilon_t$	$Y_t = me^{(-c(e^{(-bt)}))} + \varepsilon_t$	$Y_t = (P + \frac{q}{m}Y_t - 1)(m - Y_t - 1) + \varepsilon_t$	$Y_t = \frac{m}{1+ce^{-b\ln(t)}} + \varepsilon_t$	$Y_t = \frac{mY_{t-1}}{Y_{t-1} + e^{-q}(m - Y_{t-1})} + \varepsilon_t$
Pakistan	**RMSE**	2.349E-05	1.747E-06	2.506E-06	2.360E-06	2.184E-05	3.48683E-06
	MAPE (%)	9.95	76.53	39.21	11.97	59.48	16.65
	Future Forecasting MAPE%	12.35	9.11	6.51	11.39	26.12	5.158456492
	m	102.7148	0.0104	0.0107	0.0101	-1.1131	0.0108
	b	0.0000	0.0000	55.4977		0.0003	
	c	102.7164	0.8576	0.5927	-0.0028	1.4535	
	q						0.6555
	P				0.9571		
Hong Kong	**RMSE**	3.127E-08	4.068E-08	3.986E-08	4.072E-09	2.529E-08	8.062E-09
	MAPE (%)	59.45	76.59	75.15	9.87	35.13	11.88
	Future Forecasting MAPE%	35.25	36.14	36.20	7.78	37.99	6.76
	m	2.53308	0.30000	2.92179	0.10046	9023.57308	0.00027
	b	0.00001	0.00013	10.05599	-0.32348	0.00006	
	c	2.53299	0.06836	0.00734		0.66189	
	q						1.00004
	P				0.00089		
UK	**RMSE**	3.729E-04	7.080E-04	4.168E-04	4.587E-04	6.526E-04	3.927E-03
	MAPE (%)	6.38	9.55	7.85	6.76	9.36	31.13
	Future Forecasting MAPE%	2.53	10.06	0.81	0.85	8.18	24.45
	m	199.3352	14.9992	0.2955	238.0358	37964.1381	32.4337
	b	0.0000	0.0370	2.3181		0.0235	
	c	199.3106	0.0973	0.0779	0.0000	0.6447	
	q						0.1465
	P				0.0082		

7.5.6 Summary of Technological Forecasting

Overall, the results of comparison with the Euromonitor forecast have validated the models chosen to forecast selected technologies and demonstrated their reliability. Table 7.7 illustrates a summary of the best models identified for each country for forecasting various technologies.

Table 7.7 Best Models with which to Forecast Technology

Technology	UK	Hong Kong	Pakistan
Pcs In Use	Simple Logistic Model	Simple Logistic Model	Bass Model
Mobiles in Use	Simple Logistic Model	Simple Logistic Model	Simple Logistic Model
Internet in Use	Bass Model	Bass Model	Gompertz
Satellite Households	Modified Exponential Model	Local Logistic Model	Simple Logistic Model

The results show that in Pakistan the Simple Logistic Curve was the best model for forecasting the future of Mobiles in Use and Satellite Households. The forecast the future of Internet in Use, the Gompertz Model was best, and to forecast the future of PCs in Use it was the Bass Model.

For Hong Kong, the Simple Logistic Curve was the best model for Mobiles in Use and PCs in Use. However, for the Internet in Use the Bass Model was considered most suitable, while for Satellite Households it was the Local Logistic Curve.

For the UK, the Simple Logistic Curve and Bass Model were the best models, although to forecast the future of Satellite in Use, the Modified Exponential Model was found most suitable.

Overall, the models most frequently identified as superior for forecasting the future of technology in the UK were the Simple Logistic Curve and the Gompertz Curve. However, when the forecasts were compared to Euromonitor's forecast, the Gompertz Curve was considered to be the best model. In addition, the Gompertz Curve was evaluated as to how well it could forecast the future of interactive technologies when compared to the Simple

Logistic model. The conclusion drawn was that to forecast the future of interactive technologies such as interactive TV, both the Simple Logistic Curve and the Gompertz Curve would be the most suitable models.

The following section will forecast the future of interactive technologies by applying these models to different data sets. The reason for using different data sets is that it has been difficult to identify valid data for forecasting the future of interactive TV. Therefore digital TV data will be examined, and data retrieved from the different sources measuring interactive TV activities will be utilised to forecast the future of interactive TV.

7.6. Future of Interactive Technology

This chapter has analysed various technological forecasting models and data sets for previous successful technologies. The analysis indicated that for the UK the Simple Logistic Curve and the Gompertz Curve were the best fitted models for forecasting the future of interactive technologies, especially interactive TV. Therefore these models will now be applied to various data sets to predict the future of interactive TV. The following data sets were used:

- Digital Satellite TV
- Digital TV Households
- Digital Views Press Red Interactive TV Button
- Digital Users employing Interactive TV to Access Wakefield Council Pages

Applying the models to these data sets will permit speculation about the future of interactive TV. The reason for choosing three different data sets for the purpose was to validate the selection of data and confirm the reliability of the forecasts.

7.6.1 Forecasting Digital Satellite Pay TV

The category “Digital Satellite Pay TV” refers to the number of subscribers to digital pay TV services (packages) receiving the service via satellite, either direct to home or via group satellite receivers. Digital satellite TV provides access to interactive TV red button functionality. Determining the future of digital satellite pay TV provides an analogy with which to estimate the growth of interactive TV, inasmuch as a percentage of Digital Satellite Pay TV will be potential users of interactive TV. The Simple Logistic Curve and Gompertz Curve were applied to the data set, and the results are displayed in Figure 7.11.

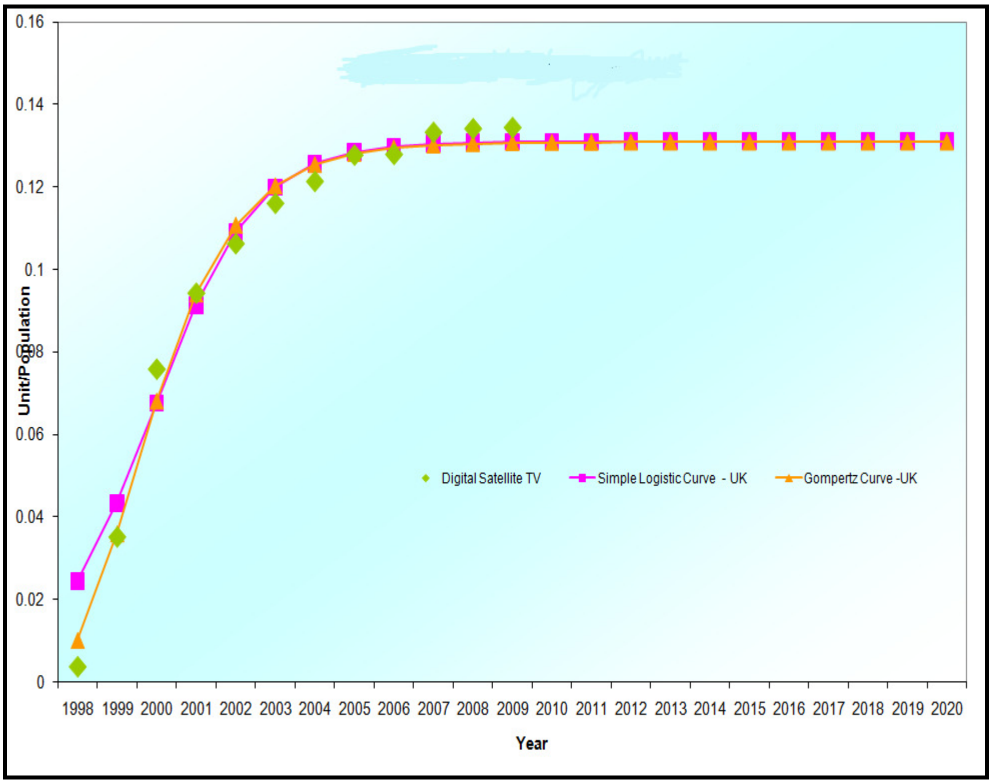


Figure 7.11 Forecasting Digital Satellite Pay TV

The results show that the Gompertz Curve (1.942×10^{-4}) had a smaller RMSE value than the Simple Logistic curve (6.428×10^{-4}), although the MAPE value for the Simple Logistic Model (3.76%) was much smaller than that of the Gompertz Model (8.02%). These results suggest that Digital Satellite Pay TV has reached saturation and maximum growth, and therefore that the maximum penetration of interactive TV users has already been achieved.

7.6.2 Forecasting Digital TV Households

The existing analogue TV signal is due to be switched off and replaced with a much stronger digital TV signal, enabling users to receive digital TV via the aerial. Digital TV offers many new ways of enjoying TV services, particularly by providing access to interactive TV services. This development will increase the range of people having access to the service. Therefore, forecasting the future of digital TV makes it possible to ascertain that of interactive TV. Digital TV household data were obtained from the BARB (Broadcast Audience Research Board). Shown in Figure 7.12 are the results obtained for forecasting Digital TV Households.

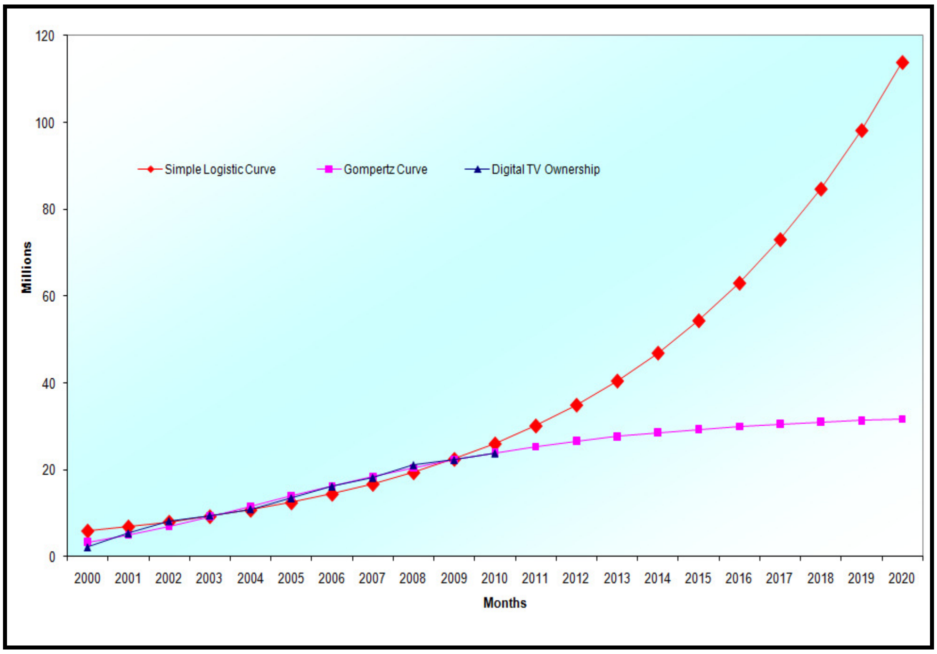


Figure 7.12 Forecasting Digital TV Households

After the data set was fitted into the selected models, namely, the Simple Logistic Curve and Gompertz Curve, the results showed a suitable fit between the actual data and the forecasting data. Overall, the Gompertz Curve showed a smaller RMSE value ($3.95x10^{0}$) than the Simple Logistic Curve ($3.090x10^{1}$), as well as a much smaller MAPE value (6.03%) than that shown by the Simple Logistic Curve (25.12%). The models were further extended so as to forecast the future growth of Digital TV. Here again, the Gompertz Curve and Simple Logistic Curve showed disparate results, those of the Gompertz Curve inferring that the growth of digital TV has reached saturation whereas, according to the Simple Logistic Curve, digital TV can still look forward to a significant logistic growth phase. Sales of digital TV are expected to maintain rapid growth up to the year 2020. According to the BARB (http://www.barb.co.uk, 2011), there are currently 24.6 million Digital TV households. Total TV households in the UK number 26.2 million, suggesting close to maximum penetration of households by Digital TV. Therefore the Gompertz model is more suitable for forecasting the future of Digital TV.

7.6.3 Forecasting Interactive TV Red Button Users

Interactive TV services are mostly accessed via pressing the red button. BARB (Broadcast Audience Research Board) have carried out independent research to establish the percentage of users who press the red button when using Digital TV. BARB has been conducting this study since May 2002, repeating it every six months. The data set was obtained and the Simple Logistic Curve and Gompertz Curve were applied, with results as shown in Figure 7.13.

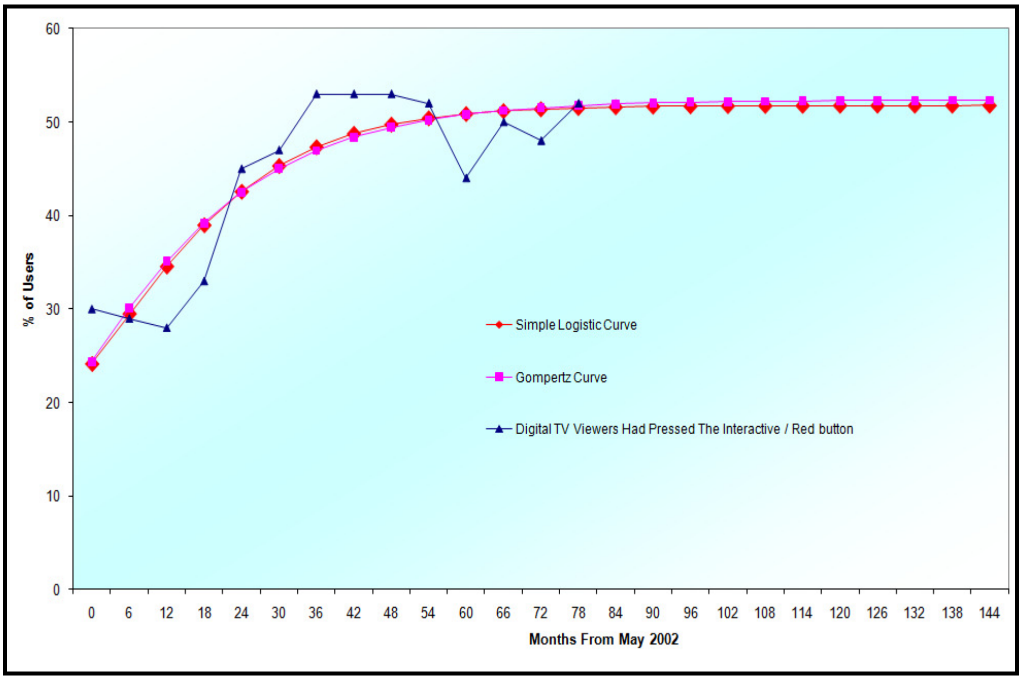


Figure 7.13 Future of Interactive TV Red Button in the UK

It can be seen that the Simple Logistic Curve (2.460E+02) had a slightly smaller RMSE value than the Gompertz Curve (2.667E+02). The overall MAPE value for the Gompertz Curve (8.85%) was slightly smaller than that for the Simple Logistic Curve (9.66%). To forecast the future of users pressing the Red Button to access interactive services, the models were applied to the outlook for the next five and a half years. This forecast suggests that the number of users pressing the Red Button has reached saturation. Therefore the growth of users accessing the interactive services has passed its maximum level.

7.6.4 Forecasting Users Accessing Interactive TV Digital Pages

Further to seeking validity and reliability in the forecasting of interactive technology, especially regarding the future of interactive TV, the data set for users accessing Wakefield Council's interactive digital pages for information was obtained. The Simple Logistic Curve and Gompertz Curve were applied to forecasting the future of access to the pages. Figure 7.14 illustrates the results obtained.

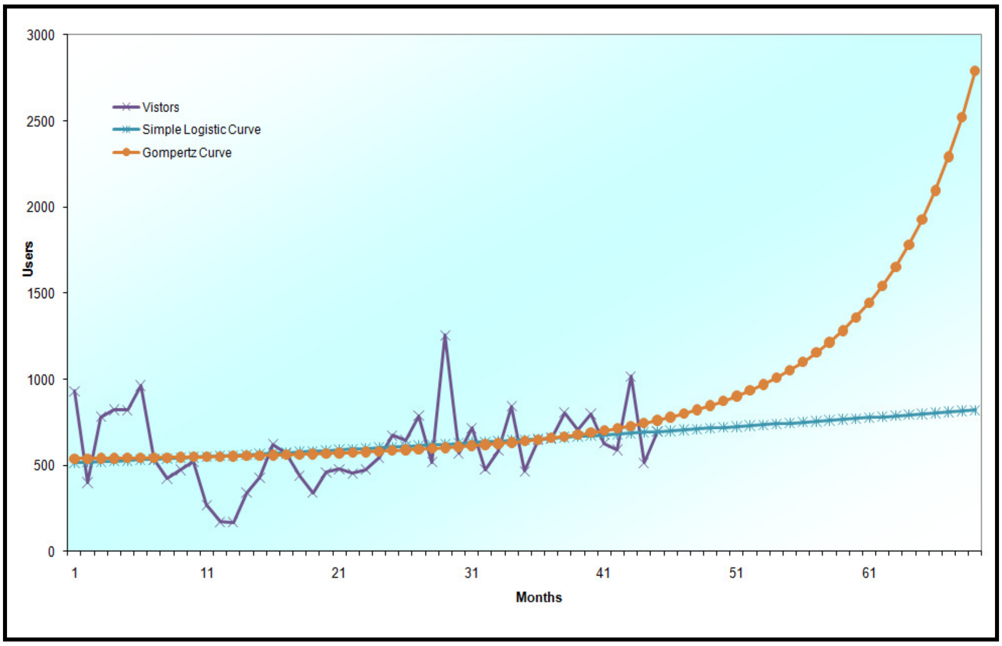


Figure 7.14 Users Access to Wakefield Council Digital Pages

RMSE and MAPE values for both the Simple Logistic Curve (1.97E+06, 33.83%) and Gompertz Curve (1.92E+06, 33.50%) were extremely high, although the difference between the two models was slight. When forecasting the future, the Gompertz Curve predicted a significant growth, whereas the Simple Logistic Curve suggested that it had nearly reached saturation. The actual data for users accessing Wakefield Council's (2011) digital pages produced a more sinusoidal growth, which is why it has produced significantly high RMSE and MAPE values for the two forecasting models. This suggests that applying forecasting models to this data set was not suitable. An alternative forecasting method could of been adopted. Also, this growth suggested that the users in Wakefield County in England only accessed the interactive digital pages after an event had taken place, although the data set has established users' access pattern.

7.7. Discussion and Conclusion

Internet, Mobile and Satellite technologies have entered into a digital phase which has increased their capacity for interactivity. Therefore these technologies will be classed as interactive technology. The aim of this chapter has been to apply technological forecasting methods to secondary data such as that for PCs, internet, mobiles and satellite TV in use, in order to forecast the future of interactive technologies, especially iTV, and to identify a suitable model with which to forecast interactive technologies in the UK, Hong Kong and Pakistan.

7.7.1. Technological Forecasting

The process of technological adoption and diffusion varies for different technologies and for different nations (Chinn and Fairlie, 2007). Andres et al (2010) emphasised that through understanding and examining different technologies, they have found that at a given point in time there are substantial disparities in the degree of adoption across different nations. The level of technology diffusion and adoption is influenced by many factors, such as culture, economics, politics and sociology. The economy is becoming digitalised because of the internet and many other interactive technologies such as mobile telephones. As Fink and Kenny (2003), Roller and Waverman (2001) and Sanchez-Robles (1998) have all recognised, "the Internet has been identified as the strategic tool for economic development. The Internet is evolving and is being recognised more of an interactive technology due to its interactive capabilities. The Internet can be considered to be the most successful interactive technology compared to the mobile phone and interactive TV."

Trappey and Wu (2008) argued that, owing to new technical innovation and high demand, in order to meet consumers' requirements electronic products and services are replaced within a few years. Therefore, analysing and forecasting the penetration of new products has become more demanding and complex, with fewer data being available for market analysis and technology forecasting. Forecasting the future of interactive technologies and especially iTV was challenging because of the quality of data.

Applying growth curves to different data sets made it possible to establish the most accurate growth curve for the technology and helped in finding a suitable growth model with which to predict the future of interactive technologies and iTV. Adopting this approach, various models were selected and applied to various interactive technologies to determine the best model for forecasting their future.

7.7.2 Evaluation of Forecasting Models

To understand the adoption of PCs, the data for PCs in Use for the three countries were analysed. PCs in Use data were provided in millions of users, to obtain a better picture of the country, and the number of PCs in Use was divided by the estimated population. Comparison of the results and the adoption of PCs in the three countries revealed significant differences. As the UK and Hong Kong are well developed economically, the results showed that growth between 1991 and 2004 was linear, while according to the forecast PCs in Use will approach maximum growth after 2004. For Pakistan, on the other hand, the penetration of PCs in Use was very low compared to the UK and Hong Kong. Andres et al (2010) concluded that the adoption rate of technology is different for low and high income countries and this research supports their findings.

The modelling results showed that the Simple Logistic Curve was the best model for Hong Kong and UK, whereas for Pakistan it was the Bass Model, as the RMSE and the ability to forecast the future data points (MAPE) were smaller compared to the other models.

Similarly, when forecasting the future growth of Mobile Telephones in Use, the Simple Logistic Model was considered to be the best for Hong Kong, the UK and also in this case for Pakistan. Forecasting Internet in use, the Bass Model was identified as best for Hong Kong and the UK, whereas for Pakistan it was the Gompertz Model. For predicting the future of Satellite Households, the Local Logistic Curve was shown as more appropriate for Hong Kong, but for the UK it was the Modified Exponential Model, and for Pakistan the Simple Logistic Curve.

These results demonstrate that different models perform better for different countries and technology types. The models most commonly identified during the technological forecasting exercise were the Gompertz Curve, the Bass Model and the Simple Logistic Curve.

The Log Logistic Curve and Local Logistic Curves are both considered valuable models as in some instances they did outperform other models. However, they were not considered for predicting the future of interactive technologies, as they were not as commonly identified as the Simple Logistic Curve, the Bass Model and the Gompertz Curve.

Overall, the Modified Exponential Curve in most instances reported higher RMSE and MAPE values than other models. However, to forecast the future of Satellite TV Households, the Modified Exponential Model was considered the best. But on the whole the Modified Exponential Curve is an inappropriate model with which to forecast the future of interactive technologies. Meade and Islam (1995) carried out a study to compare the forecasting performance of growth curves. The conclusion was that the Modified Exponential Curve is not an appropriate model to use, as it may give an unsuitable representation of the data. They also concluded that it is preferable to use less complex models where more than three parameters are required to perform the forecast.

Some studies suggest that Logistic models outperform the Gompertz Curve. Botelho and Costa Pinto (2004), Hwang et al (2007) and Gamboa and Otero (2009) agreed that Logistic models characterise the diffusion model better than the Gompertz Curve. They judged that the Gompertz model is better for predicting the future of consumer durable goods than for predicting that of high technology goods such as mobile phones. However, in this research into forecasting the future growth of the PCs, Mobile Telephones, Internet and Satellite TV Households, the Gompertz and Simple Logistic models seemed to be the most suitable ones, performing better than other forecasting models.
Trappey and Wu (2008) suggested that the Gompertz model and Simple Logistic model are the most frequently referenced models for forecasting the penetration rate of technology based products. But caution is advised when

using these models to predict the upper limits of growth, since inaccurate predictions may result. Forecasting the upper limits of growth is a challenge, because of the difficulty of determining when the product will reach 100% penetration. Meade and Islam (1998) further argued that the Simple Logistic and Gompertz models are further limited by the shape of curve. For example, the Simple Logistic model is symmetric in respect of its point of inflection, so that if the data set does not have these characteristics, then the curve may not perform very well. By contrast, the Gompertz model is an asymmetric S-curve and reaches the point of inflection before market penetration. Trappey and Wu (2008) concluded that the Gompertz model will be more suitable than the Simple Logistic model for application to certain types of short lifecycle products.

Overall this study has established that, compared to the Modified Exponential model, the Bass, Simple Logistic, Gompertz, Local Logistic and Log Logistic models are more appropriate for forecasting the future of interactive technologies. These models were identified as the most common ones for forecasting PCs, Internet, Mobiles and Satellite in Use compared to other models. The Simple Logistic Model, Bass Model and Gompertz models reported smaller RMSE and MAPE values. In some instances the Bass Model, Local Logistic and Log Logistics models outperformed others in the case of some technologies; thus, the Bass Model was better for forecasting the Internet in Use in the UK and Hong Kong and to predict PCs in Use in Pakistan.

To validate further the models selected as best for each technology, their future forecasts were compared to those of Euromonitor. The results showed very low RSME and MAPE values compared to Euromonitor forecasts. This procedure helped to validate the forecast by comparison with other forecasts for the technology. In addition, similar predictions for the technology were identified, confirming the selection of the best model for it. The Simple Logistic Model and Gompertz models were further applied in forecasting the future of interactive technologies. The study has also recommended that to forecast the penetration of interactive technologies for Hong Kong and Pakistan, the most suitable model to use will be the Simple Logistic, as it was considered the best in more than one instance.

7.7.3 Future of Interactive Technology and iTV

To obtain actual data for iTV was challenging, so to overcome this obstacle, data were selected from different sources who have either performed an independent study or collected data through users using their iTV services. Interactive technologies arrived as technology was becoming more advanced and digitalised. Interactive TV was launched in 2000 and a hopeful future was predicted for it, but because of technical infrastructure issues it has never reached its full potential. To understand the prospects for growth of iTV, growth models were applied to various sets of data relating to providers of iTV services, such as Digital Satellite Pay TV. Understanding the potential penetration of this technology will assist in speculating on the future of iTV. Application of the two best forecasting models to Digital Satellite established that it has reached its market saturation. Use of both the Gompertz and Simple Logistic models led to the conclusion that the maximum exposure of iTV has been reached. To confirm these findings further, the Simple Logistic and Gompertz models were also applied to Digital TV Households, since iTV is provided as a service along with Digital TV. The results showed that the Simple Logistic model reported exponential growth whereas, according to the Gompertz model, three thirds of market saturation has already been reached. This suggests that the Simple Logistic model did not perform well in this instance. Fitting the Simple Logistic model also indicated higher RMSE and MAPE values compared to the Gompertz model.

The forecasts indicate that Digital TV also has nearly reached its full market saturation, meaning that the audience has the full potential to use the interactive services. But the interactive services provided are limited. If there were an increase in the number of services provided by interactive TV, it would suggest that the users were using the service and that more services were being provided to sustain competitive advantage. However, that is not the case. Instead, over the years, services have been removed: for example, Tesco Shopping and HSBC bank.

To validate further the best models with which to forecast the future of interactive technologies and iTV, data were obtained from BARB, whose independent study captured data on the number of times users pressed the red button to use the interactive service. Both models suggested that maximum saturation has been reached, but the Gompertz model performed slightly better than the Simple Logistic model. The study showed that approximately 50% of those users who have access to the interactive service will press the red button. Wakefield Council provided iTV digital pages which the public could access for information. The future usage of service was not predicted very well by the growth models, as the Gompertz model predicted exponential growth while the Simple Logistic model reported saturation.

This research has suggested that the Gompertz Curve and Simple Logistic models are appropriate for forecasting the future of interactive technology, although the Gompertz model performed slightly better than the Simple Logistic model. The research also indicated that iTV has reached its full market saturation. Among users with digital TV and digital satellite, 50% may access the iTV service. However, there has been a limited increase in the number of services provided via iTV, which suggests that iTV's future does not look promising, unless the service providers begin to augment further the services they offer via iTV. This chapter has applied a technological forecasting method to forecast the future of interactive technologies, especially iTV. The next chapter will present and discuss the results obtained by the judgemental forecasting approach.

Chapter 8 Delphi Forecasting

The previous chapter has explored the future of interactive technologies by applying technological forecasting models and analysing past numerical data to predict the future. This chapter will apply a judgemental approach in order to understand the future of interactive technologies, evaluate the drivers and inhibitors of interactive TV as an example, and justify the future growth in market share for interactive TV. Delphi forecasting is a Judgmental technique which provides a useful prognosis when the knowledge and experience of human experts are added to the forecasting method. Chapter 3: Forecasting provided a comprehensive review of Delphi forecasting and the validity of the Judgmental approach. The research model for conducting the Delphi forecast was adopted in three stages. Initially key drivers and inhibitors of interactive technology were identified through literature research, which permitted the development of testable hypotheses as discussed in Chapter 5. That chapter has provided a comprehensive review of the research model. Further to this, Chapter 6 discussed the methodology adopted to apply Judgmental forecasting technique. The present chapter will report and discuss the results obtained from the Delphi study. The results were analysed in three waves. Firstly, descriptive analysis is carried out for results of the first and second rounds of the Delphi enquiry. Then the characteristics of optimistic and pessimistic individuals are analysed and identified. Thirdly, the results are further analysed to assess the relationships among various drivers and inhibitors.

8.1. Delphi Study

Here is a summary of the findings that emerged from the successful first and second rounds of the Delphi study to forecast the future of interactive television. The participants were international experts, with backgrounds varying from industry to academia. Their contribution to the findings has thus been significant in forecasting the future of iTV. The analysis focused on the following five specific areas to which the results of the various questions could be applied.

- Growth of iTV Market
- Inhibitors and Promoters of iTV
- iTV Services
- Technology Convergence
- Future of iTV

The first round of the Delphi study consisted of 12 questions, and a further consolidated 18 statements were assessed by the panellists during the second round. Likert scales were adopted during the second round rather than other question types such as multiple choice or open-ended questions, as it was important that a consensus be reached at the end of the study. 34 panellists who contributed to the first round of Delphi were invited to take part in the second round and 22 panellists responded. Two of the responses were disregarded as they were incomplete. The remaining 20 responses were reviewed to conclude the Delphi study. The following section will review the conclusion derived from the first and second rounds of the Delphi study. The two Delphi questionnaires and the panellists who participated in this Delphi study can be reviewed in Appendix 1.

8.1.1 Growth of iTV Market

In terms of growth, the iTV market at the moment is possibly best described as being in the infancy of its product life cycle. The participants were asked when they think iTV would reach its adolescent phase, that is, the stage between infancy and product maturity. As can be seen by referring to Figure 8.1, 42% of the respondents suggested that within 2 to 5 years the iTV market might reach the adolescent phase, whereas 38% felt that it would be within the next 5 to 10 years. However, 8% of the respondents believed that it would take more than 10 years, and another 8% that it would take under 2 years. Only 4% of the respondents expected that the iTV market would never reach its adolescent phase.

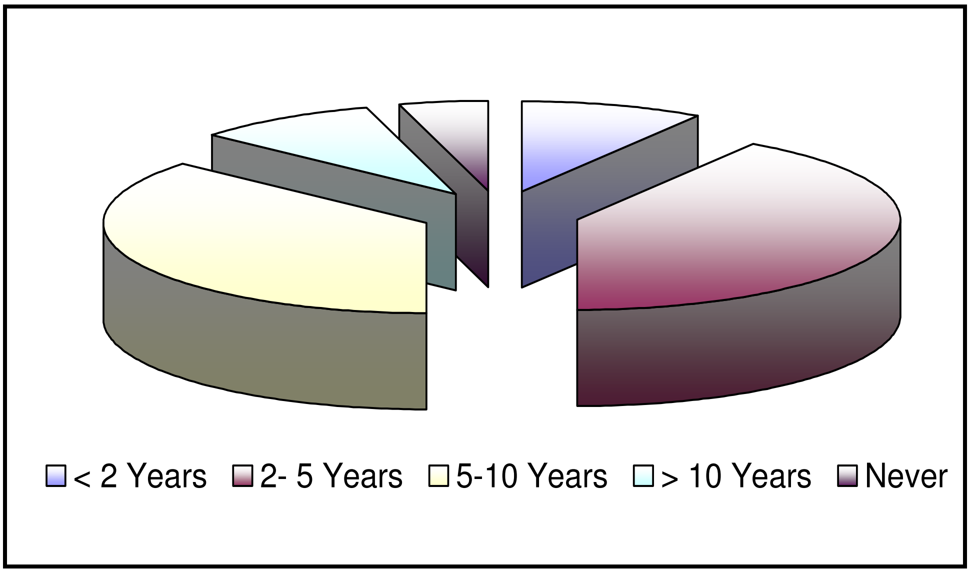


Figure 8.1 Time Required for iTV to Grow to Its Adolescent Phase

This analysis shows that iTV will reach its adolescent phase in the product life cycle within the next 2 to 5 years, although, as 38% of the participants suggested, it may be between 5 and 10 years. So, during the second round the participants were asked to assess the following statement: "ITV will reach its adolescent phase in product life cycle within the next 2–5 years." Figure 8.2 illustrates the agreed consensus for this statement.

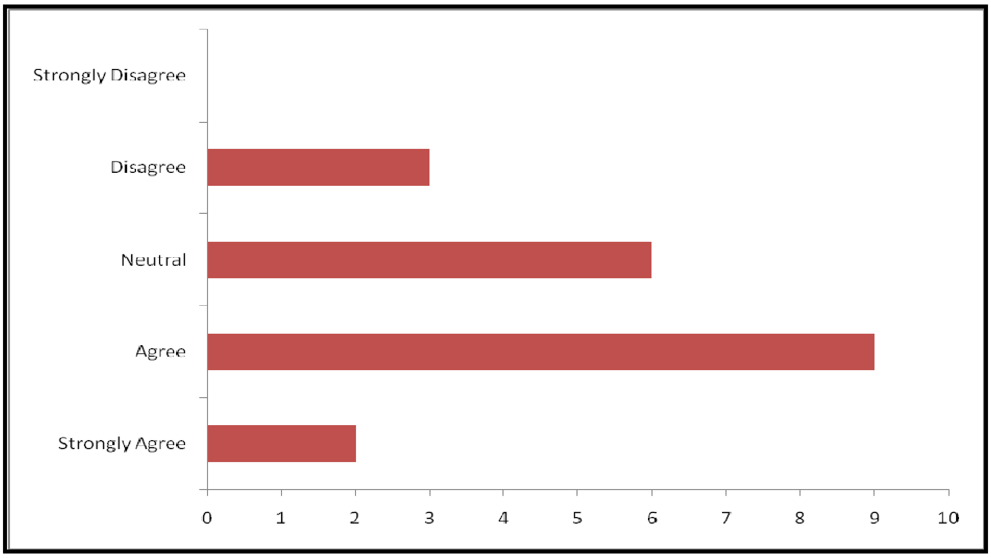


Figure 8.2 Reach Its Adolescent Phase within the Next 2–5 Years

10% (n=2) of the participants strongly agreed that within the next 2 to 5 years iTV will reach its adolescent phase. 45% (n=9) agreed with the statement, 30% (n=6) were neutral and 15% (n=3) disagreed. From this evaluation it can be concluded that iTV will reach its adolescent phase within the next 2 to 5 years.

Currently the share of the ICT market attributable to iTV is considered to be less than 5%. As shown by Figure 8.3, 82% of the respondents agree that there will be an increase of 10–39% in iTV's share of the ICT market in the next 5 years. 62% expected the same increase in the next 10 years, whereas 18% of the respondents thought that the market share increase would be bigger, namely 40–69% in the next 10 years. Considering the next 20 years, 41% of the respondents suggested that the share of iTV would be only 10–39%; however, 27% expected that it would increase its share between 40–69%. 23% of the respondents believed it might increase more than 70% in the next 20 years' time.

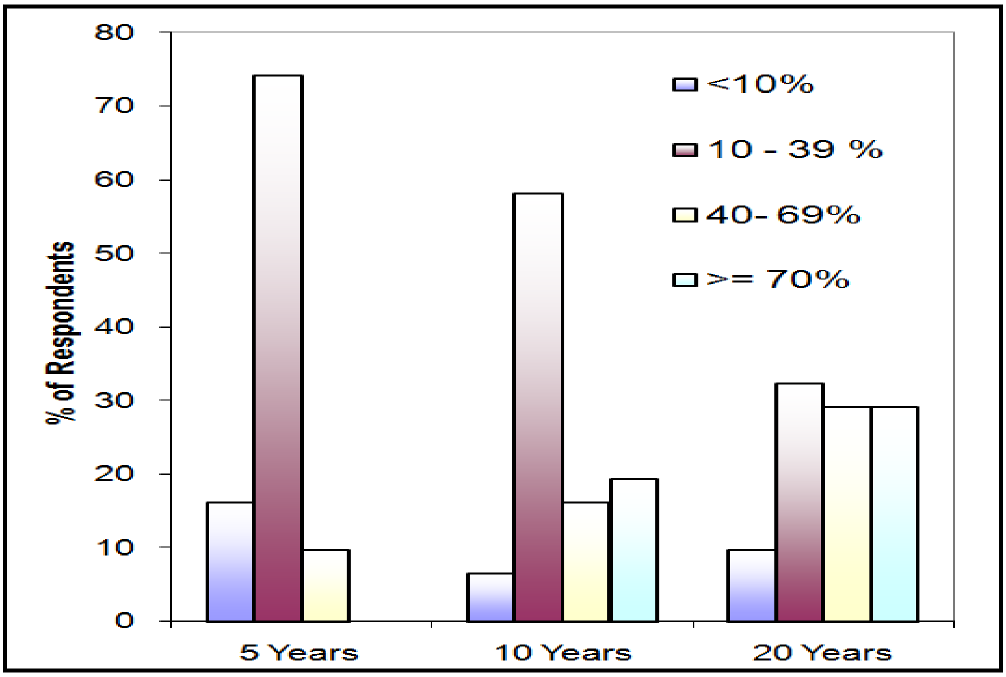


Figure 8.3 Share of iTV in the ICT Market

In conclusion it is suggested that there will be at least 10–39% growth in the share of iTV in the ICT market within the next 5, 10 and 20 years time. However the study also reveals that the share of iTV in the ICT market may increase more than 40% in 20 years' time.

To confirm this conclusion the following statement was presented for review: "It is most likely that the market share for iTV will increase by at least 10–40% within the next 5–10 years." Figure 8.4 illustrates the findings.

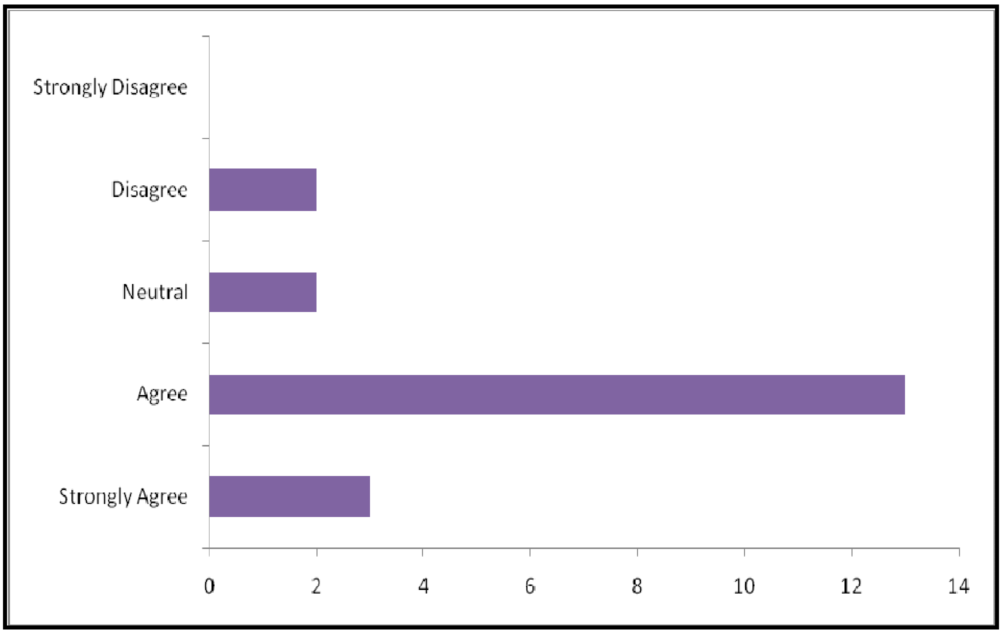


Figure 8.4 Market Share for ITV Increase by 10–40% in Next 5–10 Years

The findings showed that 15% (n=3) of the participants strongly agree that the market share for iTV will most likely increase by at least 10–40% within the next 5–10 years. 65% (n=13) agreed with the statement while 10% (n=2) were neutral. Only a further 10% (n=2) disagreed. From this review it can be determined that in all likelihood the market share for iTV will increase by at least 10–40% within the next 5–10 years.

8.1.2 Inhibitors and Promoters of iTV

The participants were asked to rate the importance of various drivers and inhibitors of iTV technology uptake. The results show that the strongest current promoter is the fact that there has been an increase in quality, also that iTV is now much simpler and easier to use. Figure 8.5 summarises the findings, 64% of the respondents agreeing that iTV is now much easier to use, and 50% suggesting that there has also been an increase in its quality.

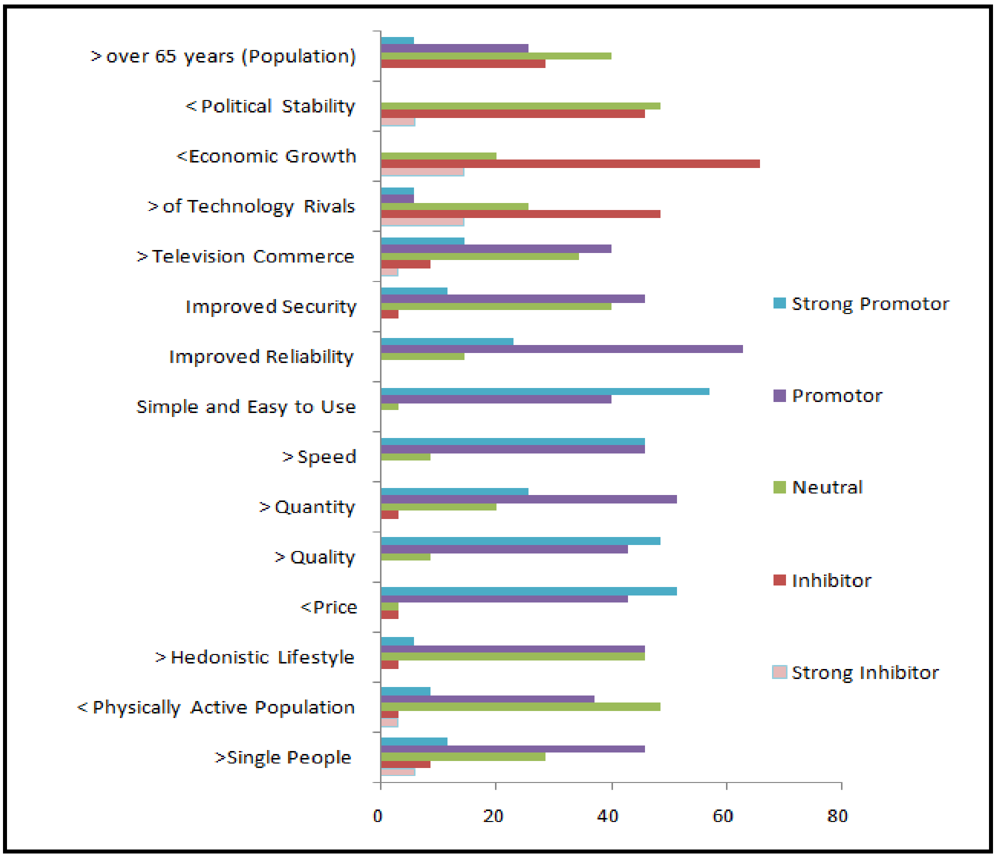


Figure 8.5 Inhibitors and Promoters of iTV Technology Uptake

41% of the respondents felt that another strong promoter of iTV is the decreasing Price of the service and equipment. 77% suggested Improved Reliability of the service as a promoter of iTV. The strongest inhibitor reported by the survey was the increase in Technology Rivals; for example, the internet and WAP, other inhibitors being Reduced Economic Growth and Reduced Political Stability.

To confirm further the findings of the second round of Delphi, the participants were asked to evaluate the following statement: "The strongest promoter of iTV is 'much simpler and easier to use'." Summarised in Figure 8.6 are the findings, two of the participants strongly agreeing with the statement, a further 55% (n=11) agreeing and 30% (n=6) being neutral. Only one of the participants disagreed.

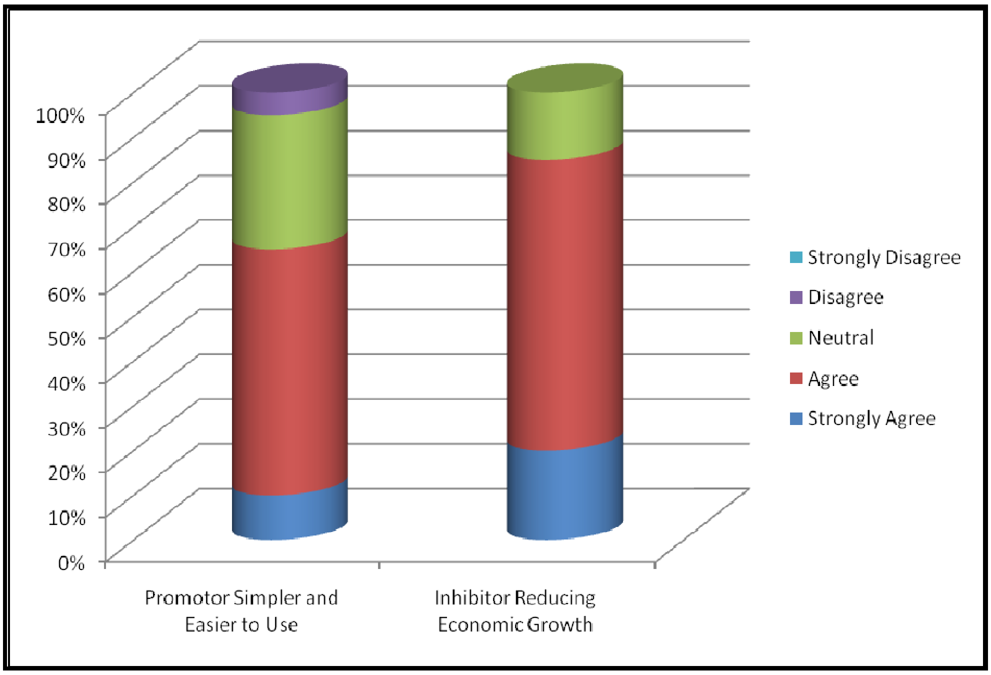


Figure 8.6 Current Promoter and Inhibitor of iTV technology

From this it can be concluded that the strongest promoter of iTV technology uptake is that it is Simpler and Easier to Use. During the second round of the Delphi, the participants were also asked to review the following statement "Strong inhibitor of ITV is Reduced Economic Growth". As illustrated in Figure 8.6, 20% (n=4) strongly agree that Reduced Economic Growth is a strong Inhibitor of iTV, 65% (n=13) also agreed and only 15% (n=3) were neutral.

The participants were asked what they think the main future inhibitors and promoters of iTV technology uptake will be. According to Figure 8.7, 28% of the respondents suggested that the future main inhibitor would be Rival Technology such as WWW and alternatives to Internet Protocol TV (IPTV) platforms. 20% suggested that there would be User Interface (UI) issues such as screen design of iTV services. 12% of the respondents surmised that lack of interest and User Ignorance might prevent future uptake of iTV services. Some also believed that design and Usability issues could cause problems for older and disabled people. Others suggested possible future inhibitors of iTV uptake such as Accessibility and Hardware problems.

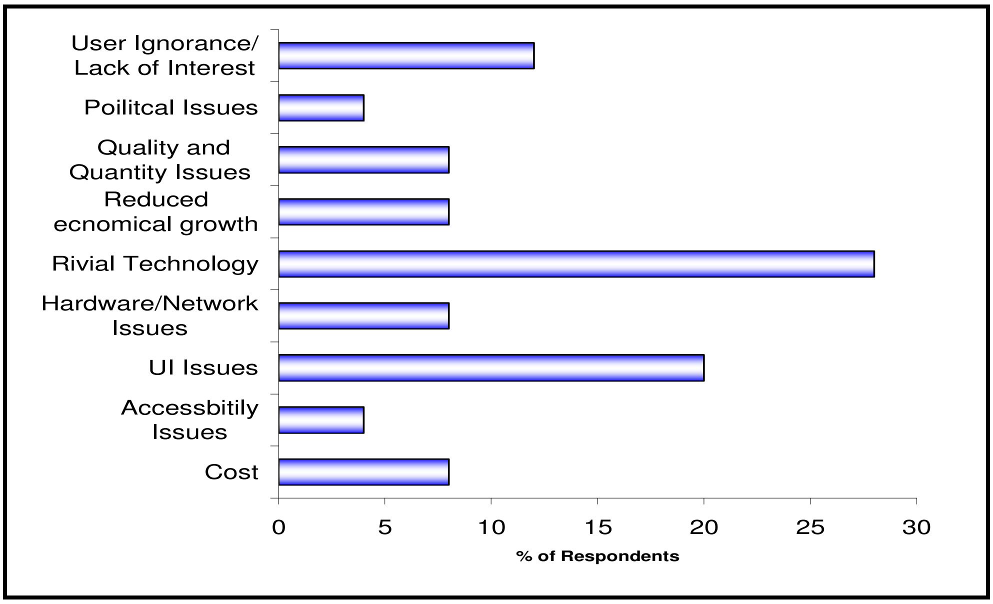


Figure 8.7 Future Main Inhibitors of iTV Technology Uptake

In the second round of the Delphi study the participants were asked to assess the following statement: "The main future inhibitor of iTV will be a Technology Rival". Figure 8.7 illustrates the findings. 30% (n=6) of the participants strongly agreed, 40% (n=8) agreed and only one was neutral towards the statement, while 25% (n=5) disagreed. From these figures it can be concluded that the main future inhibitor of iTV will be Technology Rivals.

From Figure 8.8 it can be seen that 31% of the respondents considered the main future promoter of iTV uptake to be Improved Quality and Quantity. Diversifying services and increasing the quality and quantity of iTV service may promote the technology's growth in future. Improvements in Usability and decrease in iTV service and hardware Costs may also be future promoters of iTV. Some respondents have also suggested that Improved TV viewing Practices and Digital Switchover could be future promoters.

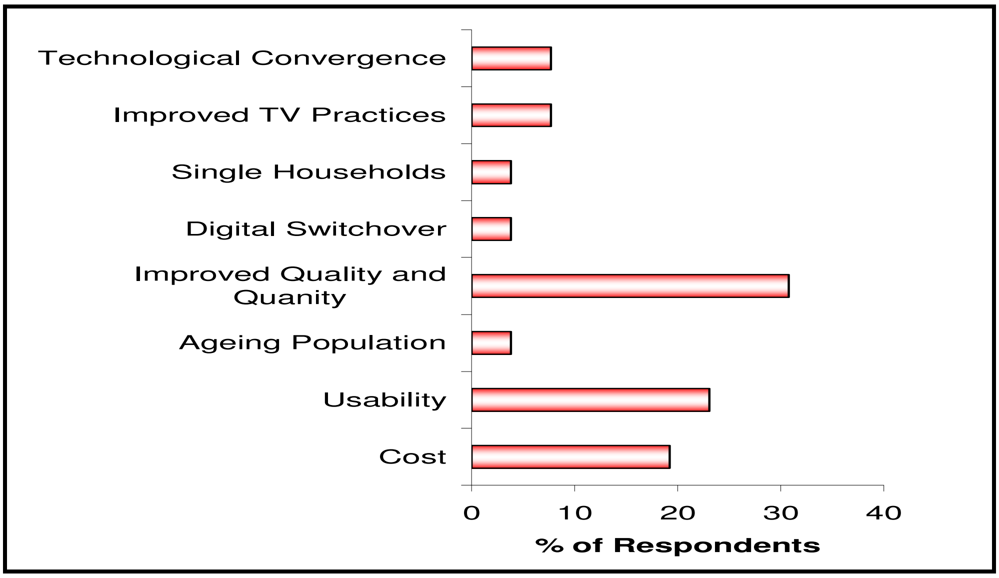


Figure 8.8 Main Future Promoters of iTV Uptake

Thus, during the second round of Delphi participants were asked to evaluate the following statement: "The main future promoter of iTV will be both improved quality and quantity of the service". 20% (n=4) of the participants strongly agreed with the statement and 65% (n=13) agreed. Only 15% (n=3) were neutral towards the statement. The various views on future promoters of iTV are displayed in Figure 8.9.

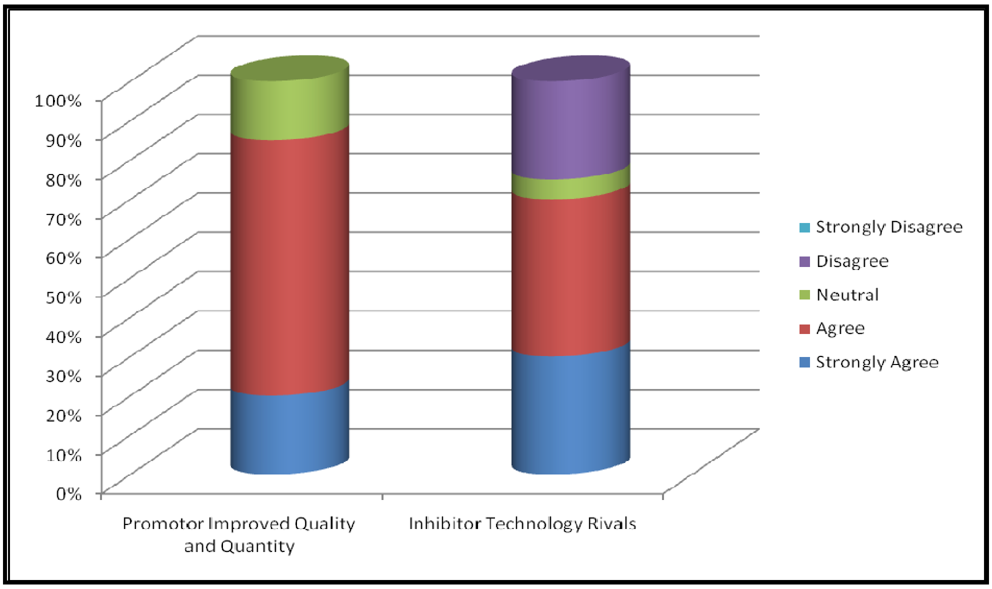


Figure 8.9 Future Promoters and Inhibitors of iTV

In conclusion, the current strongest promoter of iTV technology uptake is its improved quality, plus its simplicity and ease of use. The strongest current inhibitor of iTV technology uptake is the increase in technology rivals such as the internet and WAP. The future main inhibitor of iTV technology will also be technology rivals, while the future main promoter will be the improved quality and quantity of iTV services.

8.1.3 iTV Services

Participants were asked which services will generate most of iTV's growth, as some services will produce more growth than others. The respondents were asked to rank each service in order of its contribution to iTV growth so as to determine the biggest contributor. The findings are presented in Figure 8.10.

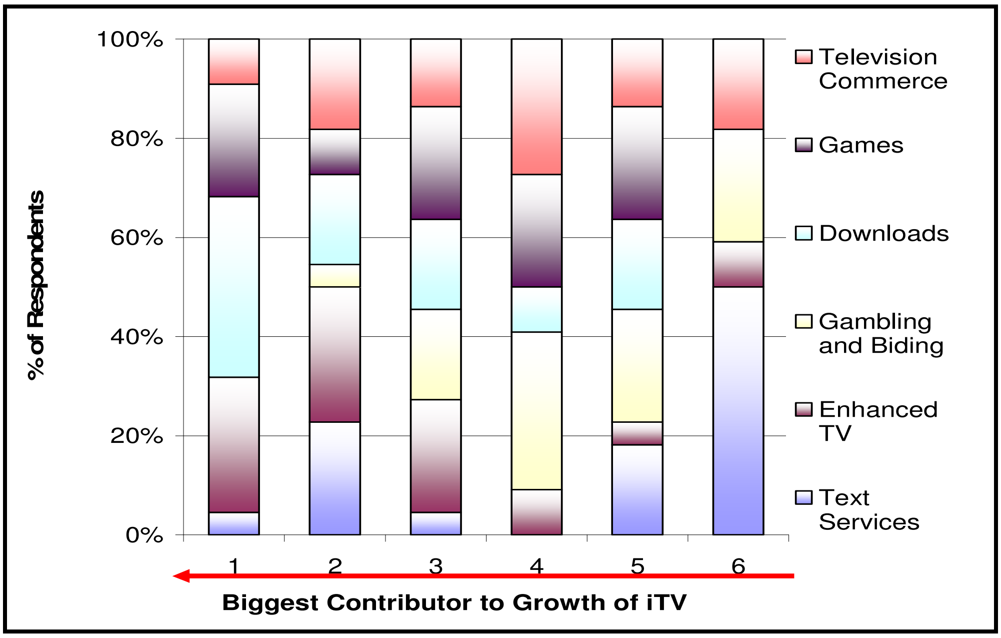


Figure 8.10 Services Which May Contribute to Growth of iTV

50% of the respondents suggested that Text Services such as emailing constituted the smallest contributor to the growth of iTV, although 23% indicated that Text Services may contribute to its growth. 36% of the respondents felt that the biggest contributor to iTV growth is Downloads of items such as books, films and music. Currently this service is limited on iTV. Other contributors include Enhanced TV, providing services such as Voting, Competitions and Quizzes. However. the least growth will be generated by Gambling and Bidding and Television Commerce such as Interactive Advertising, Banking, and Retailing etc.

In the second round of the Delphi study, the participants were asked to assess the following statement: "Downloads services such as music, films and books will become the biggest contributor to the growth of iTV". Two strongly agreed with the statement and 40% (n=8) agreed. 30% (n=6) were neutral, 10% (n=2) disagreed with the statement and a further 10% (n=2) strongly disagreed. Therefore it can be concluded that Download services will become the biggest contributor to the growth of iTV. The results indicating the largest and least contributors to the growth of iTV are illustrated in Figure 8.11.

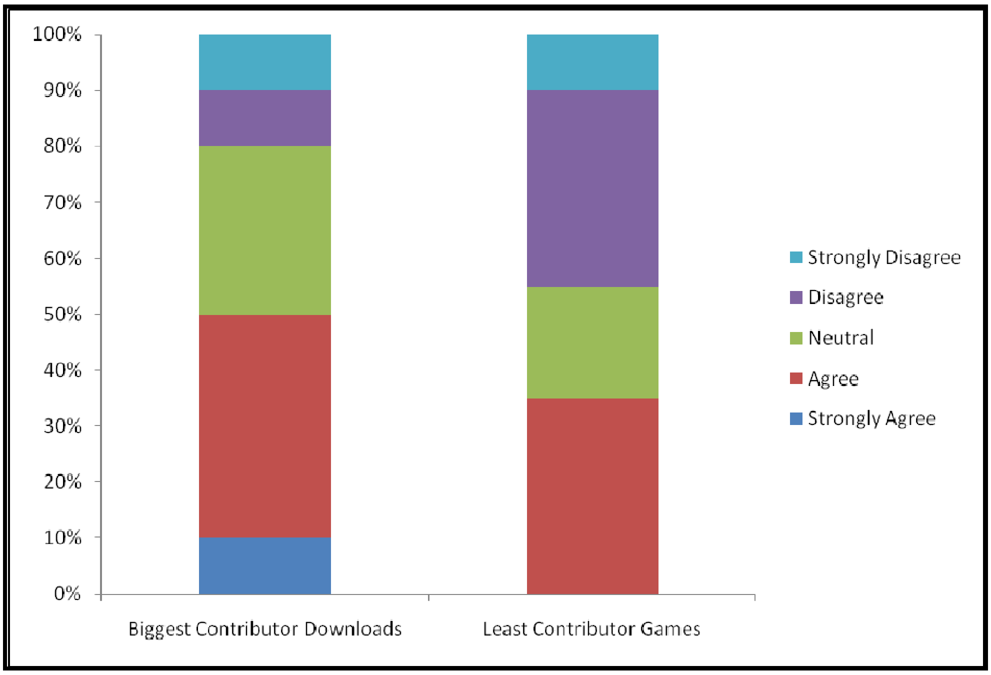


Figure 8.11 Biggest and Least Contributors to the Growth of iTV

The panellists were asked to review the following statement "Playing Games will be the least contributor to the growth of iTV". 35% (n=7) agreed with the statement and 20% (n=4) were neutral towards it. However, 35% (n=7) disagreed and a further 10% (n=2) strongly disagreed. As the percentage of disagreed and strongly disagreed is higher compared to the agreed percentage, it can be concluded that Playing Games is not the least contributor to the growth of iTV.

The panellists were further asked which services will have the biggest share of iTV services in 20 years' time. Figure 8.12 illustrates the findings. Entertainment on average will have a 34% share; Games will have a share of 22% on average. The smallest share of iTV services will be found in Post School Education and Financial Services.

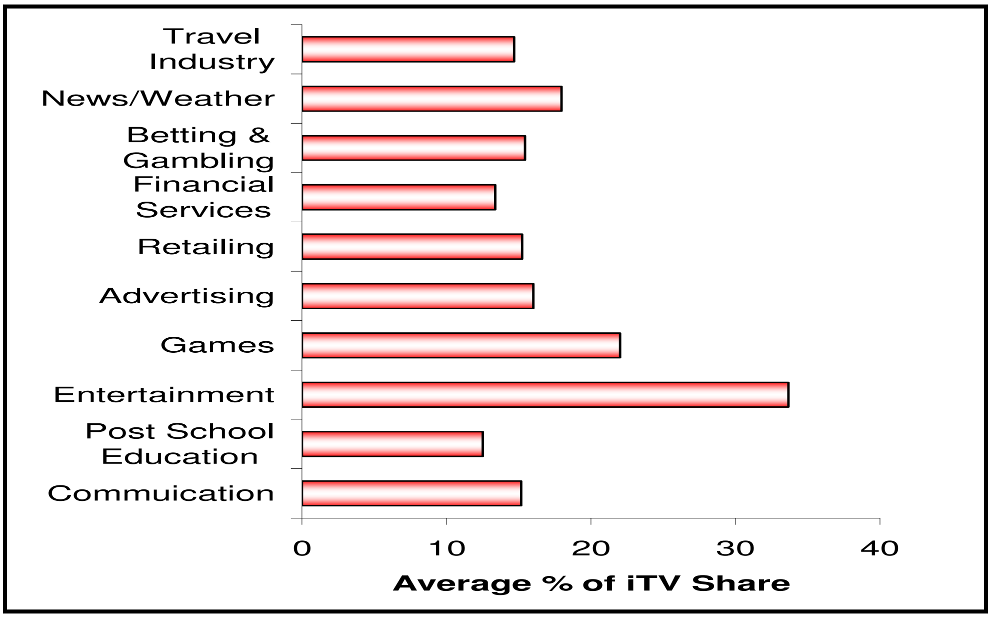


Figure 8.12 Share of iTV Services in 20 Years' Time

In the second round of Delphi, the following statement was reviewed: "In 20 years' time Entertainment will hold the biggest share of iTV services". 20% (n=4) of the participants strongly agreed with the statement and 65% (n=13) agreed. Two of the participants were neutral and only one expert disagreed with the statement.

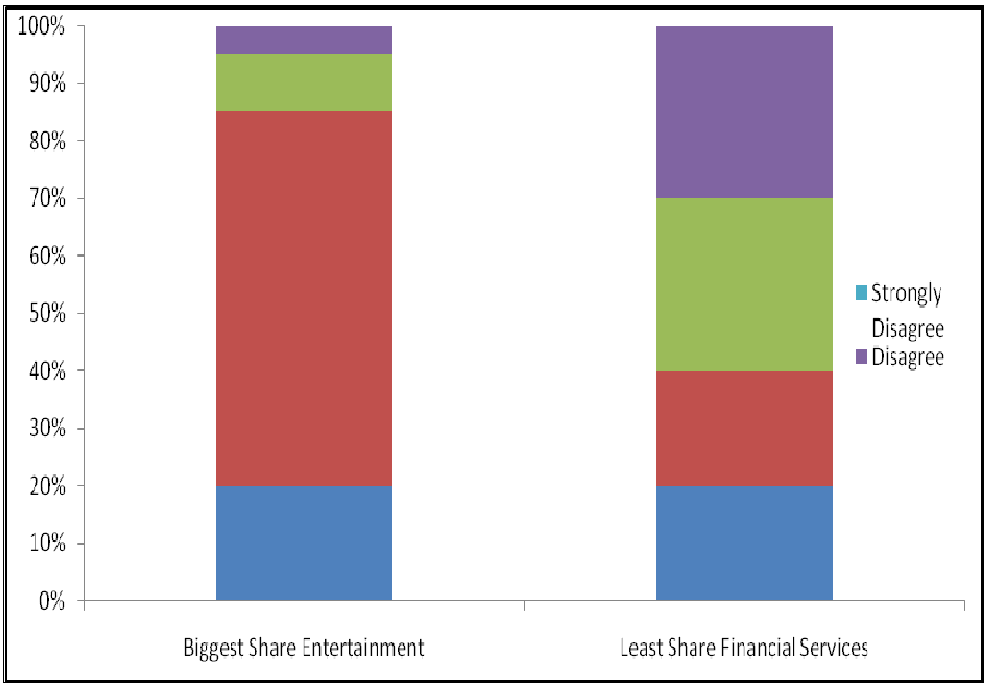


Figure 8.13 Biggest and Least Share of iTV Services in 20 Years' Time

From these figures it can be determined that in 20 years' time Entertainment is expected to hold the biggest share of iTV services.

The participants were asked to evaluate the following statement: "In 20 years' time Financial Services will have the least share of iTV Services." 20% (n=4) of the participants strongly agreed with the statement and a further 20% (n=4) agreed. 30% (n=6) were neutral and 30% (n=6) disagreed. From this evaluation it can be concluded that Financial Services will have the least share of iTV Services. Summarised in Figure 8.13 are the results for the biggest and least share of iTV services at that time.

The participants were asked which platform they think will be the dominant media provider for various services. The results are presented in Figure 8.14.

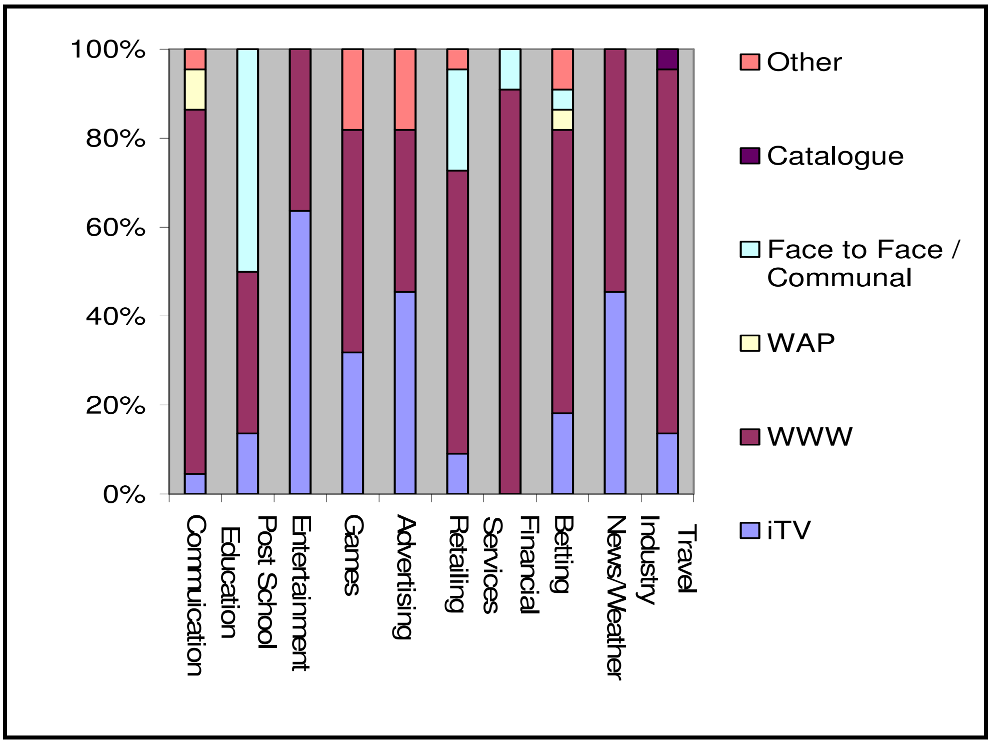


Figure 8.14 Dominant Media Provider for Services

As can be seen, 64% of the respondents indicated that iTV would be the dominant service provider for Entertainment, while 45% envisioned it as dominant for Advertising, News and Weather information. iTV was seen as the smallest media provider for Communication such as mail and live chats, the dominant media provider for Communication being WWW. For Post School Education the dominant provider would be Face to Face or Communal. Considering Retailing of goods such as food, clothes and books, only 23% of the respondents expected such service to be performed Face to Face or Communal, with 64% suggesting that it would be carried out by WWW in the future. 50% of respondents suggested that the future dominant media provider for Games would be WWW, also perceived as the main provider for future Financial Services such as banking and paying bills, as well as for the Travel Industry, News/Weather, Betting and Gambling.

In the second round of Delphi, the participants were asked to assess the following statement: "WWW will be the dominant service provider for Financial Services". 25% (n=5) strongly agreed with the statement and a further 60% (n=12) agreed. Only three were neutral towards the statement and none of the participants disagreed with it. Thus it can be concluded that the WWW will be the dominant service provider for Financial Services.

Responding to the statement: "ITV will be the dominant service provider for Entertainment", 55% (n=11) strongly agreed and 30% (n=6) agreed. Only two were neutral and one disagreed. Participants were further asked whether "Face to Face/Communal will be the dominant service provider for Post School Education"; 10% (n=2) strongly agreed and 25% (n=5) agreed with the statement. The majority, 55% (n=11), were neutral and 10% (n=2) disagreed. The results are illustrated in Figure 8.15.

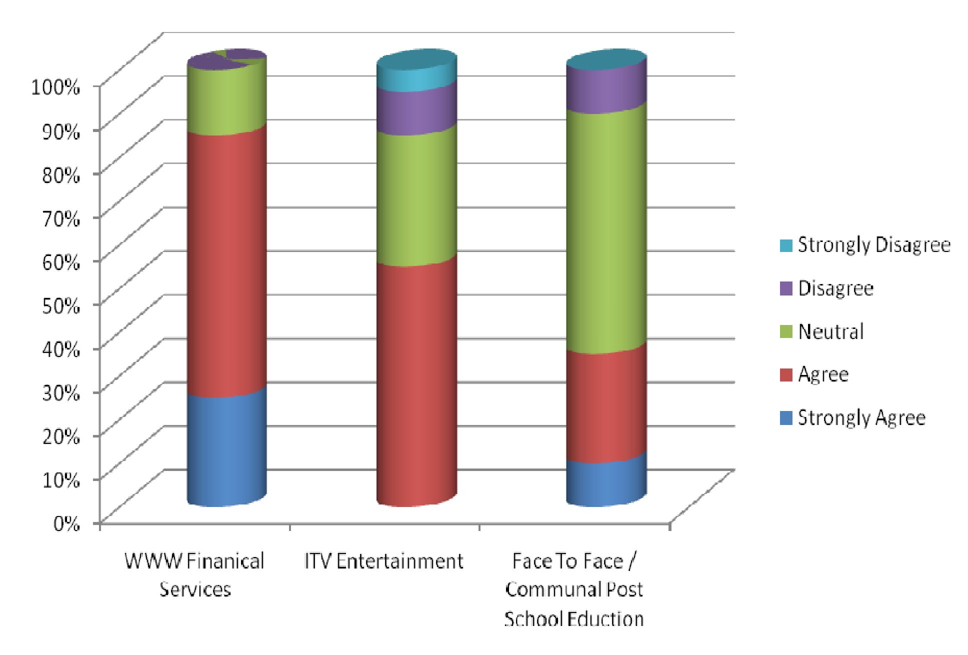


Figure 8.15 – Future Dominant Platform for Services

The conclusion from this review is that iTV will be the dominant service provider for Entertainment, with a majority being neutral towards Face to Face/Communal as the dominant service provider for Post School Education.

8.1.4 Technological Convergence

Respondents were asked what the main platform supporting ICT would be and their answers are displayed in Figure 8.16. It can be seen that 60% of the services were expected to be provided on the WWW platform, which indicates that WWW may be the dominant platform for providing most services. Only 25% were provided on the iTV platform. The platform used least for services was WAP. In the second round of Delphi, participants were asked to confirm that "WWW will be the dominant service provider for most of the services, followed by iTV and WAP". One of the experts strongly agreed and 50% (n=10) agreed with the statement. 35% (n=7) had neutral views and only two disagreed. The conclusion is that WWW will be the dominant service provider for most of the service, followed by iTV and WAP.

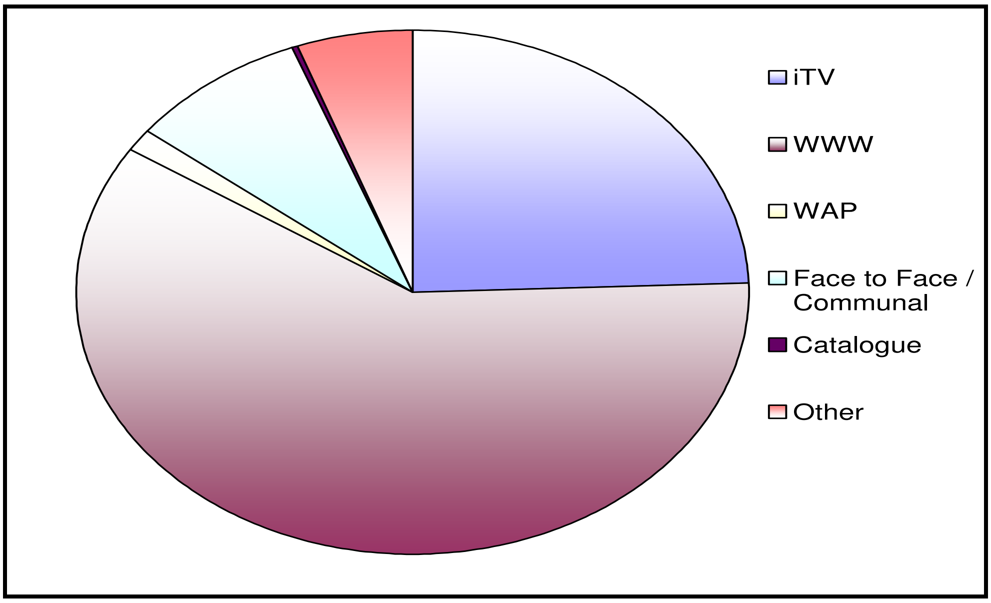


Figure 8.16 Main Platform to Support ICT

There has been a major increase in the level of convergence owing to replacement of analogue technologies with their digital counterparts, which has resulted in networks that carry a variety of media instead of one. Now many devices can handle a multiplicity of media types where formally they had only one prescribed purpose. Therefore it was important to determine if WWW, WAP and iTV will exhibit technological convergence. Responses are illustrated in Figure 8.17.

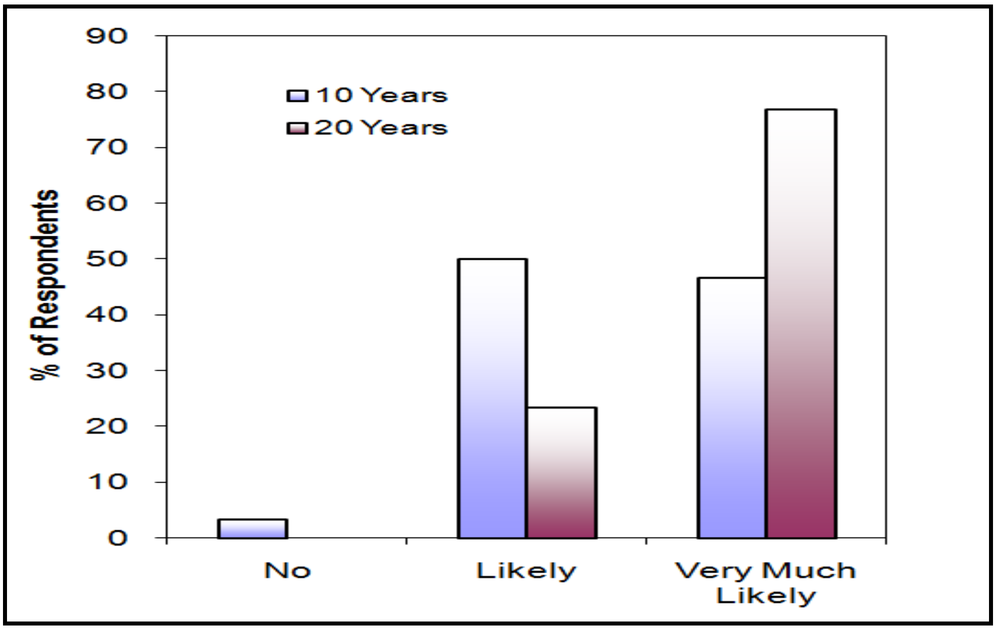


Figure 8.17 Exhibit Technology Convergence

Only 61% of the respondents considered it likely that technological convergence will take place in 10 years' time. However, 74% suggested that in 20 years' time technological convergence would be very likely. So, in the second round of the Delphi study, participants were asked to assess the following statement: "It is most likely that WWW, WAP and iTV will exhibit technological convergence in 20 years' time". 35% (n=7) strongly agreed and 45% (n=9) agreed with the statement. Only 15% (n=3) were neutral and 5% (n=1) disagreed. The conclusion is that that WWW, WAP and iTV will most likely exhibit technological convergence in 20 years' time.

In the first round of Delphi the participants were asked which platform they would converge to if there were technological convergence. As shown in Figure 8.18, 60% of the respondents suggested that if there should be technological convergence it was most likely to converge into WWW, with only 34% of the respondents expecting it to converge into iTV.

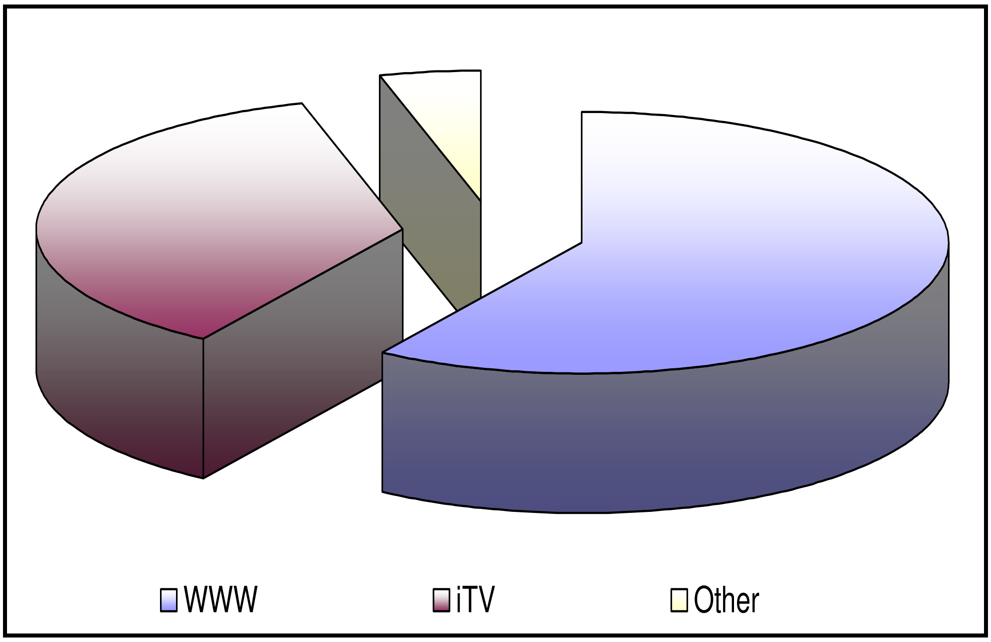


Figure 8.18 Platform Convergence

In the second round of Delphi, the participants were asked to review the following statement: "If there is technology convergence it is most likely to converge into WWW". Three experts strongly agreed and 45% (n=9) agreed. In addition, 35% (n=7) were neutral and one expert disagreed with the statement. From this review, as a majority agreed with the statement, it can be determined that if technology convergence should occur, it is more likely to converge into WWW.

8.1.5 Future of iTV

From Figure 8.19 it appears that, as 52% of the respondents suggest, it is most likely that the market share for iTV will increase in 10 years. 39% suggested that the market share would slightly increase. Only 13% expected it either to stay the same or to decrease. 57% of the respondents believed that there would be an increase in market share over the next 20 years. Some of the participants felt that iTV would remain in the market but would not be a dominant provider. There would be continuous growth of iTV but it would be slow. However, the majority of the experts felt that iTV has already missed the opportunity to become the dominant provider of many services. To compete effectively, iTV needs to capitalise on its intrinsic relationship with television program content. Many also believe that the cost of iTV needs to stabilise as that would increase its uptake. Some respondents also anticipated a convergence of both iTV and the computer, with iTV used as a central medium in homes and the computer used mostly in the workplace.

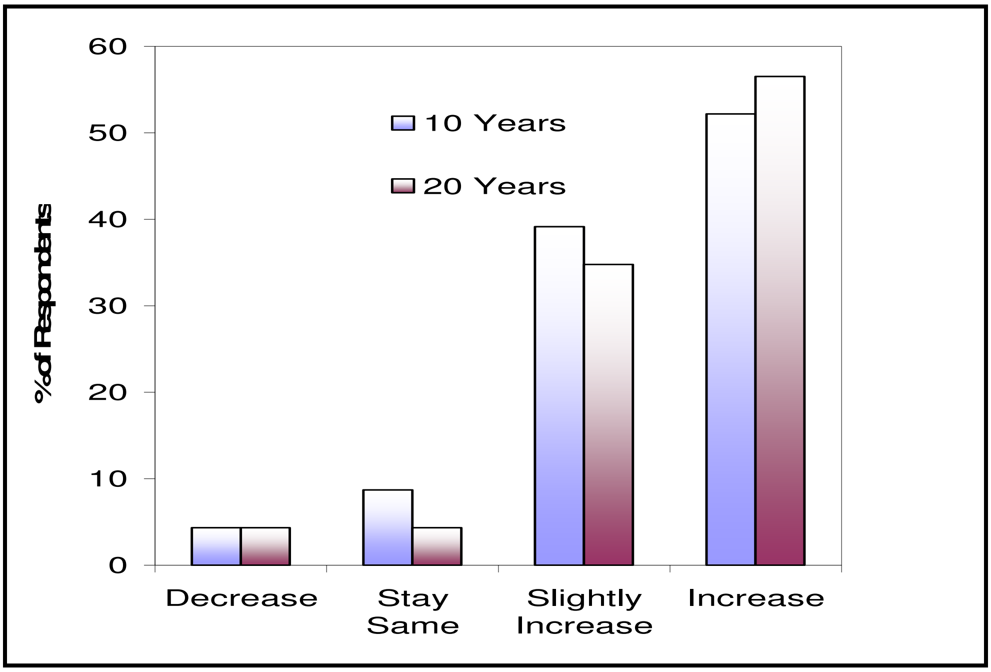


Figure 8.19 Future Market Share of iTV

The success of iTV will largely depend on the services provided. Some participants believe that communication and gaming will become increasingly sophisticated on iTV, as they are on WWW and WAP. There will also be an increase in communication services such as instant messaging, Facebook etc. across all platforms (iTV, WWW, WAP). iTV's success in these areas rests with both society and consumers. It also depends on the user interface, quality, usability and flexibility of interactive TV. From this study it seems indicated that iTV has the potential to become the dominant service provider of Entertainment and Advertising. However, it will not become the dominant technology in the future but will continue to increase its market share.

The first round of the Delphi study established a number of confirmed acceptance statements with which to forecast the future of iTV. Therefore it was valid to have a second round of Delphi which allowed panellists to review the consolidated results from the first round and to assess the acceptance statements on the basis of which consensus might be reached. The next section will review the results obtained from the second round of the Delphi study.

8.2. Optimistic and Pessimistic Views

The Delphi study provided a constructive and effective forecast for the future of ITV. Many agreed assumptions were determined by the Delphi forecast. The results were further analysed to identify the characteristics of Optimists and Pessimists, which will help to distinguish the potential early adopters and late adopters of technology. Different types of statistical analysis were employed; the next section provides an analysis of the results.

To analyse the characteristics of Optimists and Pessimists the two groups first need to be identified. To differentiate between them, answers to the following question were examined: "At the moment in terms of growth, the iTV market is possibly best described as in its infancy. When do you think it might make it to the adolescent phase?" Individuals identified as potential optimists will suggest that growth will be within five years, as optimistic people have a more positive and assertive attitude. Pessimistic individuals are more negative and apprehensive; therefore they will predict that the adolescent phase will take more than 5 years to arrive, or never will. There were 32 participants, of whom 56.2% (n=18) were identified as optimists and 43.8% (n=14) were pessimistic. Varied statistical analyses were performed to understand the views of optimists and pessimists.

Currently the share of the ICT market attributed to iTV is considered to be less than 5%. Optimists and Pessimists both have similar visions of iTV's future outlook, although Optimists have a higher mean than Pessimists. Regarding the market share in 5 years Optimists' mean was 18.33 (σ=13.72) and Pessimists' Mean was 12.43 (σ=13.72). The variations of means between the two groups were much smaller when the market share 10 and 20 years hence was considered. Therefore the Pessimists and Optimists have a similar expectation of the market share growth of iTV in the next 5 years. When forecasting iTV's market share in 10 years' time, Optimists had a mean of 38.63 (σ=29.60), Pessimists, of 25.64 (σ=13.08). There is a bigger difference in the means between Optimists and Pessimists. This suggests that Optimists envision a higher market share in the next 10 years compared to Pessimists. Similar results were obtained when the means of Optimists, 50.00 (σ=32.77) and Pessimists, 41.71 (σ=25.48) were compared for the market share in 20 years' time. According to this analysis Optimists and Pessimists both believe market share will increase over the years, but Optimists expect a higher growth than Pessimists.

To differentiate between inhibitors and promoters as viewed by Pessimists and Optimists, the Error Bar of 95% confidence level chart was plotted and cross tabulations were analysed. Visually analysing the Error Bar plot in Figure 8.20, one can find no evidence of a significant difference between the inhibitors and promoters identified by Pessimists and Optimists. Both groups agree on the same inhibitors and promoters.

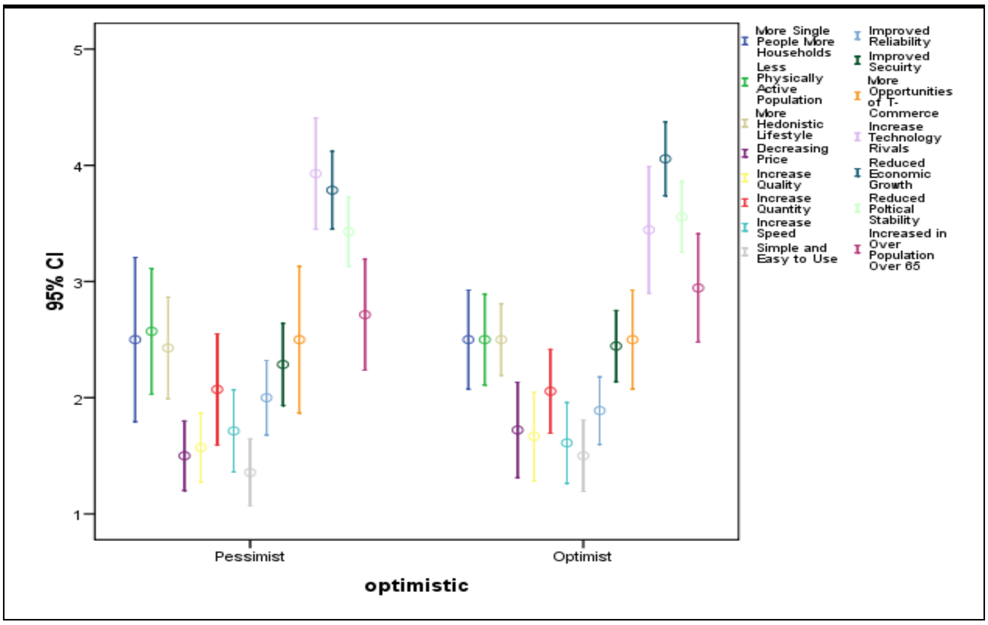


Figure 8.20 Confidence Intervals of Inhibitors and Promoters for Optimistic and Pessimistic

The participants were asked to determine which services will generate most of the growth for iTV. This question was examined by Error Bar plot for Optimists and Pessimists. Figure 8.21 illustrates the findings, again demonstrating that there is no significant difference between the Optimists and Pessimists. Both groups suggested similar rankings for the services expected to generate most of iTV's growth.

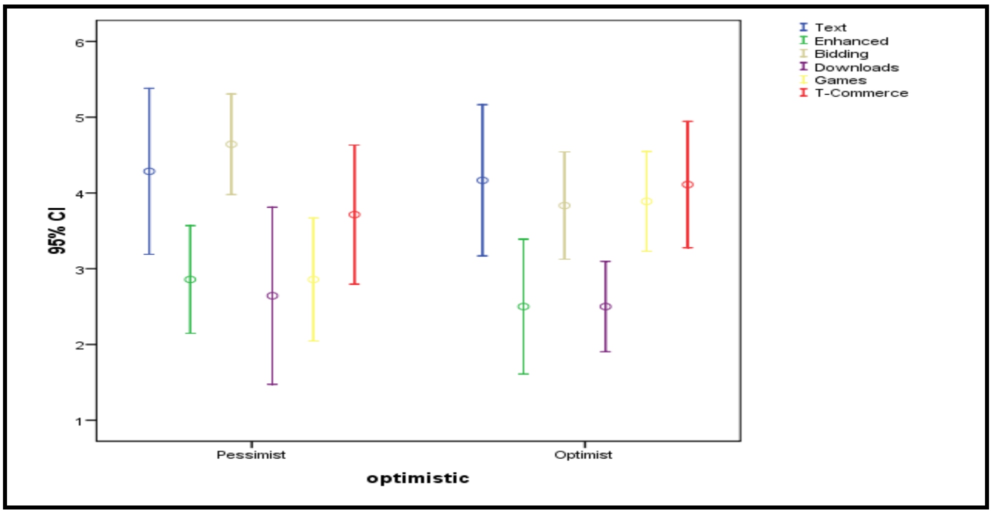


Figure 8.21 Confidence Intervals of Growth of Services for Optimistic and Pessimistic

The participants were asked to envision the size of the share of services held by iTV in 20 years' time. Figure 8.22 illustrates the Error Bar plot for iTV's share of services by that date. The findings show that there is no significant difference between the two groups regarding the expected shares of services in 20 years' time. Pessimists and Optimists have a similar outlook on this point.

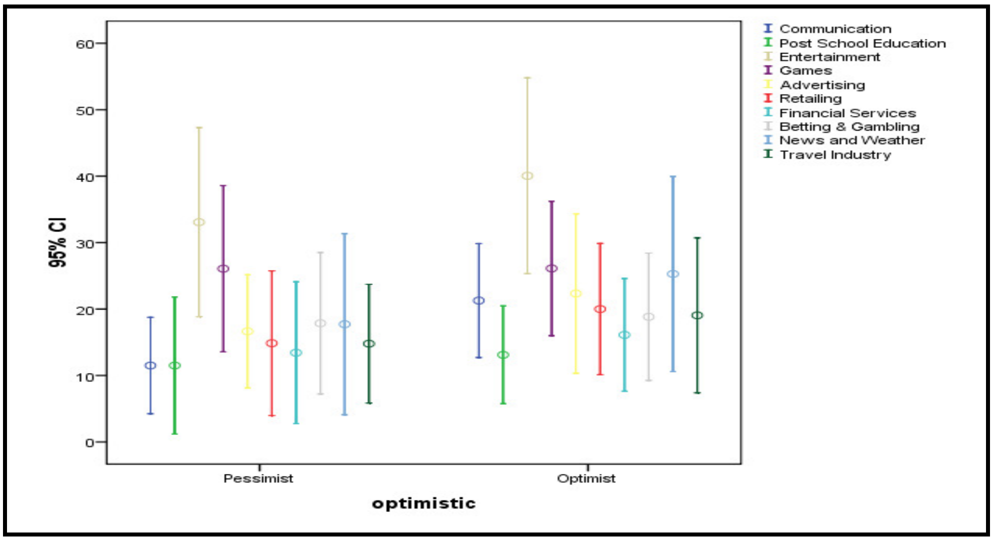


Figure 8.22 Confidence Intervals of 20 Years Share of Services on iTV for Optimistic and Pessimistic

However, when comparing the means of services between the two groups, Optimists have a higher mean of 21.28 (σ=17.23) for Communication compared to Pessimists' 11.50 (σ=12.56), indicating Optimists expect a higher share than Pessimists for Communication. For Post School Education, Optimists, at 13.11 (σ=14.79) and Pessimists, at 11.50 (σ=17.86) had similar means. Thus, both groups suggest that Post School Education will share a similar percentage in 20 years time. Optimists, at 40.06 (σ=29.62) believe Entertainment will have a higher share in 20 years' time compared to Pessimists, at 33.07 (σ=24.63). The Optimists, at 26.11 (σ=20.33) and Pessimists, at 26.07 (σ=21.07) both believe that Games will have the same share in 20 years' time. The Pessimists' mean of 16.64 (σ=14.77) shows that they expect Advertisement to have a lower share in 20 years than that expected by the Optimists, with a mean of 22.33 (σ=24.12). Pessimists also suggest that Retailing (14.86 (σ=18.84)), Financial (13.43 (σ=18.48)), News and Weather (17.86, (σ=23.61)) and Travel Industry (14.79 (σ=15.48)) will have lower market shares than those indicated by the Optimists, i.e.: Retailing (20.00 (σ=19.85)), Financial (16.11 (σ=17.05)), News and Weather (25.28, (σ=29.52)) and Travel Industry (19.06 (σ=23.43)). However, Optimists (17.86 (σ=18.43)) and Pessimists (18.83 (σ=19.27)) both believed that Betting and Gambling would have the same market share in 20 years time. The participants were further asked what they thought the dominant media provider for various services would be. Figure 8.23 shows the summary of the results. Generally the WWW seems to be considered the most dominant media provider by both Optimists and Pessimists. Optimists believed that it would be the most dominant media provider for Communication, while three of the Pessimists suggested that there would be other forms of Communication media providers. 56% (n=10) of Optimists, compared to only 36% (n=5) of Pessimists, felt that the dominant media for Post School Education would be Face To Face/Communal. Optimists and Pessimists both suggested that the dominant media provider for Entertainment would be iTV. For Games, 44% (n=8) of Optimists expected it to be WWW, whereas the Pessimists surmised that it would be WWW (36% (n=5)) and Other providers (36% (n=5)). 56% (n=10) of Optimists suggested that iTV would be the dominant media provider for Advertising, while 43% (n=6) held the view that there would be Other dominant media providers. Optimists and Pessimists both thought that the dominant media provider for Retailing, Financial Services, Betting, Games and Travel Industry would be the WWW. Both groups suggested that for the News and Weather it would be iTV and WWW.The participants were asked their views as to the likely future market share of iTV in 10 and 20 years' time. No significant difference between the Optimists and Pessimists was found. They were further asked whether they thought WWW, WAP and iTV would exhibit technology convergence; again, no significant difference appeared between the two groups. 64 % (n= 9) of Pessimists suggested that if there were to be technological convergence it would be towards WWW, whereas 39% (n=7) of Optimists believed that it would be WWW and the other 39% (n=7), that it would be iTV.

This section has described some of the characteristics of Optimists and Pessimists. Many similarities were found between the two groups. Generally they both agree that there will be an increase in the market share of iTV, although Optimists expected faster growth than Pessimists did.

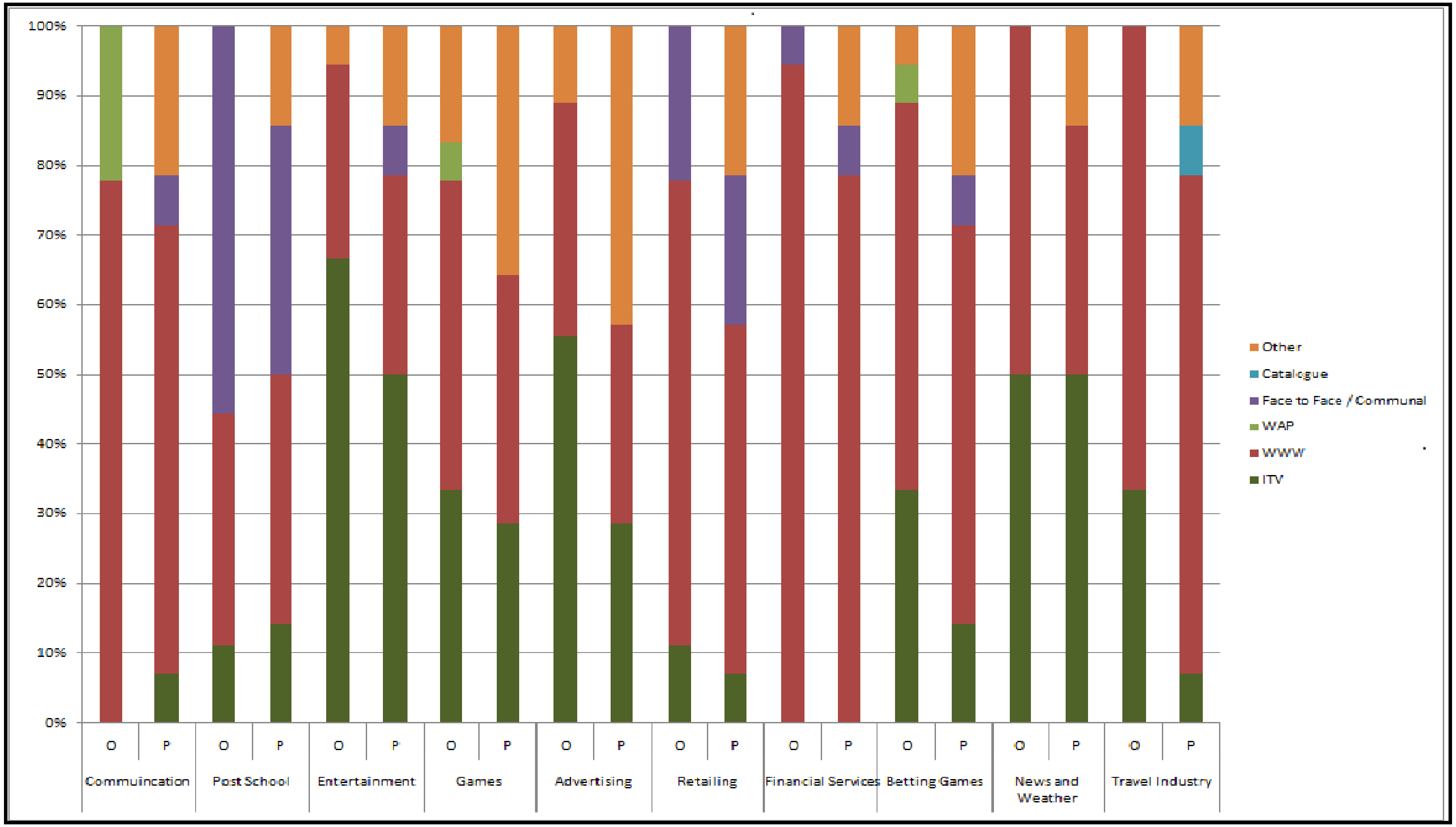


Figure 8.23 Optimists and Pessimists on Dominant Media Provider for Various Services

8.3. Evaluate the Relationship between Promoters and Inhibitors

Initially the Promoter and Inhibitor variables were correlated with the growth in market share of iTV in 5, 10 and 20 years. The only variables yielding a significant relationship between the market share and the inhibitors and promoters were Increased Speed, Improved Reliability and Improved Security. The results are shown in Table 8.1.

Table 8.1 Correlation of Market Share and Key Indicators

		Market Share in 5 years time	Market Share in 10 years time	Market Share in 20 years time
Increased Speed	r	-.385*	-.555**	-.477**
	P value	0.039	0.002	0.009
	n	29	29	29
Improved Reliability	r	-0.332	-.527**	-.481**
	P value	0.078	0.003	0.008
	n	29	29	29
Improved Security	r	-.430*	-0.268	-0.247
	P value	0.02	0.16	0.196
	n	29	29	29

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

The results show that Increased Speed has a significant positive association with the market share of iTV in 5, 10 and 20 years. The strength of the relationship between Market Share in 5 years and Increased Speed is medium ($r=-0.385$, $n=29$, $p<0.05$). The coefficient of determination can be used to discern the degree of variance the variables share. Between Market Share of iTV in 5 Years and Increased Speed there is 14.82% shared variance. This suggests that Increased Speed explains only 14.82% variance of Market Share in 5 years' time. The strength of the relationship between Market Share in 5 years and Increased Security is medium ($r=-0.430$, $n=29$, $p<0.05$), the shared variance being 18.50%.

The strength of the relationship between Market Share in 10 years and Increased Speed is large ($r=-0.555$, $n=29$, $p<0.01$). The shared variance is 30.80%. The strength of the relationship between Market Share in 10 years and

Improved Reliability is also large (r=-0.527, n=29, p<0.01), with a shared variance of 27.77%.

The strength of the relationship between Market Share in 20 years and Increased Speed is medium (r=-0.477, n=29, p<0.01), with a shared variance of 22.75%, while the strength of the relationship between Market Share in 20 years and Improved Reliability is also large (r=-0.481, n=29, p<0.01); here the shared variance is 23.13%,

The Inhibitors and Promoters were further analysed to discover whether there were relationships between them and the variables, but limited evidence was found. The results are presented in Table 8.2.

Table 8.2 Correlation of Promoters and Inhibitors

Correlations

		Increased Spread	Improved Reliability	Improved Security	Less Active Population	Reduced Political Stability	More Hedonistic Lifestyle	Simple and Easy to Use	Increased Quality
Improved Reliability	Pearson Correlation	.465**							
	Sig. (2-tailed)	0.007							
	N	32							
Improved Security	Pearson Correlation	0.172	0.258						
	Sig. (2-tailed)	0.346	0.154						
	N	32	32						
Less Active Population	Pearson Correlation	0.108	.412*	0.165					
	Sig. (2-tailed)	0.556	0.019	0.366					
	N	32	32	32					
Reduced Political Stability	Pearson Correlation	-0.043	-0.201	-.373*	0.034				
	Sig. (2-tailed)	0.813	0.269	0.035	0.855				
	N	32	32	32	32				
More Hedonistic Lifestyle	Pearson Correlation	0.085	-0.09	0.108	-0.169	-.381*			
	Sig. (2-tailed)	0.643	0.622	0.555	0.354	0.032			
	N	32	32	32	32	32			
Simple and Easy to Use	Pearson Correlation	.509**	.494**	0.258	0.106	0	0.122		
	Sig. (2-tailed)	0.003	0.004	0.154	0.563	1	0.505		
	N	32	32	32	32	32	32		
Increased Quality	Pearson Correlation	.440*	0.281	.361*	-0.036	0.086	-0.173	.541**	
	Sig. (2-tailed)	0.012	0.119	0.042	0.844	0.64	0.344	0.001	
	N	32	32	32	32	32	32	32	
Increased Quantity	Pearson Correlation	.565**	0.31	0.017	0.047	0	-0.059	0.31	.370*
	Sig. (2-tailed)	0.001	0.084	0.925	0.797	1	0.747	0.084	0.037
	N	32	32	32	32	32	32	32	32

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

*. Correlation is significant at the 0.05 level (2-tailed).

The results show a positive relationship between Increased Speed and the following variables: Improved Reliability ($r=0.465$, $n=32$, $p<0.01$), Simple and Easy to use ($r=0.509$, $n=32$, $p<0.01$), Increased Quality ($r=0.440$, $n=32$, $p<0.05$) and Increased Quantity ($r=0.565$, $n=32$, $p<0.01$). There is a positive relationship between Improved Reliability and the following variables: Less Physically Active Population ($r=0.412$, $n=32$, $p<0.05$) and Simple and Easy to Use ($r=0.494$, $n=32$, $p<0.01$). The analysis also indicated that there is a positive relationship between Improved Security and Improved Quality ($r=0.361$, $n=32$, $p<0.05$), although the relationship between Improved Security and Reduced Political Stability ($r=0.373$, $n=32$, $p<0.05$) is negative, as is that between Reduced Political Stability and More Hedonistic Lifestyle ($r=0.381$, $n=32$, $p<0.05$). There is a positive relationship between Simple and Easy to Use and Increased Quality ($r=0.541$, $n=32$, $p<0.01$), and also between Increased Quality and Increased Quantity ($r=0.370$, $n=32$, $p<0.05$).

This section has established that there are relationships between some of the inhibitors and promoters of iTV and its future market share. Additionally, it has identified some relationships among the variables. The results obtained will be further discussed in the next section.

8.4. Discussion and Conclusion

The aim of this research was to apply a judgmental approach in order to understand the future of iTV and evaluate the characteristics of optimistic and pessimistic individuals. In addition, the relationships between the inhibitors and promoters were further examined. The research model identified three key stages of the research which successfully met the following objectives.

Objective 1*: Identify Key Promoters and Inhibitors of Interactive Technology*

To achieve this objective, extensive literature research was carried out to identify the current promoters and inhibitors of interactive technology. This research assisted in developing testable hypotheses which were further evaluated through the Delphi study.

Objective 2: *Apply a judgmental approach to understanding the future of interactive technology as viewed by Optimists and Pessimists.*

To achieve this objective, the testable hypotheses contributed to the development of a set of questions to be evaluated during rounds 1 and 2 of the Delphi. Additional descriptive analysis was performed on the results obtained from the questionnaire. Evaluation of the results helped in reaching an agreed consensus as required by the Delphi study, and in ascertaining the views of optimists and pessimists.

Objective 3: *Evaluate the relationship between drivers and inhibitors of interactive TV in order to forecast future growth in the market share of interactive technologies.*

Evaluating the relationship between the inhibitors and promoters determined the key elements which will assist the growth of interactive technology. This research made it possible to assess and predict the future of interactive technologies by adopting the judgmental forecasting method.

This section will discuss the various findings further so as to draw conclusions from the Delphi study as to the future of interactive technologies.

8.4.1 Growth of iTV Market

The Delphi study has provided the conclusion that iTV, currently described as in its infancy, will reach its adolescent phase in the product life cycle within the next 2 to 5 years. It is also most likely that the market share for iTV will increase by at least 10 to 40% within the next 5 to 10 years. Thus it appears that the technology experts chosen as panellists for the Delphi study believe in the potential of iTV to increase its market share in the current market. They have also established a number of promoters and inhibitors of the technology.

8.4.2 Key Drivers and Inhibitors of Interactive TV

The literature review identified various key drivers and inhibitors of interactive TV which would have either a negative or a positive impact on its growth. What follows will discuss the hypotheses derived for various drivers and inhibitors of interactive TV and assess the correctness of the various hypotheses proposed.

Arning and Ziefle (2007) and Venkatesh et al (2003) argued that age is a significant factor influencing technology acceptance. Jung et al (2010) and Saunders (2004) indicated that older adults are reluctant to use technology because of lack of confidence and increased anxiety, although the older generation will be more confident with technology which they have used during their middle years than with new technology which they have only learned and used in old age (Turner et al 2007). The Delphi study revealed the belief of 29% (n =10) of the participants that the increasing Age of the population will inhibit the growth of interactive TV. However, 32% (n=11) suggested that increasing age after 65 will promote the use of interactive TV. 40% (n=14) of the participants gave neutral responses to the statement. In addition, when this variable was correlated against the potential market share growth in the next 5, 10 and 20 years, no significant relationship was found between the variables. Nor was a correlation found between other inhibitors and promoters of interactive TV. The conclusion is that, although age may be a significant factor influencing technology acceptance, this Delphi study produced no evidence to support the hypothesis, possibly because the majority of the participants gave a neutral response to the question.

Decrease in Political Stability can be a significant inhibitor of interactive technology as it governs security and privacy policies affecting the adoption of new technology. In the Delphi study, 52% (n=18) of the participants agreed that Decrease in Political Stability is a significant inhibitor of interactive technology, while 49% (n=17) were neutral towards the statement. Further analysis of the correlation between other inhibitors and promoters disclosed a significant positive relationship between Decrease in Economic Growth and Decrease in Political Stability ($r=0.459$, $n=29$, $p<0.01$). This relationship is valid, since, as Feng (1977) pointed out, decreasing political stability reduces economic growth. The results also demonstrated that decreasing political stability has a negative relationship with more Hedonistic Lifestyles ($r=-0.381$, $n=29$, $p<0.05$). Increase in hedonism has an impact on democracy, since hedonists enjoy freedom and are outspoken about political strategies. This produces a decrease in political stability. The results also demonstrated that Reduced Political Stability has a negative effect on Increased Security ($r=-0.381$, $n=29$, $p<0.05$). A decrease in political stability will result in a decrease in the security of technologies by affecting the security policies that are governed by political bodies.

The Delphi study questioned whether Reduced Economic Growth is one of the inhibitors of interactive technology uptake. During the second round of the study, 50% (n=10) disagreed that Reduced Economic Growth is a strong inhibitor of interactive TV, with 50% (n=10) expressing a neutral opinion on the statement. Usually a decrease in economic growth will result in a less competitive market for small players such as interactive TV as compared to the internet and mobile. Further analysis of the correlation between Reduced Economic Growth and other inhibitors and promoters demonstrated a negative relationship between Increased Speed and Reduced Economic Growth ($r=-0.374$, $n=29$, $p<0.05$). There was also a negative relationship between Improved Reliability and Reduced Economic Growth ($r=-0.381$, $n=29$, $p<0.05$) These findings indicate that Reduced Economic Growth will have an impact on the speed and reliability of interactive technology.

Increase of Technology Rivals allows potential adopters choices and this will increase competition in the market. In the second round of the Delphi study, 70% (n=14) of participants agreed that the main future inhibitor of iTV would be Technology Rivals. When the relationship between the different inhibitors and promoters was analysed, no correlation was found between the variables.
TV is a well adopted technology and on average Britons spend 4 hours per day watching it. As the main advertising medium it creates many sales opportunities; additional sales opportunities will be created by an increase in television commerce. In the Delphi study, 54% (n=19) of the participants agreed that Increasing Television Commerce will promote the adoption of interactive TV. On further analysis of the relationship between the inhibitors and promoters, no correlation between the variables was identified.

Paine et al (2007) and Lee et al (2003) stated that improved security gives the user the perception that personal data is protected and stored in a secured location. Improved security is most likely to promote the adoption of interactive TV. The Delphi results demonstrated that, according to 57% (n=20) of the participants, Improved Security will promote the growth of interactive TV. When relationships between the different inhibitors and promoters were analysed further, a positive relationship was found between Increased Quality and Improved Security ($r=.361$, $n=29$, $p<0.05$). DeLone and McLean (1992) suggest that the factor of information quality is significant in helping to promote information systems. However, the results also showed a negative relationship between Improved Security and the growth of iTV's market share in the next five years. No correlation was identified between the growth of interactive market shares in the next ten and twenty years and improved security. As the commerce technology infrastructure has advanced considerably over the years, technology adopters may be expecting the security to be at an adequate acceptance level; therefore no relationship is found between potential growth and improved security.

The reliability of technology is measured by its system availability, responsiveness and system flexibility. 86% ($n=30$) of the respondents agreed that Improved Reliability is a promoter of interactive TV. Improved Reliability implies that the technology is technically sophisticated. Analysis of the relationship between the different variables illustrated that Improved Reliability has a positive relationship with Simple and Easy to Use ($r=0.494$, $n=29$, $p<0.01$) and Increased Speed ($r=0.465$, $n=29$, $p<0.01$). But the results also show that Improved Reliability has a negative relationship with the market share of interactive TV in the next 10 years ($r=-0.527$, $n=29$, $p<0.01$) and next 20 years ($r=-0.481$, $n=29$, $p<0.01$). However, Improved Reliability has a positive relationship with physically Less Active Population ($r=0.412$, $n=29$, $p<0.05$).

Potential users will be more attracted to a technology if it is simple and easy to use (Park et al 2007 and 2009). In the second round of the Delphi study, 65% ($n=13$) of the respondents agreed that the strongest promoter of iTV is simplicity and greater ease of use. On analysis, Simple and Easy to Use is positively associated with decrease in Price ($r=0.505$, $n=29$, $p<0.01$) and Increased Quality ($r=0.541$, $n=29$, $p<0.01$).

Increased speed of accessing and using the technology is a significant factor in its uptake. Pagani (2006) stresses that speed is a critical barrier to adoption of technology. 92% ($n=30$) of the participants agree that Increased Speed is a promoter of interactive technology. But it had a negative relationship with the market share of interactive technology in the next five years, ($r=-0.385$, $n=29$, $p<0.05$), the next ten years ($r=-0.555$, $n=29$, $p<0.01$) and the next twenty years

($r=-0.477$, $n=29$, $p<0.01$). The results also demonstrated that Increased Speed is positively associated with Increased Quality ($r=0.440$, $n=20$, $p<0.05$) and Increased Quantity ($r=0.565$, $n=29$, $p<0.01$).

Huizingh (2000) and Ahn et al (2007) have emphasised that quality influences users' intention to uptake technology. 85% (n=17) agree that the main future promoter of iTV will be both Improved Quality and Quantity of the service.

Price plays an important role in the adoption of the technology as emphasised by Bradner (2001) and LaRose and Atkin (1992). Shin (2009) and Shim et al (2006) have already suggested that increased price is perceived as an adoption barrier. Similarly, 94% (n=33) of the Delphi participants suggested that decreased price is a promoter of interactive TV adoption.

Increase in Single People, Increase in Hedonistic Lifestyle and physically Less Active Population play a major role in the uptake of technology. The participants agreed that these variables are considered major promoters of interactive technology uptake.

In Figure 8.24 and Table 8.3, the results for various testable hypotheses are summarised in order to predict and understand the relationship between various inhibitors and promoters of interactive technology. Figure 8.24 illustrates the promoters and the inhibitors identified during this research. This figure further assists in verifying the hypotheses.

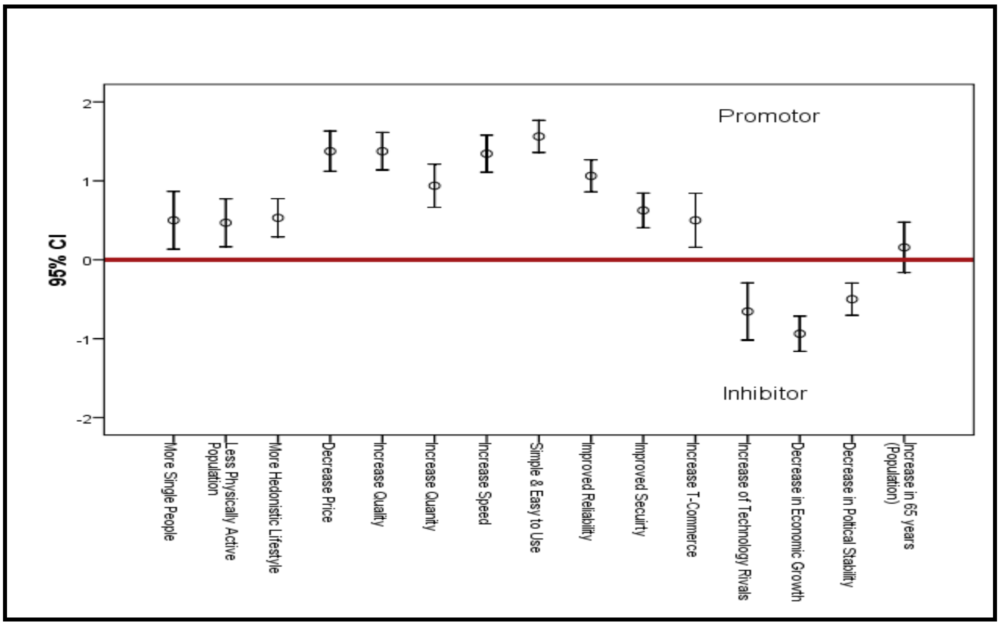


Figure 8.24 Identification of the Key Inhibitors and Promoters

Table 8.3 shows that increasing Age is negatively associated with the growth of Interactive Technologies. The research also showed that a Decrease in Political Stability, Increase in Economic Growth and Increase of Technology Rivals is negatively associated with the future growth of Interactive technologies. In addition, an increase in T-Commerce, Ease of Use, Improve Reliability and Security, Increase in Speed, Quality, Quantity is positively associated with the growth of Interactive technologies.

Further to this, the findings show that an Increase Hedonistic Lifestyle and increase in Single people is also positively associated with the growth of Interactive technologies.

However, the findings also that decrease in price and decrease in physically active population is negatively associated with the growth of Interactive technologies.

Table 8.3 Summary of Hypotheses and Findings

Hypotheses		Agreement
H1 (c)	Increasing Age is negatively associated with the future growth of Interactive Technologies	Yes
H3 (b)	Decrease in Political Stability is negatively associated with the future growth of Interactive Technologies	Yes
H3 (c)	Decrease in Economic Growth is negatively associated with the future growth of Interactive TV	Yes
H5 (a)	Increase of Technology Rivals is negatively associated with the future growth of Interactive TV	Yes
H5 (b)	Increase of Television Commerce is positively associated with the future growth of Interactive TV	Yes
H7 (a)	Improved Security is positively associated with the future growth of Interactive TV	Yes
H6 (a)	Improved Reliability is positively associated with the future growth of Interactive TV	Yes
H2 (a)	Simple and Easy to Use is positively associated with the future growth of Interactive TV	Yes
H6 (a)	Increased Speed is positively associated with the future growth of Interactive TV	Yes
H6	Increased Quality is positively associated with the future growth of Interactive TV	Yes
H6(a)	Increased Quantity is positively associated with the future growth of Interactive TV	Yes
H5 (d)	Decreased Price is positively associated with the future growth of Interactive TV	Yes
H1 (j)	Increase in Hedonistic Lifestyle is positively associated with the future growth of Interactive TV	Yes
H1 (i)	Decrease in Physically Active Population is positively associated with the future growth of Interactive TV	Yes
H1 (h)	Increase in Single People is positively associated with the future growth of Interactive TV	Yes

8.4.3 Future of iTV

The study has established that iTV does have a future, although its main future inhibitors will be technology rivals such as WWW, WAP and iPTV etc. However, if iTV becomes simpler and much easier to use, its growth will be promoted. Another key future promoter of iTV will be improvements in both the quality and quantity of the service. Download services such as music, films and books will make the biggest contribution to the growth of iTV. It is expected that, in 20 years' time, entertainment will hold the largest share of iTV services and financial services the smallest share.

The Delphi study has also revealed the likelihood that WWW will be the dominant service provider for financial services such as banking or financial products, while iTV will be the dominant service provider for entertainment. WWW will in fact be the dominant provider for most of the services, followed by iTV and then WAP. It is most likely that WWW, WAP and iTV will exhibit technology convergence in 20 years' time and are most likely to converge into WWW.

The present chapter on the Delphi study has established a future outlook for iTV and contributed considerably to the thesis by elucidating the current and future market place of iTV and other interactive technologies. The next chapter will identify the cross-cultural variables that will have an impact on technology adoption.

Chapter 9 Cross-Cultural Study

9.1. Introduction

The previous chapters explored the future of interactive technologies by applying technological and judgmental forecasting methods. This chapter will analyse the results of the cross-cultural study in order to predict the future of interactive technologies and discuss the findings. The study will make it possible to establish the growth and acceptance of interactive technologies in each culture. The cross-cultural study analysed three diverse cultures: Western Culture through the UK, and Eastern Culture through Pakistan and Hong Kong. The UK is a developed high-tech country. Pakistan is a developing country with low acceptance of innovative technology, whereas Hong Kong is thriving in the production of innovative technology but its actual use there is uncertain. The aim of this study was to examine the cultural differences and assess the impact they might have on technology acceptance. This chapter will then use multivariate statistical analysis to establish the model for predicting the future of interactive technologies.

9.2. Cross-Cultural Study

The literature research has underlined the importance of certain variables which influence the future usage and adoption of interactive technologies. One of the objectives of this study is to assess and evaluate those variables which might assist in predicting interactive technology adoption. A survey was carried out containing 38 questions which evaluated the following factor Demographic and Social Economic, Attitude and Social Interaction, Technological and Quality factors. 600 questionnaires were distributed among the three countries: Hong Kong, Pakistan and the UK. 200 were distributed in the UK, where the response rate was 65%, although there were 30 incomplete questionnaires which were disregarded for any further analysis. 200 questionnaires each were distributed in Pakistan and Hong Kong with a response rate of 60% and 70%. Overall 50% of the distributed questionnaires counted towards the response rate, only 100 being analysed for each country as some of those returned were incomplete. The questionnaire can be reviewed in Appendix 2; Table 9.1 shows the profile of the respondents.

Table 9.1 Profile of the Respondents

Variable		UK	Hong Kong	Pakistan	Total
Gender	Male	51	35	64	150
	Female	49	65	36	150
Age Group	< 30	80	57	96	233
	30 +	20	43	4	67
Marital Status	Married	0	37	10	47
	Single	100	63	90	253
House Status	Living Alone	20	9	9	38
	Living Together	25	42	21	88
	Living with Parents	55	49	70	174
Education	< Degree	80	45	35	160
	Degree +	20	55	65	140

Table 9.1 shows that Pakistan had the most male respondents compared to China and the UK, while China had the most female respondents compared to the UK and Pakistan. For all three countries, most of these respondents – 78% – were below the age of 30. In Pakistan 90% of the respondents were single whereas in China it was 63% and in the UK, 100%. In Pakistan 70% of the respondents were living with their parents, as were 55% of UK respondents. But in China, 42% were living together or sharing accommodation rather than living with parents or living alone. The results were further statistically analysed to assist in determining the elements likely to influence the growth and adoption of interactive technologies.

9.3. Descriptive Analysis

9.3.1 Social Interaction and Demographic Variables

The demographic variables for each country were analysed to examine the relationship between the demographics and the social interaction variables. Social interaction activities consisted of spending time with family and friends, watching TV, reading for leisure, studying and doing traditional shopping. Table 9.2 gives a summary of the number of hours spent each week on social interaction activities by each country.

Table 9.2 Hours Spent on Various Social Interaction Activities per Week

Country		Hours Spent on Various Social Interaction Activities per week					
		Watching TV	With Family & Friends	Reading for Leisure	Gaming & Leisure Activities	Studying	Traditional Shopping
Pakistan	Mean	19.82	28.95	8.05	9.24	22.11	8.35
	N	100	100	100	100	100	100
	s.d.	16.18	29.06	7.62	13.74	31.39	11.07
Hong Kong	Mean	12.18	15.50	5.28	2.28	9.14	4.32
	N	100	100	100	100	100	100
	s.d.	7.24	12.19	5.66	3.77	6.54	4.48
UK	Mean	14.66	24.08	3.76	4.01	10.12	5.20
	N	100	100	100	100	100	100
	s.d.	8.87	18.69	4.28	5.00	5.58	5.96
Total	Mean	15.55	22.84	5.70	5.18	13.79	5.96
	N	300	300	300	300	300	300
	s.d.	11.84	21.81	6.25	9.18	19.64	7.87

The findings from Table 9.2 show that respondents in Pakistan spend approximately 29 hours per week socialising with friends and family. In the UK at least 24 hours per week are spent in this way, whereas in China only 15.5 hours per week are spent with family and friends.

The results also indicate that in Pakistan 20 hours per week are spent watching TV; in China it is 12 hours and in the UK, 16. In addition, respondents in Pakistan spend approximately 8 hours per week in leisure-time reading, those in China spend 5 hours and in the UK, 6 hours. In Pakistan, according to the results, more hours were spent on leisure activities such as playing games and taking part in sport activities. In Hong Kong approximately 2.5 hours were spent on this type of activity and in the UK it was 4 hours.

As regards shopping activities, Pakistan showed the most hours spent shopping via traditional methods such as visiting malls etc. The results disclose that in Pakistan 8 hours per week were spent shopping, in China it was 4 hours per week and in the UK, 6 hours per week. A one way analysis of variance was performed to discern whether significant national differences in social interactions existed. The test confirmed that there are statistically significant differences among the three countries regarding the hours per week spent in social interactions per week. Other demographic variables were also analysed against social interaction activities. Figure 9.1 shows the error plot for social interaction activities and gender for each country.

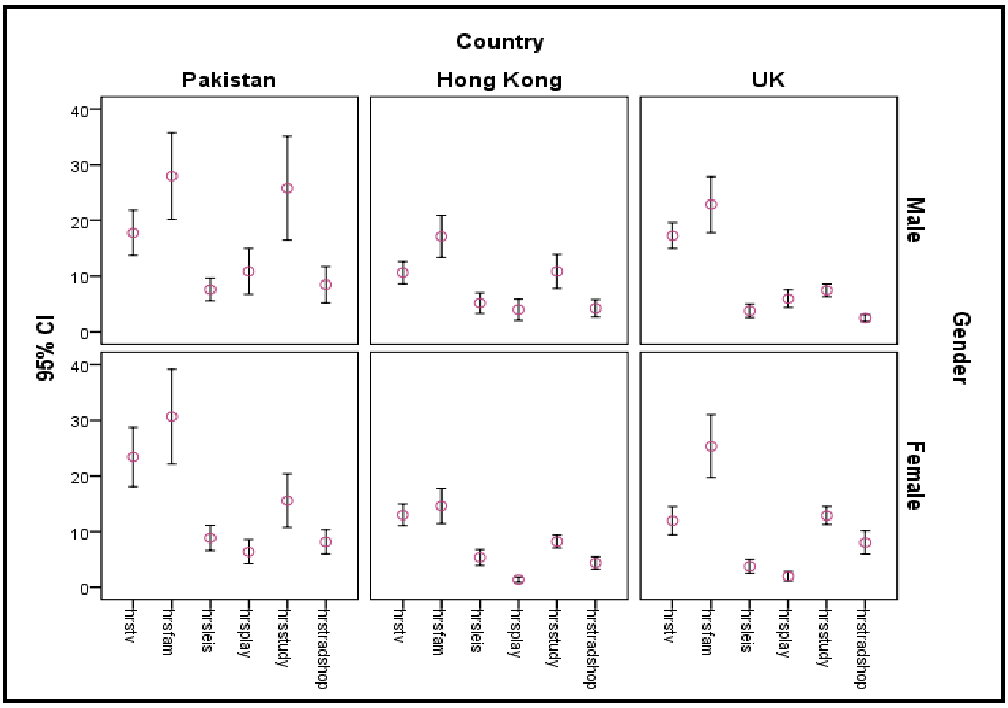


Figure 9.1 Confidence Interval of Mean Score of Gender and Social Interaction Activities per Week

The findings reveal a significant difference between genders in different countries relative to social interaction. The analysis showed that males spend more hours per week than females in playing games. On average males spend approximately 8 hours per week in this activity whereas females spend 3 hours per week. Males also spend more time studying compared to females, the rate for males being approximately 16 hours per week and for females, 12 hours per week. Females spend slightly more hours per week shopping than males, shopping for 6 hours per week compared to the males' 5 hours.

Figure 9.2 shows the error plot for social interaction and age group. The results indicate that those under 30 spend more time with family than on other social interaction activities.

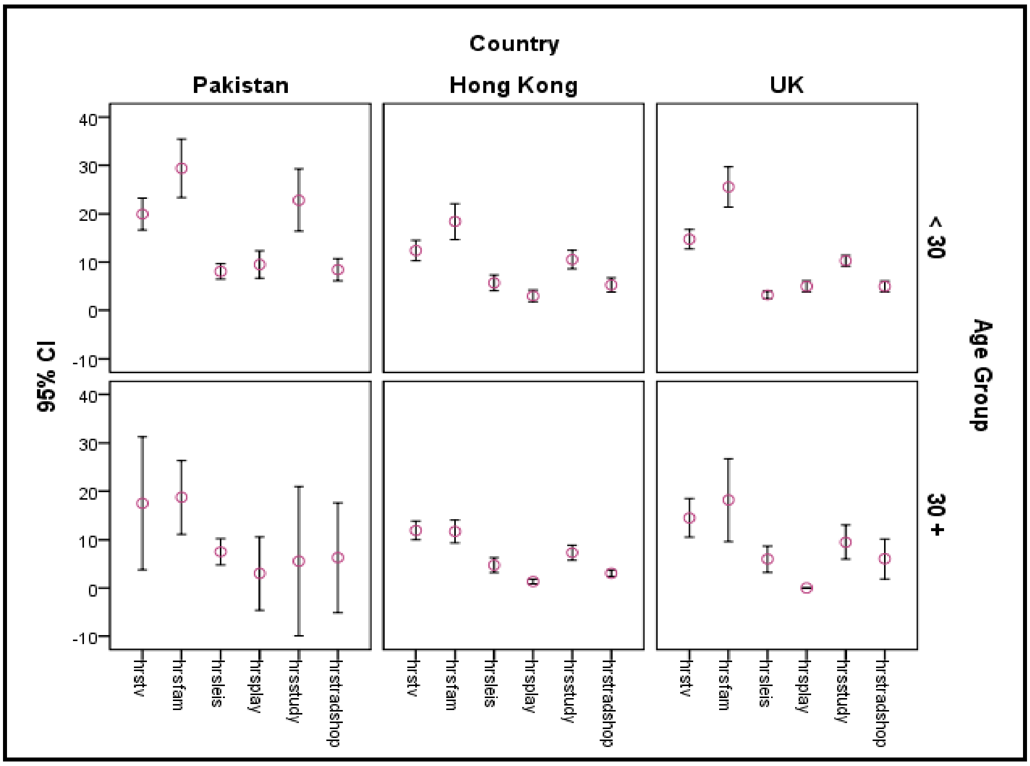


Figure 9.2 Confidence Interval of Mean Score of Age Group and Social Interaction Activities per Week

On average 25 hours were spent with family, while the over-30 age group spent only 14 hours per week with family. It was also found that, on average, people under 30 spend more time studying or engaging in leisure activities than those over 30. The findings show that there is no significant difference between age groups regarding the amount of time spent reading for leisure, although there is a significant difference between other social interaction variables relative to age groups.

Figure 9.3 shows the error plot for social interaction and marital status. An independent samples t-test was performed to check whether there were any significant differences in respect of marital status and social interaction activities. The results showed statistically significant differences regarding marital status and social interaction activities; in particular there were significant differences in marital status relative to leisure reading. The findings demonstrate that married people spend less time with family compared to single people and that generally, married people spend less time in social interaction compared to single people.

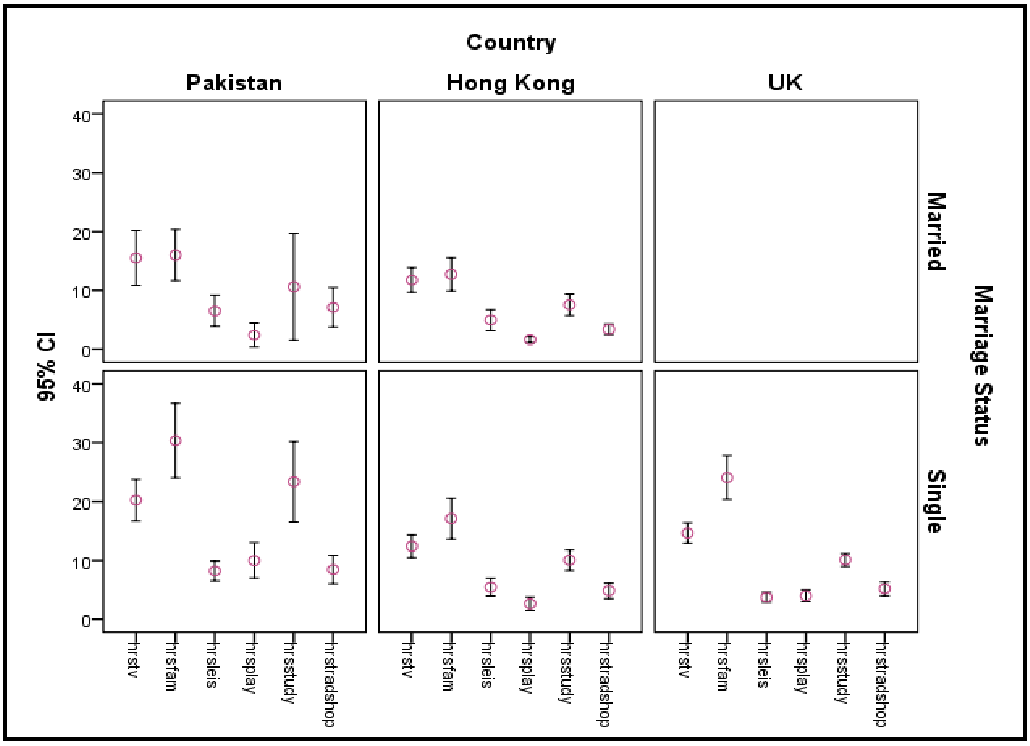


Figure 9.3 Confidence Interval of Mean Score of Marital Status and Social Interaction Activities per Week

The literature research established that housing status affects social interaction activities. Performing a n independent samples t-test confirmed that there is a significant difference between types of housing status relative to social interaction activities, except as regards hours spent on leisure reading, leisure activities and traditional methods of shopping. Figure 9.4 shows the error plot for housing status and social interaction activities. It can be seen from the error plot that the significant differences are mainly in Pakistan as compared to Hong Kong and the UK. People in Pakistan living on their own or living with parents spend more time with family compared to people living together. Also, in Pakistan people who are living on their own spend more time studying compared to people living together or living with parents.

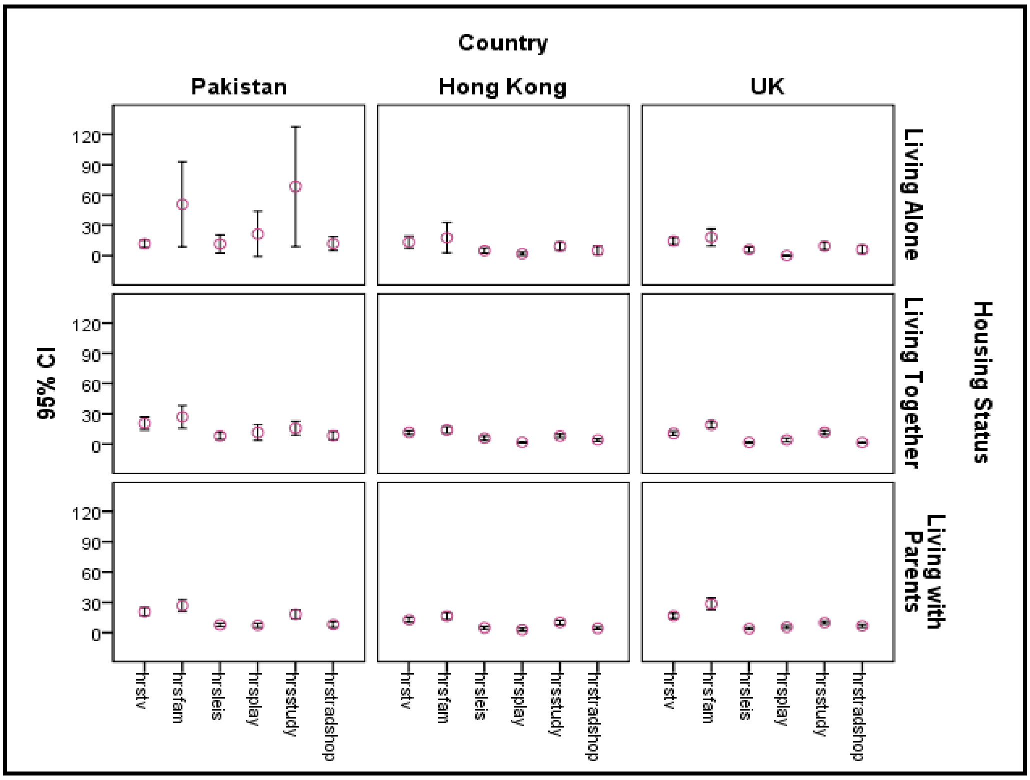


Figure 9.4 Confidence Interval of Mean Score of Housing Status and Social Interaction Activities per Week

Figure 9.5 shows the error plot for education and social interaction activities. The independent samples t-test shows that there is no significant difference between education levels regarding social interactive activities. Further to this, a number of house occupants were assessed for social interaction activities, and the findings showed that the only significant differences were in number of hours spent watching TV ($p<0.01$) and undertaking leisure activities ($p<0.05$). In this chapter other variables such as income and employment status were going to be examined; however, as the majority of respondents were students and thus otherwise unemployed, the income and employment status variables would have been invalid for additional assessment.

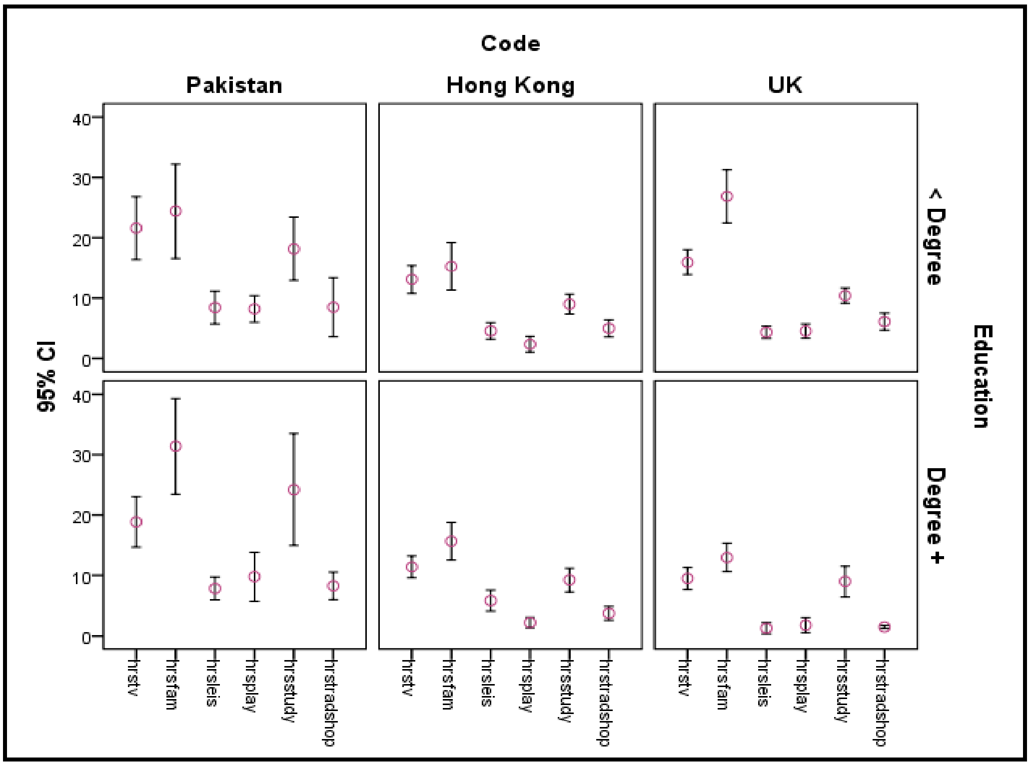


Figure 9.5 Confidence Interval of Mean Score of Education and Social Interaction Activities per Week

9.3.2 Ownership of Technology

The literature review determined that ownership of technology is significantly associated with individuals' use of interactive technology. The respondents were asked to state the amount of telecommunication technology they own. Then, to develop this information further, a technology score variable was created by taking the average of all the telecommunication technology the respondents owned. Figure 9.6 shows the error plot for the technology score and country. The results show that UK people own more telecommunication technology than people in Hong Kong and Pakistan. The T-test confirmed that there are significant differences between technology scores for different countries ($p<0.01$). To establish whether there was any significant relationship between the technology scores and the demographics, Pearson's correlation was utilised, with results summarised in Table 9.3.

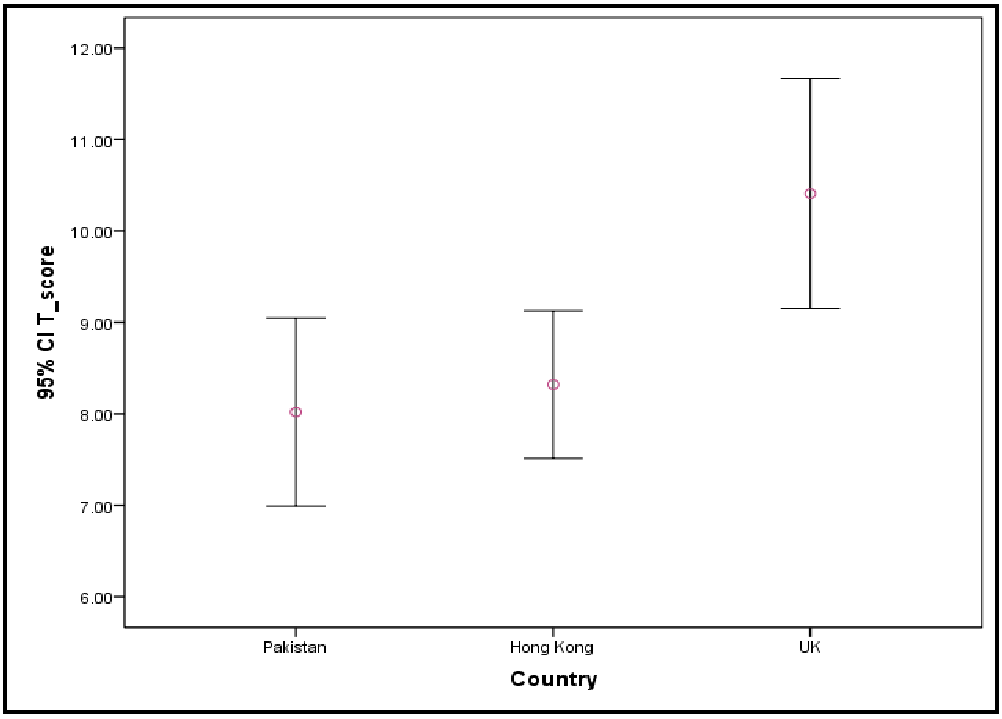


Figure 9.6 Error Plot of Technology Score and Country

Table 9.3 shows that Technology Score is significantly associated with all the demographic variables except for marital status and gender. Education ($r = 0.231$, $n=300$, $p<0.01$) and Age ($r= -0.220$, $n=300$, $p<0.01$) are negatively associated with technology score. This suggests that the less you are educated, and the older you are, the less technology you are likely to own. Further analysis of the results suggests that people who are educated to degree level own more telecommunication technology than those holding less than a degree qualification. The findings also indicate that people living alone own less telecommunication technology than those living together or living with family. In addition, according to the statistical analysis, married people have a lower technology score than single people and younger people have a lower score than older people.

Table 9.3 Correlation Between Technology Score and Demographic Variables

Correlations

Variables		Education	Occupants	Marriage Status	Age Group	Housing Status	T_score	Gender
Education	Pearson Correlation	1						
	Sig. (2-tailed)							
	N	300						
Occupants	Pearson Correlation	-.047	1					
	Sig. (2-tailed)	.420						
	N	294	294					
Marriage Status	Pearson Correlation	-.075	.129*	1				
	Sig. (2-tailed)	.197	.027					
	N	300	294	300				
Age Group	Pearson Correlation	.140*	-.370**	-.473**	1			
	Sig. (2-tailed)	.015	.000	.000				
	N	300	294	300	300			
Housing Status	Pearson Correlation	-.127*	.300**	.185**	-.411**	1		
	Sig. (2-tailed)	.028	.000	.001	.000			
	N	300	294	300	300	300		
T_score	Pearson Correlation	-.231**	.126*	.096	-.220**	.250**	1	
	Sig. (2-tailed)	.000	.031	.097	.000	.000		
	N	300	294	300	300	300	300	
Gender	Pearson Correlation	-.094	-.018	-.046	.088	.066	.055	1
	Sig. (2-tailed)	.106	.763	.429	.128	.255	.340	
	N	300	294	300	300	300	300	300

*. Correlation is significant at the 0.05 level (2-tailed).

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

9.3.3 Attitude Factors

Knowledge and confidence are important factors contributing to the use of technology. The attitude factors were analysed for each country and the results showed significant differences between attitude factors and each country. Figure 9.7 shows the error plot of the attitude attributes and the country. The results show a significant difference in the knowledge, confidence and usage of each interactive technology in different countries. The means of attitude factors were compared for each country and the results showed that Hong Kong has a lower mean in knowledge of the three technologies WWW, WAP and iTV compared to the UK and Pakistan.

The results also showed that the UK's use of interactive technology is greater than that of Hong Kong and Pakistan. The findings also show that the UK is more confident in using the interactive technology compared to Pakistan and Hong Kong.

The T-test confirmed that there is a significant difference between the knowledge, confidence and usage of interactive technologies for each country except as regards using the WWW. The results indicate no significant difference between the usage of WWW in the different countries.

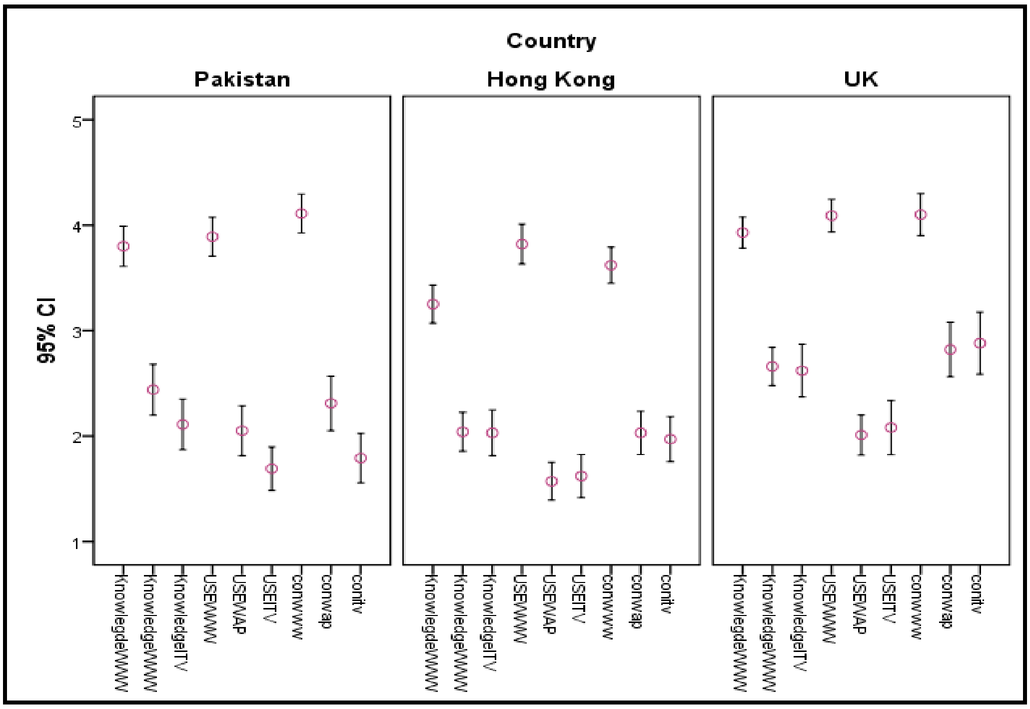


Figure 9.7 Error Plot of Attitude Factors and Country

9.3.4 Attributes of Interactive Technology

The respondents were asked to evaluate technology attributes in order to assess those for interactive technology. Then they were asked why they use the technology. The analysis showed that each culture has a different view regarding each of the interactive technology attributes. Figure 9.8 displays the error plot for these attributes. According to the results, on average the three countries agree that the WWW is quick to use. However, there is significant variation among the countries as to the level of quickness they ascribe to WWW ($p<0.05$). Users in the UK, Hong Kong and Pakistan believe that WWW is easy to use and the results show no significant differences among the three countries. In addition, it is believed that the WWW is cheap to use and to purchase items on and offers a good quantity of information; again, no significant national differences were found. The three countries had a more negative opinion about the reliability and security of WWW, the mean of these variables being slightly lower than for the Easy to use and Quick attributes. Here there was no significant difference among the three countries. However, there was a significant difference regarding the quality of WWW ($p<0.05$) for each country. Generally all three countries agree that they use the WWW because it enables them to find something unique, is cheap, and offers greater variety and convenience. But the three countries also agree that security is not a reason for using the WWW.

The results reveal significant differences among the countries for the following attributes of WAP: reliability ($p<0.05$) and quantity ($p<.0.01$). There were also significant differences as to why the respondents use the WAP, as well as in regard to ability to find something unique on WAP ($p<0.05$), greater variety ($p<0.05$), and convenience ($p<0.01$). Hong Kong and the UK slightly disagreed that they would use WAP because of being able to find something unique, or for greater variety or convenience; whereas Pakistan slightly agreed with these statements.

The findings also demonstrate significant differences of attitude from country to country among all the attributes for iTV. On the whole it was disagreed that iTV is quick, easy to use, cheap, reliable, and secure to use and that the quality and quantity of content are adequate. Pakistan and Hong Kong respondents slightly disagree that they will be able to find something unique on iTV, while Hong Kong and UK respondents slightly disagree that they can find something cheaper on iTV and would use it because it is more secure. However, respondents in Pakistan and in the UK felt that iTV is more convenient to use, as compared to those in Hong Kong.

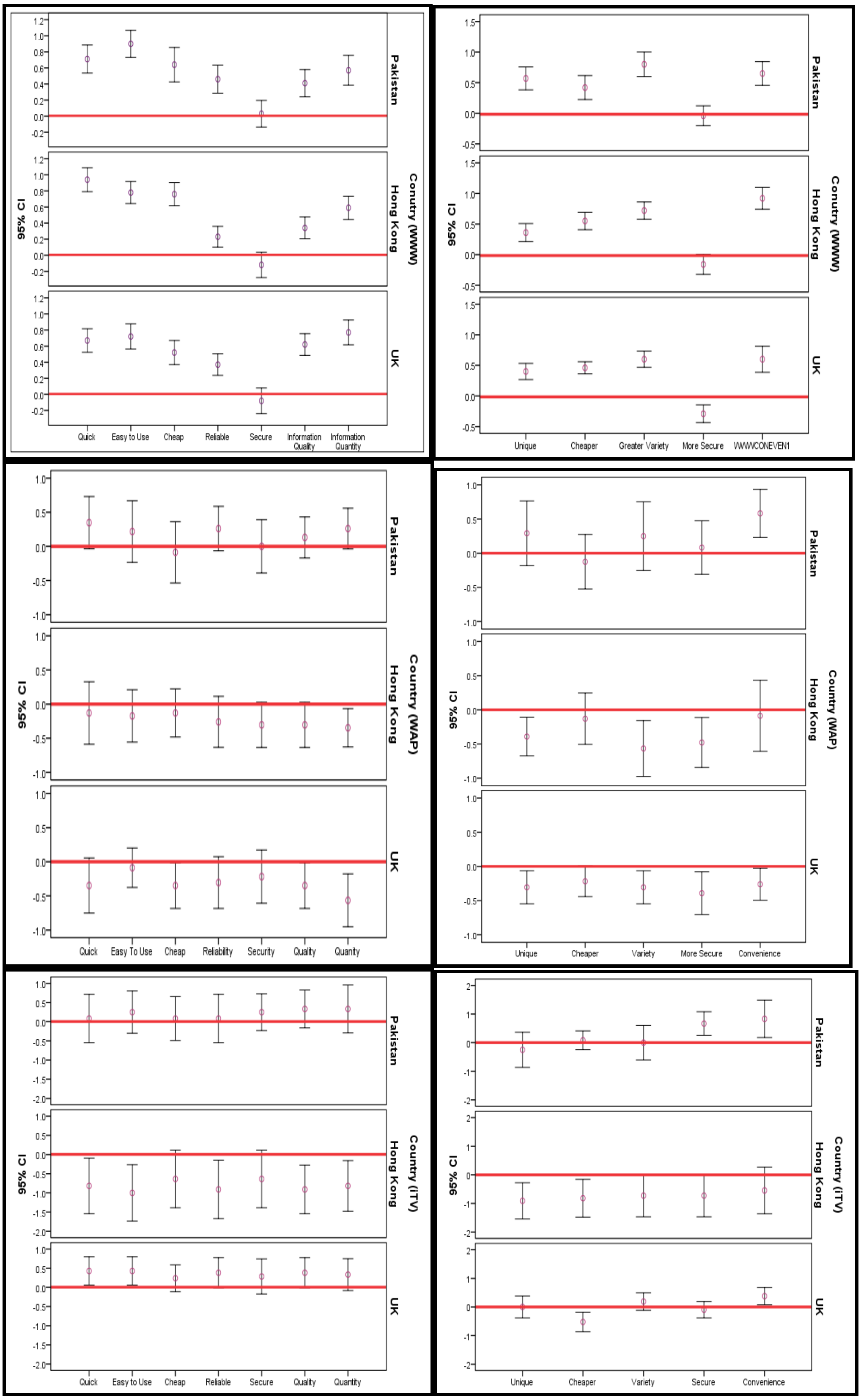


Figure 9.8 Error Plot of Attitude Factors and Country

9.3.5 Paying Bills and Communication

The respondents were asked which method they use to pay bills. Table 9.4 shows a summary of the currently most preferred methods. All three countries strongly suggest that the most likely method will be the bank. In total 229 respondents agreed that they pay bills this way. The least preferred method of paying bills is iTV, and then WAP. The majority of the respondents for all three countries still prefer to pay bills by traditional methods such as the Phone, Post, Post Office or the Bank.

Table 9.4 Current Preferred Methods to Pay Bills

Country	PayPhone		PayPost		PayPostOffice		PayBank		PayWWW		PayWap		PayiTv	
	Likely	Unlikely	Likely	Unlikely	Likely	Unlikely	Likely	Unlikely	Likely	Unlikely	Likely	Unlikely	Likely	Unlikely
Pakistan	40	60	23	77	44	56	86	14	25	75	8	92	6	94
Hong Kong	74	26	50	50	41	59	83	17	53	47	10	90	6	94
UK	45	55	40	60	50	50	60	40	36	64	5	95	5	95
Total	159	141	113	187	135	165	229	71	114	186	23	277	17	283

The respondents were further asked which method of communication they prefer. Figure 9.9 shows the error plot for the most preferred methods. Generally all three countries agree that Email, Phone and SMS text messaging are preferable to Fax, iTV email and Letter.

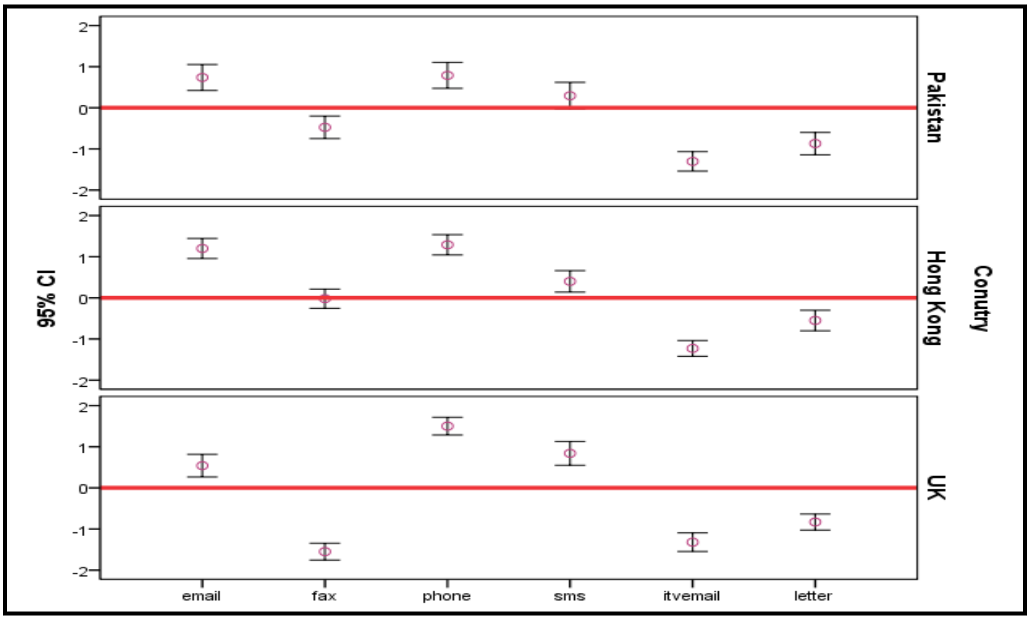


Figure 9.9 Error Plot of Preferred Communication Method and Country

Additionally, the respondents were questioned as to what they expected to be the most likely method of communication in the future. Figure 9.10 shows the error plot for the likely communication channels. According to the findings, all three countries agree that the Mobile phone and WWW will be the most likely channels in the future and that Letter will be the least likely.

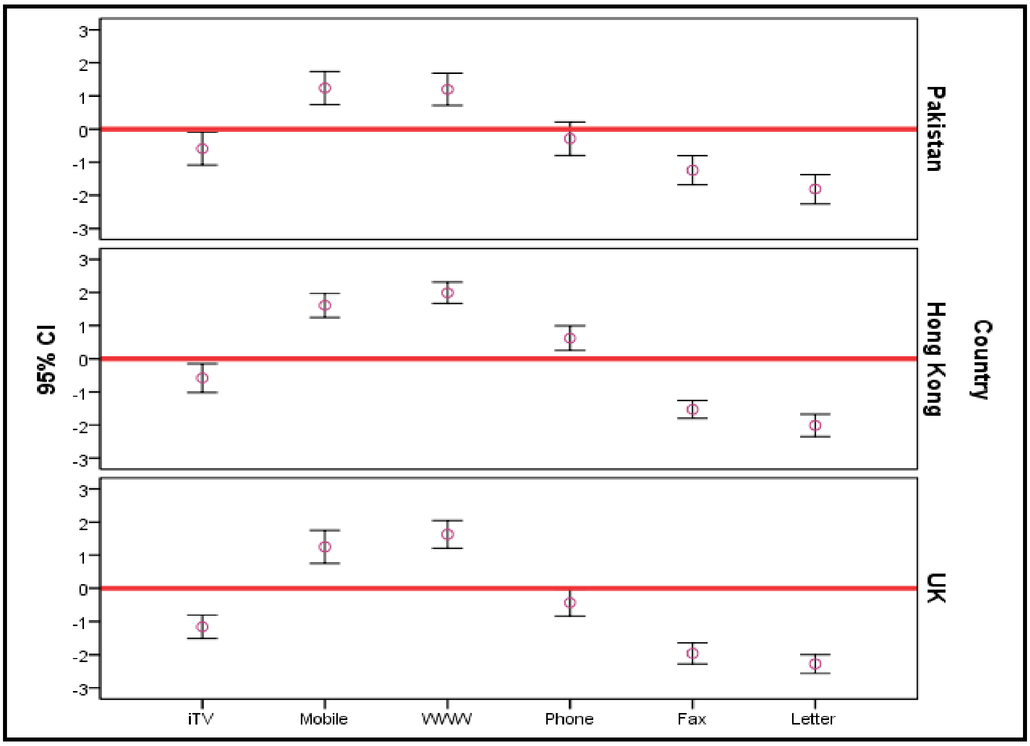


Figure 9.10 Error Plot of Preferred Communication Method and Country

Next the respondents were asked to determine the most common methods of purchasing items and acquiring information and services in the future. The WWW was identified as the most common method for all these purposes.

The respondents were asked to determine what will the methods to purchase items and gain information and services. The WWW was identified as the most common method for future purchases, services and information. Also a variable for each technology was created measuring the future intension to use by summing across the questions which was measuring preferred future platform. Figure 9.11 shows the most preferred future platform and the results show that the WWW is the most preferred future platform in all the three countries.

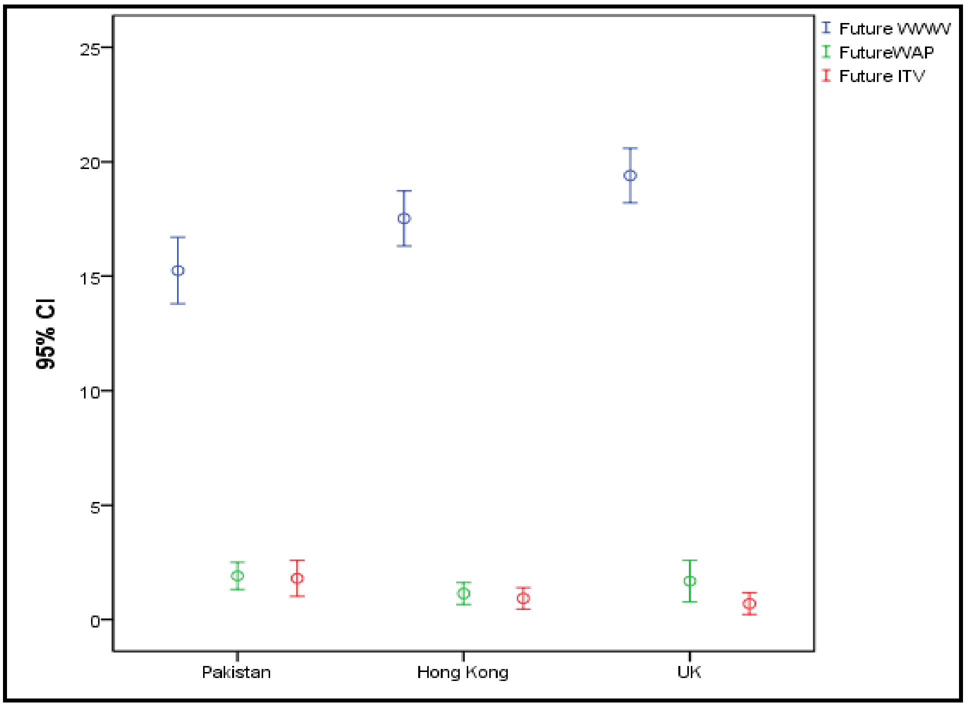


Figure 9.11 Most Preferred Future Platform

This section has provided a descriptive analysis of the cross-cultural study and a summary of the findings, identifying any significant differences among the three cultures. The next section will provide statistical analysis to determine whether significant relationships exist among usage of interactive technologies, demographic variables, social interaction and ownership of technology (technology score).

9.4. Predict Current Usage of Interactive Technologies

In this section the following underlying factors: Demographics, Social Interaction, Technology Score and Interactive Technology Attributes are further analysed to identify any significant relationships between the variables and usage of interactive technologies.

9.4.1 Analysis of Knowledge, Confidence and Usage of Interactive Technologies

The literature review established that knowledge of and confidence in a technology leads to its further usage (Levine et al 1997; Konana, 2005). To ascertain whether there was any significant correlation among the variables, Pearson's correlation was utilised. Table 9.5 shows the correlation of Knowledge, Confidence and Usage of interactive technologies for the UK.

The results suggests that, for an individual to use the WWW in the UK, he or she will require Knowledge of WWW, WAP and iTV, experience in Usage of WAP and Confidence in WWW and WAP. Usage of WAP in the UK will require Knowledge of WWW, WAP and iTV, as well as Usage experience of WWW and iTV and Confidence in WWW, WAP and iTV. In the UK, Usage of iTV will require Knowledge of WAP and iTV, Usage experience of WAP, and Confidence in WAP.

The next step was to check whether there were any significant relationships among Usage of, Knowledge of and Confidence in interactive technologies in Hong Kong. Table 9.6 shows the correlation of these factors for Hong Kong.

To summarise, the analysis indicates that an individual using the WWW in Hong Kong will need Knowledge of WWW and WAP and Confidence in WWW. Further to this, Usage of WAP in Hong Kong will require Knowledge of WAP and iTV and also user experience of iTV and Confidence in WAP and iTV. For an individual to use iTV in Hong Kong, he or she will require Knowledge of WWW, WAP and iTV and have Usage experience of WAP and Confidence in WAP and iTV.

For Pakistan, analysis of the correlation results for the Knowledge, Confidence and Usage attributes revealed significant differences among the variables. On this analysis, WWW Usage in Pakistan requires Knowledge of WWW and WAP, with Usage experience of ITV and Confidence in WWW and WAP. An individual using WAP in Pakistan will need Knowledge of WAP and iTV, experience in Usage of iTV and Confidence in WAP and iTV. Usage of iTV in Pakistan will require Knowledge of WAP and iTV and Usage experience of WWW and WAP, as well as Confidence in WAP and iTV.

All these variables are significant objects of further analysis with which to predict the usage of each interactive technology. The Demographic, Social

Interaction, Technology Score and Technology Attributes factors were also analysed to investigate possible significant relationships among the variables for each country.

Table 9.5 Correlation between Knowledge, Confidence and Usage of Interactive Technologies for the UK

		Knowledge WWW	Knowledge WAP	Knowledge iTV	Usage WWW	Usage WAP	Usage iTV	Confidence WWW	Confidence WAP	Confidence ITV
Knowledge WWW	Pearson Correlation	1								
	Sig. (2-tailed)									
	N	100								
Knowledge WAP	Pearson Correlation	.170	1							
	Sig. (2-tailed)	.091								
	N	100	100							
Knowledge iTV	Pearson Correlation	.237*	.386**	1						
	Sig. (2-tailed)	.017	.000							
	N	100	100	100						
Usage WWW	Pearson Correlation	.398**	.271**	.322**	1					
	Sig. (2-tailed)	.000	.006	.001						
	N	100	100	100	100					
Usage WAP	Pearson Correlation	.398**	.487**	.602**	.242*	1				
	Sig. (2-tailed)	.000	.000	.000	.015					
	N	100	100	100	100	100				
Usage iTV	Pearson Correlation	.082	.509**	.289**	.016	.225*	1			
	Sig. (2-tailed)	.415	.000	.004	.871	.024				
	N	100	100	100	100	100	100			
Confidence WWW	Pearson Correlation	.494**	.081	.395**	.533**	.277**	-.121	1		
	Sig. (2-tailed)	.000	.426	.000	.000	.005	.232			
	N	100	100	100	100	100	100	100		
Confidence WAP	Pearson Correlation	.184	.607**	.402**	.204*	.419**	.320**	.428**	1	
	Sig. (2-tailed)	.066	.000	.000	.041	.000	.001	.000		
	N	100	100	100	100	100	100	100	100	
Confidence ITV	Pearson Correlation	.352**	.470**	.631**	.159	.642**	.168	.377**	.755**	1
	Sig. (2-tailed)	.000	.000	.000	.113	.000	.095	.000	.000	
	N	100	100	100	100	100	100	100	100	100

*. Correlation is significant at the 0.05 level (2-tailed).

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

a. Code = UK

Table 9.6 Correlation between Knowledge, Confidence and Usage of Interactive Technologies for Hong Kong

		Knowledge WWW	Knowledge WAP	Knowledge iTV	Usage WWW	Usage WAP	Usage iTV	Confidence WWW	Confidence WAP	Confidence ITV
Knowledge WWW	Pearson Correlation	1								
	Sig. (2-tailed)									
	N	100								
Knowledge WAP	Pearson Correlation	.251*	1							
	Sig. (2-tailed)	.012								
	N	100	100							
Knowledge iTV	Pearson Correlation	.265**	.512**	1						
	Sig. (2-tailed)	.008	.000							
	N	100	100	100						
Usage WWW	Pearson Correlation	.510**	.237*	-.051	1					
	Sig. (2-tailed)	.000	.018	.615						
	N	100	100	100	100					
Usage WAP	Pearson Correlation	.100	.416**	.654**	.007	1				
	Sig. (2-tailed)	.320	.000	.000	.942					
	N	100	100	100	100	100				
Usage iTV	Pearson Correlation	.204*	.567**	.442**	.094	.555**	1			
	Sig. (2-tailed)	.042	.000	.000	.352	.000				
	N	100	100	100	100	100	100			
Confidence WWW	Pearson Correlation	.516**	.197*	.072	.545**	-.027	.002	1		
	Sig. (2-tailed)	.000	.050	.478	.000	.792	.981			
	N	100	100	100	100	100	100	100		
Confidence WAP	Pearson Correlation	.257**	.593**	.383**	.115	.433**	.672**	.164	1	
	Sig. (2-tailed)	.010	.000	.000	.256	.000	.000	.103		
	N	100	100	100	100	100	100	100	100	
Confidence ITV	Pearson Correlation	.251*	.388**	.683**	.067	.593**	.416**	.199*	.556**	1
	Sig. (2-tailed)	.012	.000	.000	.510	.000	.000	.048	.000	
	N	100	100	100	100	100	100	100	100	100

*. Correlation is significant at the 0.05 level (2-tailed).

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

a. Code = Hong Kong

Table 9.7 Correlation between Knowledge, Confidence and Usage of Interactive Technologies for Pakistan

		Knowledge WWW	Knowledge WAP	Knowledge iTV	Usage WWW	Usage WAP	Usage iTV	Confidence WWW	Confidence WAP	Confidence ITV
Knowledge WWW	Pearson Correlation	1								
	Sig. (2-tailed)									
	N	100								
Knowledge WAP	Pearson Correlation	.332**	1							
	Sig. (2-tailed)	.001								
	N	100	100							
Knowledge iTV	Pearson Correlation	.157	.417**	1						
	Sig. (2-tailed)	.118	.000							
	N	100	100	100						
Usage WWW	Pearson Correlation	.597**	.326**	.087	1					
	Sig. (2-tailed)	.000	.001	.387						
	N	100	100	100	100					
Usage WAP	Pearson Correlation	.064	.383**	.598**	.115	1				
	Sig. (2-tailed)	.529	.000	.000	.254					
	N	100	100	100	100	100				
Usage iTV	Pearson Correlation	.119	.548**	.270**	.249*	.324**	1			
	Sig. (2-tailed)	.238	.000	.007	.013	.001				
	N	100	100	100	100	100	100			
Confidence WWW	Pearson Correlation	.526**	.219*	-.007	.714**	-.063	.040	1		
	Sig. (2-tailed)	.000	.029	.948	.000	.530	.689			
	N	100	100	100	100	100	100	100		
Confidence WAP	Pearson Correlation	.244*	.684**	.329**	.299**	.332**	.606**	.225*	1	
	Sig. (2-tailed)	.015	.000	.001	.002	.001	.000	.025		
	N	100	100	100	100	100	100	100	100	
Confidence ITV	Pearson Correlation	.233*	.470**	.603**	.165	.648**	.244*	.172	.508**	1
	Sig. (2-tailed)	.020	.000	.000	.102	.000	.014	.088	.000	
	N	100	100	100	100	100	100	100	100	100

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

*. Correlation is significant at the 0.05 level (2-tailed).

a. Code = Pakistan

9.4.2 Analysis of Usage of Interactive Technology

The usage of interactive technology was further analysed with reference to Demographic, Social Interaction, Technology Score and Interactive Technology Attributes to identify the significant factors influencing the usage of each interactive technology.

Technology Attributes

The Technology Attributes factors were reduced to create more measures variables with which to assess the attributes. First, Cronbach's (alpha) test was carried out on the perceptual items to evaluate the reliability of the measures, as suggested by Nunnally (1978). The Cronbach's alpha test confirmed that the technology attributes for WWW (0.875), WAP (0.995) and iTV (0.996) were reliable, since the Cronbach's alpha value was above 0.7.

Factor Analysis for WWW Attributes

A factor score was calculated for each of the perceptual constructs based on their underlying items. The KMO and Bartlett's test illustrate a value of 0.815. Values between 0.8 and 0.9 are described as very good (Hutcheson and Sofoniou, 1999). Bartlett's measure tests the null hypothesis that, if the original correlation matrix is an identity matrix, then all correlation coefficients will be zero. Therefore we want this test to be significant. A significant test would tell us that the R-matrix is not an identity matrix, and that therefore some relationships exist among the variables which we hope to include in the analysis. In this instance, Bartlett's test is highly significant ($p < 0.001$) and thus factor analysis is appropriate. The factor analysis for the WWW Attribute produced five new factors which were Ease of use, Quality and Quantity, Security and Reliability, Cheapness and Features. Table 9.8 shows the rotated component matrix for the WWW Attributes.

Table 9.8 Factor Loading for WWW Attributes Rotated Component Matrix

	Component				
	Ease of Use	Quality & Quantity	Cheapness	Security & Reliability	Features
Convenience	.854				
Quick	.764				
Ease of Use	.721				
Quality		.837			
Quantity		.805			
Cheap			.851		
Cheaper			.850		
Secure				.874	
More Secure				.770	
Reliable		.506		.599	
Unique					.864
Variety					.636

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 7 iterations.

Five factors were identified which explained 80.5% of the original variance Ease of Use explains 19% of the variance, whereas the factor of Quality and Quantity explains 17%. The variance explained by each of the remaining variables is as follows: Cheapness 17%, Security and Reliability 15.5%, and Features 12%.

Factor Analysis for WAP and iTVAttributes

Further factor analysis was carried out for the WAP and iTV Attributes. The KMO and Bartlett's test for these attributes confirmed the validity of performing factor analysis. For WAP, the KMO and Bartlett's test value was 0.941 ($p<0.01$) and for iTV it was 0.881 ($p<0.01$). Only one factor each was created for WAP and iTV, being named as WAP Attributes and iTV Attributes. WAP Attributes explained 92% of the total variance and iTV Attributes explained 96%. The WWW, WAP and ITV Attributes were further analysed in relation to Usage of the interactive technologies in order to identify any significant relationships among the variables.

9.5. Cross Cultural Usage of Interactive Technology

The Demographic, Social Interaction, Technology Score, and Interactive Technology Attributes were assessed for each country in order to identify the significant factors influencing interactive technology usage in that country.

9.5.1 Predict Usage of WWW, WAP and iTV in Pakistan

Analysis of the correlation between Usage of WWW and the Demographic variables and Technology score for Pakistan disclosed that only Marital status ($r=0.206$, $n=100$, $p<0.05$) was significant for WWW usage. A significant relationship was found between the Usage of WWW and Demographic variables. However, no significant relationship was found between the Usage of WWW and Technology score.

On further analysis of the correlation between Usage of WWW and Social interaction variables, the one significant relationship found was with hours spent with family ($r=0.230$, $n=100$, $p<0.01$). Analysis of the relationship between Technology attributes and WWW Usage revealed that the only significant relationships were with the Quality and Quantity of the WWW ($r=0.325$, $n=100$, $p<0.01$) and WAP Attributes ($r=0.250$, $n=100$, $p<0.01$). The results also show that the Usage of WWW is significantly associated with the Technology score ($r=0.216$, $n=100$, $p<0.01$).

Logistic regression is the most popular technique available for modelling dichotomous dependent variables. A dichotomous variable was created with which to predict the users and non-users of WWW. The analysis suggests that the use/non-use of WWW can be explained by marital status, number of hours spent with family, WAP Attributes, Technology score and WWW Quality and Quantity.

The previous analysis had already established a strong correlation between Usage of iTV and Knowledge of WWW and WAP and Confidence in WWW and WAP. The following multiple regression model was fitted to the data in order to assess the effect of each variable on the Usage of WWW.

$$Log \frac{p}{1-p} = \beta_0 + \beta_1 \textit{ Marital status} + \beta_2 \textit{ Hours spent with family} + \beta_2 \textit{Technology Score} + \beta_3 \textit{ Knowledge of WWW} + \beta_4 \textit{ Knowledge of WAP} + \beta_5 \textit{ Usage of iTV} + \beta_6 \textit{ Confidence in WWW} + \beta_7 \textit{ Confidence in WAP} + \beta_8 \textit{ WAP Attributes} + \beta_9 \textit{ WWW Quality and Quantity} + \epsilon$$

Where γ is usage of WWW in Pakistan

In the logistic regression method, likelihood ration was used to carry out the regression so as to improve the quality of the model. The omnibus test of model coefficients shows the Chi-square statistics and significance level. According to the omnibus test, the model is statistically significant because the p-value is less than 0.00. The Hosmer and Lemeshow Test is a goodness-of-fit test for the overall fit of the logistic regression model. The Hosmer and Lemeshow goodness-of-fit statistic is above 0.5, indicating that the model has a good fit. The model suggests that overall it can predict 87% of the cases correctly. Multicollinearity in the logistic regression solution is detected by examining the standard errors detected by b coefficients. A standard error larger than 2.0 indicates lack of statistical significance. Analysis of the standard for b coefficient for the independent variables clearly shows that the standard error is below 2. Results from the logistic regression modelling are displayed in Table 9.9, summarising the significant variables identified during logistic modelling for predicting WWW Usage in Pakistan.

The model suggests that, in Pakistan, the greater an individual's experience of iTV and Knowledge of and Confidence in WWW, the more likely the person is to use the WWW.

Further logistic regression modelling was carried out for the use of WAP and iTV in Pakistan. The correlation analysis suggested that Usage of WAP in

Pakistan has a significantly negative association with Household occupancy (r=-0.274, n=100, p<0.01) and Technology score (r=0.318, n=100, p<0.01). In addition, the results show that WAP Usage is significantly associated with the following Social interaction variables: hours spent with family (r=0.318, n=100, p<0.01), hours spent on leisure activities (r=0.352, n=100, p<0.01), on leisure reading (r=0.204, n=100, p<0.01) and on studying (r=0.289, n=100, p<0.01). Usage of WAP, according to the results, is also significantly associated with WAP Attributes (r=0.532, n=100, p<0.01), WWW Features (r=0.401, n=100, p<0.01) and iTV Attributes (r=0.459, n=100, p<0.01). Logistic modelling to predict the Usage of WAP in Pakistan was carried out, adding the above significant variables and the identified Knowledge, Confidence and Usage variables. During the multiple regression modeling the only significant variables identified by the logistic regression model were: number of hours spent with family (p <0.01), amount of time spent on leisure activities (p<0.05) and the level of Confidence the user has in the WAP (p<0.01). The model suggests that the more time an individual spends with family and on leisure reading, the more likely it is, given a good level of Confidence in WAP, that the person will use the WAP technology.

On analysis of iTV usage, the correlation results showed that the only Demographic variable significantly associated with the Usage of iTV was marital status (r=0.202, n=100, p<0.05). Results of analysing the correlation of Usage of iTV with Social interaction activities indicate that iTV usage is significantly associated with the number of hours spent with family (r=0.512, n=100, p<0.01), on leisure activities (r=0.311, n=100, p<0.01), on studying (r=0.423, n=100, p<0.01) and on shopping by traditional methods (r=0.201, n=100, p<0.05). The usage of iTV was also significantly associated with the Technology score (r=0.209, n=100, p<0.05), as well as with the following Technology Attributes: WAP Attributes (r=0.454, n=100, p<0.01) and WWW Features (r=0.296, n=100, p<0.01). Logistic modelling was performed to analyse these significant factors along with the significant Technology Attitude factors such as Knowledge, Confidence and Usage.

During logistic modelling the only significant variable found for predicting the Usage of iTV was the level of Confidence in it. The model suggests that an increasing level of Confidence in iTV permits prediction of its usage. If a user has Confidence in iTV it is most likely that he or she will use it.

9.5.2 Predict Usage of WWW, WAP and iTV in Hong Kong

Analysis of the Demographic variables disclosed that the only significant relationship with Usage of WWW was that with Age group ($r=-0.241$, $n=100$, $p<0.05$), which was negatively associated with WWW Usage in Hong Kong. On further analysis of Social interaction variables with Usage of WWW, the number of hours spent with family ($r=0.224$, $n=100$, $p<0.05$) and hours spent on leisure activities ($r=0.213$, $n=100$, $p<0.05$) were found to be significantly associated with WWW Usage, as was the Technology score ($r=0.232$, $n=100$, $p<0.05$). The Usage of WWW was also significantly associated with the following technology attributes: WWW Ease of Use ($r=0.288$, $n=100$, $p<0.01$) and WWW Features ($r=0.205$, $n=100$, $p<0.05$). Logistic modelling was performed to analyse the above significant factors along with the significant Technology Attitude factors such as Knowledge, Confidence and Usage.

The logistical regression model for predicting the Usage of WWW in Hong Kong was statistically significant. The only significant variables identified in the logistic regression were Knowledge of WAP, Confidence in WWW and Age group. The model suggests that, in Hong Kong, the younger the individual and the more Knowledge of WAP and Confidence in WWW he or she has, the greater is the likelihood of that person using the WWW.

Evaluation of the correlation analysis of Usage of WAP and Demographic and Social interaction variables indicated that no significant relationships existed among these variables. However, the correlation results for Usage of WAP and Technology score ($r=0.246$, $n=100$, $p<0.05$) showed on analysis that they were significantly associated with each other. Usage of WAP was also significantly associated with the following Technology Attributes: iTV Attributes ($r=0.270$, $n=100$, $p<0.01$) and WWW Quality and Quantity ($r=0.275$, $n=100$, $p<0.01$).

Logistic modelling was carried out to predict the Usage of WAP in Hong Kong. However, assessment of the logistic regression modelling showed that it identified only two significant variables for predicting the Usage of WAP in Hong Kong: Confidence in WAP and Usage of iTV. The logistic model suggests that, with an increasing level of Confidence in WAP and experience in using iTV, it is most likely that WAP will be used.

The correlation results for Usage of iTV in Hong Kong and the Demographic and Social interaction variables determined that there were no significant relationships among the variables. But a significant relationship was identified between the Usage of iTV and Technology score ($r=0.305$, $n=100$, $p<0.01$). Further to this a significant relationship was found between Usage of iTV and the following Technology Attributes: iTV Attributes ($r=0.360$, $n=100$, $p<0.01$) and WAP Attributes ($r=0.428$, $n=100$, $p<0.01$). Logistics modelling was carried out for the above significant variables and the significant Technology Attitude variables. The logistic regression result identifies only three significant variables, namely, Knowledge of iTV, Confidence in WAP and iTV Attributes. According to the model, an increasing level of Knowledge of iTV, combined with adequate iTV Attributes and Confidence in WAP, will generate Usage of iTV in Hong Kong.

9.5.3 Predict Usage of WWW, WAP and iTV in the UK

Finally, the significant elements for predicting the usage of interactive technologies in the UK were analysed. Analysis of WWW Usage in the UK by Demographic variables established that Usage has a significant negative association with Age Group ($r=-0.281$, $n=100$, $p<0.01$) and with the number of Occupants ($r=-0.290$, $n=100$, $p<0.01$). Analysis of Social interaction variables determined that Usage of WWW was significantly associated with hours spent with family ($r=0.210$, $n=100$, $p<0.01$), hours spent on studying ($r=0.306$, $n=100$, $p<0.01$) and on traditional shopping ($r=0.220$, $n=100$, $p<0.05$). The results also showed that Usage of WWW was negatively associated with hours of leisure reading ($r=-0.419$, $n=100$, $p<0.01$). It was significantly associated with Technology score ($r=0.386$, $n=100$, $p<0.01$), while analysis of the

Technology Attributes demonstrated that WWW Usage was significantly associated with WWW Ease of Use (r=0.530, n=100, p<0.01) and WWW Features (r=0.383, n=100, p<0.01), but had a negative association with WWW Cheapness (r=-0.448, n=100, p<0.01). Logistics modelling was carried out for the above significant variables and the significant Technology Attitude variables. During the logistic regression modelling, Knowledge of WWW was found to be a significant variable; however, it produced a large standard error and was therefore disregarded from the model. Instead the logistic regression model identified only three significant variables: hours of traditional shopping, WWW Features and Confidence in the WWW. The logistic model suggests that, given an increasing level of Confidence, adequate WWW Features and increasing hours of traditional shopping, it is most likely that the individual will use the WWW.

When reviewing the correlation between the Usage of WAP and Demographic variables, a significant relationship was identified between Usage of WAP and House status (r=0.313, n=100, p<0.01), while Marital status (r=-0.262, n=100, p<0.01) and Education (r=-0.297, n=100, p<0.01) both had a negative association with Usage. Further analysis of WAP Usage and Social interactive variables established that Usage was significantly associated with number of hours spent watching TV (r=0.531, n=100, p<0.01), hours spent with family (r=0.447, n=100, p<0.01), hours spent studying (r=0.285, n=100, p<0.01) and hours spent on traditional shopping (r=0.366, n=100, p<0.01). WAP Usage was also significantly associated with Technology Score (r=0.711, n=100, p<0.01). Additionally, the findings show that the Usage of WAP was significantly associated with the following Technology Attributes: WAP Attributes (r=0.197, n=100, p<0.05), WWW Ease of Use (r=0.355, n=100, p<0.01), WWW Quality and Quantity (r=0.300, n=100, p<0.01), and WWW Features (r=0.426, n=100, p<0.01). Usage of WAP was negatively associated with WWW Cheapness (r=-0.331, n=100, p<0.01). All the above significant variables plus the Technology Attitude variables were further analysed with the logistic regression. The following variables were removed from the logistics models because of producing large standard errors in the logistic regression: House status, marital status and Knowledge of WAP and iTV.

The logistic model identified the following significant variables: WAP Attributes, WWW Quality and Quantity, numbers of hours spent with family, hours spent on traditional shopping, and Confidence in and Knowledge of WWW. The model suggests that with an increasing level of Knowledge of WWW, decreasing Confidence in WWW, more hours spent with family and fewer on traditional shopping, WWW Quality and Quantity plus adequate WAP Attributes, it is most likely that the individual will use the WAP.

The correlation between Usage of iTV and the Demographic variables identified significant relationships with Occupants ($r=-0.248$, $n=100$, $p<0.01$), Gender ($r-0.286$, $n=100$, $p<0.01$) and Education ($r=-0.240$, $n=100$, $p<0.05$). Usage of iTV, according to the correlation results, was significantly associated with hours spent watching TV ($r=0.197$, $n=100$, $p<0.05$) and hours spent with family ($r=0.286$, $n=100$, $p<0.01$). It was negatively associated with hours of study ($r=-0.243$, $n=100$, $p<0.01$) and hours spent on traditional shopping ($r=-0.231$, $n=100$, $p<0.01$). Usage of iTV was not significantly associated with Technology Score, but it was significantly associated with the following Technology Attributes: iTV Attributes ($r=0.320$, $n=100$, $p<0.01$), WAP Attributes ($r=0.449$, $n=100$, $p<0.01$) and WWW Quality and Quantity ($r=0.335$, $n=100$, $p<0.01$), and was negatively associated with WWW Cheapness ($r=-0.286$, $n=100$, $p<0.01$). Logistic modelling was carried out to predict the Usage of iTV in the UK by analysing the above significant variables and the significant Technology Attitude variables. The following variables were removed from the logistic model as they presented high standard errors and were causing errors in the model: Education, Knowledge and Confidence in WAP.

The logistic model suggests that Usage of iTV in the UK is most likely to result from increasing Knowledge of iTV, experience of WAP, increasing hours of watching TV, adequate WAP Attributes and decreasing number of Occupants in the household.

This cross-cultural study has identified many significant factors which will promote the usage of interactive technologies in each country. In addition, the study has established that there are significant cultural differences affecting interactive technology usage.

9.6. Modelling to Predict Usage of Interactive Technologies

To determine further an overall model for predicting the usage of interactive technologies without taking cultural differences into consideration, a new variable was created with which to measure interactive technology usage. The measure was derived from the sum of all the usages of the different interactive technologies; then significant elements were identified through Pearson correlation. Additional logistic modelling was used to identify an overall model for predicting the usage of interactive technologies, which in turn influences their future.

Analysis of the correlation of Demographic variables with usage of interactive technologies identified that Gender ($r=-0.117$, $n=100$, $p<0.05$) and Age group ($r=-0.259$, $n=100$, $p<0.01$) were negatively associated with usage. Further to this, Marital status ($r=0.234$, $n=100$, $p<0.01$) and House status ($r=0.133$, $n=100$, $p<0.05$) were significantly associated with usage of interactive technologies, as was the Technology score ($r=0.499$, $n=100$, $p<0.00$).

The Social Interaction variables were analysed to identify significant variables which will influence the usage of interactive technologies. The correlation analysis determined that hours watching TV ($r=0.148$, $n=100$, $p<0.00$), hours spent with family ($r=0.400$, $n=100$, $p<0.00$), hours spent carrying out leisure activities ($r=0.235$, $n=100$, $p<0.00$), hours of studying ($r=0.198$, $n=100$, $p<0.00$) and hours of traditional shopping ($r=0.116$, $n=100$, $p<0.00$) were all significant variables influencing interactive technology usage.

During analysis of the Technology Attitude variables, new two variables were created, one measuring the Knowledge of interactive technologies and the other measuring Confidence in them. The correlation results showed that usage of interactive technologies was significantly associated with Knowledge of interactive technologies ($r=0.747$, $n=100$, $p<0.01$) and Confidence in interactive technologies ($r=0.741$, $n=100$, $p<0.01$).

The Technology Attributes variables were analysed to ascertain whether there was a significant relationship between these variables and the usage of interactive technology. Significant relationships were identified between the usage of interactive technologies and iTV Attributes ($r=0.300$, $n=100$, $p<0.01$), WAP Attributes ($r=0.389$, $n=100$, $p<0.01$), WWW Quality and Quantity ($r=0.371$, $n=100$, $p<0.01$) and WWW Features ($r=0.315$, $n=100$, $p<0.01$).

The Future of Interactive Technologies variable was created by taking the mean of the future preferred platform variables for each interactive technology. Further correlation of Usage and Future of Interactive Technologies ($r=0.126$, $n=100$, $p<0.05$) identified a significant relationship between the two variables.

Logistic modelling was further carried out to predict the usage of interactive technologies. Additionally, all the above significant variables were analysed with the logistic regression. The following multiple regression model was fitted to the data in order to assess the effect of each variable on the usage of interactive technologies in the UK.

The logistic model identified the following significant variables: WAP Attributes, numbers of hours spent with family and Confidence and Knowledge of interactive technologies. It is thus suggested by the logistic model that with increasing levels of Knowledge and Confidence in interactive technologies, increasing hours spent with family, and adequate WAP Attributes, it is most likely that the individual will use the technologies.

Further to this Cross-Cultural study, the elements were analysed in order to identify the significant variables which would promote the usage of each interactive technology. The demographic, social interaction, technology score, technology attitude and attributes were assessed for each technology. Then logistic regression modelling was adopted to establish a suitable model.

The correlation results for Usage of WWW and demographic variables suggest that only Marital Status ($r=0.153$, $n=300$, $p<0.01$) was positively associated with the usage of WWW; whereas Age group ($r=-0.238$, $n=300$, $p<0.01$) and Number of Occupants ($r= -0.148$, $n=300$, $p<0.05$) were negatively associated with its usage. Of the social interaction variables, only the hours spent with family ($r=0.250$, $n=300$, $p<0.01$) variable was significantly associated with the usage of WWW. The technology score ($r=0.289$, $n=300$, $p<0.01$) was also strongly associated with WWW usage.

Usage of WWW was significantly associated with all the elements of technology attitude, such as Knowledge, Confidence and Usage of WAP and iTV, as well as with Knowledge and Confidence in WWW. The usage of WWW was also significantly associated with the following attitude factors of interactive technology: WWW Ease of Use ($r=0.204$, $n=300$, $p<0.01$), WWW Quality and Quantity ($r=0.213$, $n=300$, $p<0.01$) and WWW features ($r=0.179$, $n=300$, $p<0.01$). Further logistic regression modelling was applied to the use of WWW. The only significant variables identified by the logistic regression model were: Age Group ($p<0.01$), Occupants ($p<0.01$), Hours spent with family ($p <0.05$), Technology Score ($p<0.5$), WWW features ($p<0.01$), Usage of WAP ($p<0.05$) and the level of Confidence the user has in the WWW ($p<0.01$).

The model suggests that, given increasing age with decreasing number of occupants in the household, increasing number of hours spent with family and increasing ownership of technology, along with significant WWW features and usage of WAP, plus confidence in WWW, it is most likely that the usage of WWW will increase.

Further to this, similar models were constructed for WAP and iTV. The logistic regression modeling results for WAP suggests that, with increasing hours spent with family and increasing confidence in WAP alongside decrease in confidence in WWW and iTV, plus increasing knowledge of WAP and significant WAP attributes, it is more likely that usage of WAP will increase. Next, the significant elements were identified for the usage of iTV.

The logistic regression modeling results for iTV suggests that with the increasing ownership of technology and significant WWW features and WAP attributes, as well as increase in knowledge and confidence in iTV, but decrease in confidence in WWW, together with less time spent on leisure activities, it is most likely that the usage of iTV will increase.

When the significant elements in all three models are compared, the results show that knowledge and confidence in the interactive technology are significant contributors to technology acceptance. For example, to increase the usage of iTV, knowledge and confidence in it are essential. The logistic results have also highlighted the fact that increased usage of WAP most likely depends upon decreased confidence in WWW and iTV. Similar results emerged regarding increased usage of iTV, namely that it was accompanied by a decrease in confidence in WWW. Ownership of technology was also a significant factor in the greater usage of WWW and iTV. The more technology the individual owns, the more likely that WWW and iTV usage will increase. The number of hours spent with family was identified as a significant contributor to increased usage of WWW and WAP. Many significant elements identified by logistic regression seem to be common contributors to the usage of interactive technologies.

The methodology adopted and the performance of various descriptive, bivariate and multivariate analyses has made it possible to identify many significant factors which influence the usage of interactive technologies. Some factors are only significant for particular countries and technologies, while others are significant regardless of cultural differences and interactive technology types. The findings will be further discussed in the next section.

9.7. Discussion and Conclusions

This cross-cultural study has analysed the acceptance of interactive technologies in three diverse cultures. Acceptance was evaluated for three countries: the UK, Hong Kong and Pakistan. The aim of the study was to identify contributing factors which promote the usage of three different interactive technologies, namely, WWW, WAP and iTV. The literature research identified many significant elements influencing interactive technology adoption and usage. These elements were measured by means of a cross-cultural study questionnaire which was distributed to the UK, Hong Kong and Pakistan. The questionnaire was completed mostly by students as the majority of respondents were at the associated university of each country. The questionnaire measured different elements of Demographic and Social Economic factors, Social Interaction factors, Technology Attitude factors, and Quality and Technological factors. These elements were assessed for each interactive technology. Further descriptive and multivariate analysis was performed to understand the characteristics of the data, to identify the significant elements which influence the usage of interactive technologies in each culture, and to assess the overall acceptance of interactive technology.

9.7.1 Culture

The UK, Hong Kong and Pakistan have diverse cultural values. Assessing the Demographic and Social interaction variables made it possible to determine some aspects of the culture. Further to this the cultural dimensions determined by Hofstede (1991) were examined to determine the overall culture of each country. Table 9.9 summarises the cultural dimensions for each country.

Table 9.9 Cultural Dimensions for the UK, Hong Kong and Pakistan

Country	Cultural Dimensions				
	PDI	IDV	MAS	UAI	LTO
UK	35	89	66	35	25
Hong Kong	68	25	57	29	96
Pakistan	55	14	50	70	0

(PDI – Power Distance, IDV – Individualism, MAS – Masculinity, UAI- Uncertainty Avoidance, LTO- Long Term Orientation) Extracted From http://www.geert-hofstede.com/

The Power Distance Index (PDI) measures the extent to which the society accepts the influencing power (Gong et al 2007; Hofstede, 1991). Hong Kong and Pakistan both scored high in PDI, which suggests that these countries are influenced by power and are less innovative.

The Individualism dimension measures and describes the relation between the individual and the group. Hong Kong and Pakistan scored very low, indicating a lower coefficient of innovation for these countries. The cross-cultural study has ascertained that the ownership of technology is lower in Hong Kong and Pakistan than in the UK. In addition, the study found significant differences in Knowledge, Confidence and Usage of interactive technologies for each country.

The Masculinity dimension measures the degree to which a society is characterised by assertiveness versus nurturance, and is closely related to society's expectations of the gender role. Dwyer et al (2005) suggest that these cultures are great believers in innovation. The UK has scored higher in this dimension, and the cross-cultural study did find greater acceptance and usage of interactive technologies in the UK than in Hong Kong and Pakistan, as shown in Figure 9.12.

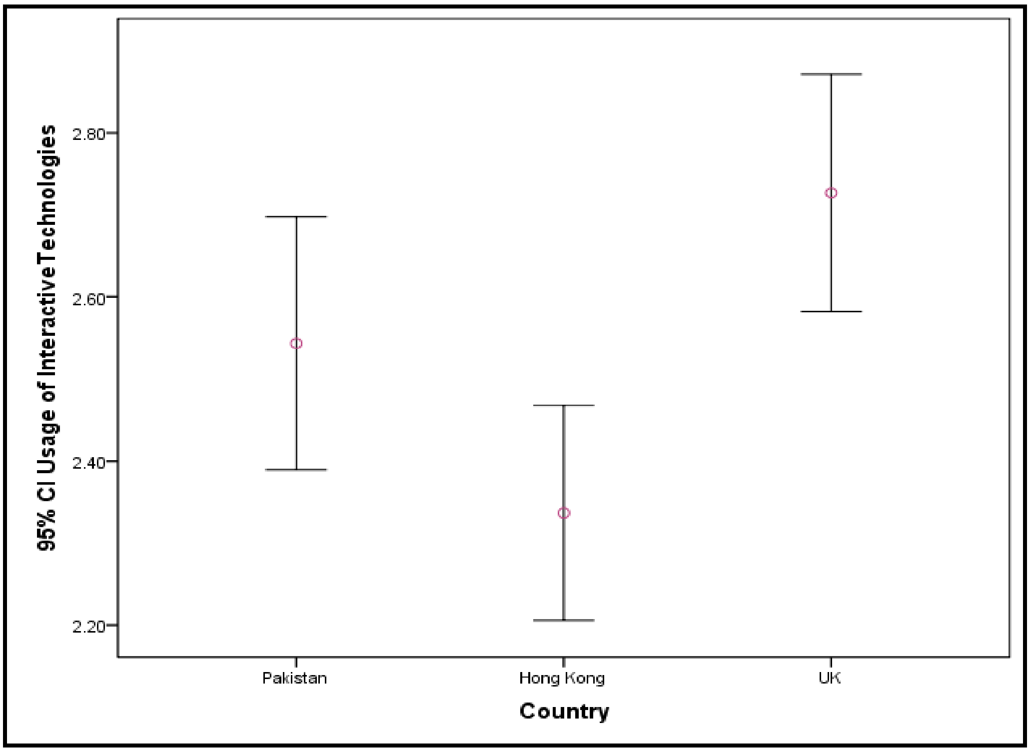


Figure 9.12 Cross-Cultural Usage of Interactive Technologies

The Long-term orientation dimension measures the individual's concern with the future. Cultures with a short–term orientation seek quick results and focus on "respect for the past and tradition, personal steadiness and stability and a reciprocation of favours and gifts" (Gong, 2007). Van Everdingen and Waarts (2003) suggest that long-term orientation cultures are more likely to adopt technology than cultures oriented towards the short term. Hong Kong has the highest ranking for LTO and no figure was available for Pakistan; whereas for the UK it was much lower, suggesting that the UK has a long-term dimension and for that reason shows greater acceptance of interactive technologies than Hong Kong and Pakistan.

Uncertainty Avoidance measures the degree to which the societies can tolerate uncertainty and ambiguity (Hofsteade, 1980). Cultures with high uncertainty avoidance are more resistant to change and reluctant to take risks and thus show less initiative. Pakistan is more resistant to change than Hong Kong and the UK. However, this study showed that interactive technologies were used more in Pakistan than in Hong Kong.

9.7.2 Demographic and Social Economic Variables

This study assessed various demographic and social economic variables. Gefen and Straub (1997) and Alagheband (2006) argued that gender has a significant impact on information technology adoption; similarly, Venkatesh and Morris (2002) stressed that males are more dominant than females in the adoption of technology. The cross-cultural study has established a significant relationship between gender and usage of interactive technologies. However, during logistic modelling gender was not considered a strong element for predicting the usage of interactive technologies. During the cross-cultural study, it was only considered a significant element for usage prediction in the UK. Gender was negatively associated with the usage of iTV. The study suggests that males are more dominant than females in the usage of interactive technologies.

Age is considered a significant factor affecting the acceptance of interactive technologies. Hertzog and Hultsch (2000) have argued that cognitive learning capabilities decline as the individual ages, so that older people are more comfortable with using technology which was introduced when they were younger, as compared to new technology released into the market when they are older. This cross-cultural study determined that Age Group is a significant factor in the UK and Hong Kong. It was not identified for Pakistan because most of the respondents there were under the age of 25. The findings show that increasing Age lessens the usage of interactive technologies.

Agarwal and Prasad (1999) and Lai and Li (2005) suggest that Education influences users' attitude. In addition, Roger (1995) maintained that most early adopters of technology have higher education and the ability to understand complex technologies. The present cross-cultural study has found that Education is significantly associated with the usage of interactive technologies, especially in the UK. No significant relationship between Education and usage was identified in Pakistan or Hong Kong. Overall, the study shows that individuals educated to below degree level are less likely to use interactive technologies.

Wilson et al (2007) and Driskell and Wang (2009) stated that the number of occupants influences both technology adoption and the decision-making process affecting the adoption of innovation. The cross-cultural study showed that House status and Number of Occupants were significant factors only in the UK and Pakistan. No significant relationship was identified for Hong Kong. However, this study discloses significant relationships between House status and Number of Occupants, respectively, and Usage of interactive technologies.

Zhang and Maruping (2008) and Wang and Driskell (2009) determined that Marriage status is a significant factor influencing technology adoption. This study has found that Marriage status is positively associated with the usage of interactive technologies.

9.7.3 Social Interaction Variables

Compeau and Higgins (1991), Hartwick and Barki (1994) and Taylor and Todd (1995) determined that social influences and interactions are equivalent to subjective norms; they are defined as other people's opinions, superior influences and peer influences. Social interaction plays a highly important role in technology adoption. This cross-cultural study found that different social interactions affect different types of interactive technology. The study has established that the number of hours spent with family is one of the most significant factors affecting interactive technology usage.

9.7.4 Technology Attitude and Attributes Elements

Ownership of ICT determines the individual's experience of using other technologies. Webster and Martocchio (1992) and Hackbarth et al (2003) suggested that experience and ownership of ICT helps in adopting technology. This cross-cultural study found Technology Ownership to be a significant factor influencing the usage of interactive technology. According to this study, the more technology the individual owns, the more likely he or she is to use interactive technologies.

Rogers (1995) and Davis (1989) found that Knowledge and Confidence play an important role in the individual's innovation characteristics. This study has identified the elements of Knowledge and Confidence as significant factors in usage of the technology in all three cultures. The study further showed that usage of interactive technologies influences their future use.

Various technology and quality factors were analysed. This study suggests that an increase in technology factors influences usage of interactive technologies. The element of WAP Attributes was considered significant in affecting interactive technology usage.

This cross-cultural study has identified many significant factors which influence the usage of interactive technology. In Table 9.10 the assessment of hypotheses proposed in Chapter 5 are summarised. Establishing these significant factors will facilitate the promotion of interactive technologies through managing the factors that influence the technologies' usage.

Table 9.10 Summary of Hypothesis Results from Cross-Cultural Study

ID	Hypothesis	Hypothesis Results
H1	Demographic and Social Economic differences significantly influence technology adoption.	Supported
H1(a)	Culture differences significantly influence technology adoption.	Supported
H1(b)	Gender is significantly associated with Intention to use interactive technology.	Supported
H1(c)	Increasing Age is negatively associated with the future growth of interactive technologies	Supported
H1(d)	Educational attainment is significantly associated with the adoption of interactive technology.	Supported
H1(e)	Income will be significantly associated with the acceptance of interactive technology adoption.	Unsupported
H1(f)	Employment Status will be significantly associated with the adoption of interactive technology.	Unsupported
H1(g)	A growing number of Household Occupants will be positively associated with the adoption of interactive technology	Supported
H1(h)	Marriage Status will be significantly associated with the acceptance of interactive technology adoption.	Supported
H2(i)	Experience and Ownership of Technology is positively associated with individuals' use of interactive technology.	Supported
H2(e)	Increasing Knowledge of interactive technology is positively associated with its use.	Supported
H2(f)	Increasing Confidence in one's ability to use interactive technology is positively associated with its adoption.	Supported
H2(g)	Increasing Usage of interactive technology is positively associated with its Future Use.	Supported
H3	Social Influences and Interaction are significantly associated with individuals' use of interactive technology.	Supported
H6	Quality is significantly associated with Intention to use interactive technology.	Supported

Chapter 10 Technology Adoption Study

10.1. Results

This present chapter will analyse the results of the Technology Adoption study and discuss the findings. The results will be examined in three stages. Firstly, descriptive analysis is carried out. Secondly, evaluation of the three competing theories is examined to clarify their validity for Interactive Technologies. Finally the results are further analysed to assess the relationships among certain variables by the use of univariate and multivariate statistical analysis.

10.2. Technology Adoption Study

The literature review highlighted the importance of those variables which influence the future usage and adoption of interactive technologies. One of the objectives of this study was to evaluate the variables in order to predict the elements which can influence the growth and adoption of interactive technologies. The questionnaire measured different aspects of Attitude, Social Influences, Perceived Behaviour Control, Technological Factors, Demographics, Risk and Quality. It contained 42 questions designed to measure various factors influencing the growth and adoption of interactive technologies; most of the questions employed a 5-point scale ranging from 1 to 5 (Strongly Agree to Strongly Disagree). Participants in the survey were asked to evaluate the factors which might promote their interest in using and adopting interactive technology. The questionnaire was distributed to 200 people. To ensure the selection of a broader sample, the questionnaire was also posted on Facebook and a paper version was distributed and collected in some residential areas. 117 participants responded to it: a response rate of 58%. Unfortunately, 38 questionnaires were only partially completed and so were removed for further analysis. In total there were 78 completed questionnaires which were analysed. 51% of the respondents were female and 49% were male. 56% of the respondents were within the 20–29-year-old age group. The results were statistically analysed to assist in determining the elements likely to influence the growth and adoption of interactive technologies. The questionnaire can be reviewed in Appendix 3.

10.3. Descriptive Analysis

10.3.1 Individual Innovativeness

Roger (1995) found that individuals show different characteristics in adopting technology. He has described the characteristics of five types of persons who will adopt technology at different stages of the product life cycle. The participants were asked to describe their innovativeness by establishing which category they belong to. Figure 10.1 illustrates the participants' innovativeness by each category.

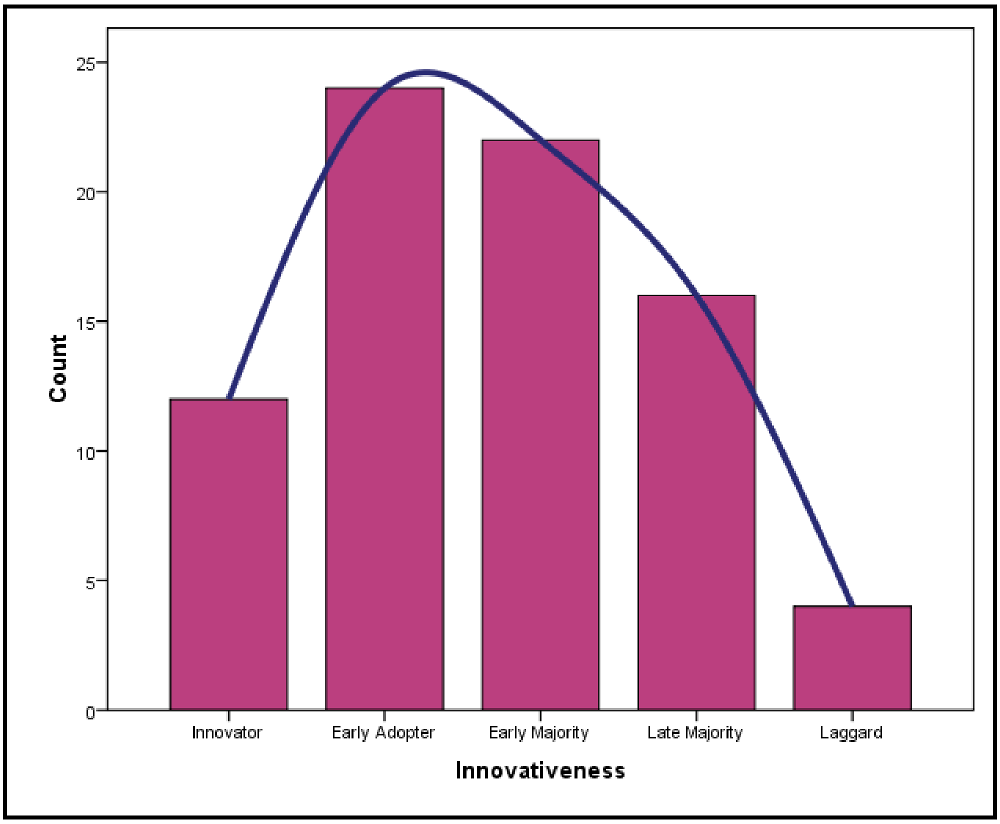


Figure 10.1 Participants' Innovativeness

Innovators tend to be experimentalists and have an interest in technology and new innovation for its own sake. The findings show that 15% (n=12) of the participants described themselves as Innovators; these were all males and 50% (n=6) were between 20 and 29 years old. This suggests that Innovators are usually males and particularly young adults.

Early Adopters may be technically sophisticated and interested in technology for solving professional and academic problems. The findings show that 30% (n=24) of the participants described themselves as Early Adopters. 75% (n=18) were females, and 50% (n=12) were in the 20–29 years age group. This result suggests that the majority of the Early Adopters are females and between 20 and 29 years old.

The Early Majority are pragmatists and constitute the first part of the mainstream of adopters. The findings demonstrate that 28% (n=22) of the participants describe their Innovativeness as Early Majority. 63% (n=14) of the Early Majority were females. Overall 63% (n=14) of the participants were between the ages of 20 and 29. Thus the majority of participants who take up technology in the first mainstream of adoption are people within that age group.

The second mainstream of adoption usually occurs once the technology adoption has reached the peak of its first mainstream of growth. This Late Majority are less comfortable with technology and are the skeptical second half of the mainstream of adopters. 20% (n=16) of the participants described themselves as Late Majority; 62% (n=10) of these were male and 75% were within the 20–29-year-old age group.

Laggards may never adopt technology and may be antagonistic and critical of its use by others. 5% (n=4) of the participants described themselves as Laggards, 50% were males (n=2) and all of them were over 40 years old.
The findings suggest that young people adopt technology more rapidly than people over 40 years old, while Laggards are usually older individuals.

10.3.2 Interactive Technology Experience

Using technology brings confidence, knowledge of the technology and especially experience. The participants were asked to state the level of experience they have reached using the following interactive technology: WWW, WAP and iTV. Figure 10.2 illustrates the participants' level of experience for each interactive technology.

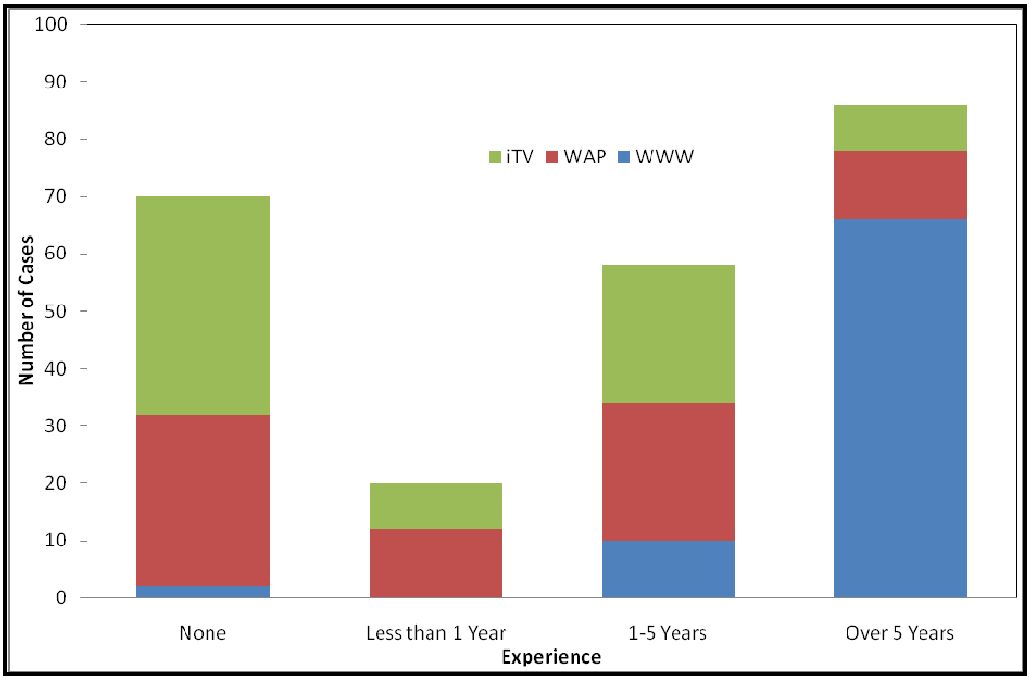


Figure 10.2 Experience of Interactive Technologies

The results demonstrate that 49% (n=38) of the participants had no experience of iTV, 38% (n=30) had no experience of WAP, but only 3% (n=2) had no experience of WWW. The results also revealed that 85% (n=66) of the participants had over 5 years' experience of WWW but only 10% (n=8) had experience of iTV and 15% (n=12) had experience of WAP. From these findings it is clear that, even though iTV and WAP are widely available technologies, many people i.e. 87% (n=68) have no experience of them. Participants have more experience of WWW, followed by WAP, than of iTV.

The data were further analysed to ascertain any possible significant link between Gender and the level of Experience for each interactive technology. The results show that there was no significant difference between Genders regarding Experience of iTV. However, Gender showed a significant negative association with the Experience of WWW ($r = -0.264$, $n=78$, $p < 0.05$), whereas it had a significant positive association with the Experience of WAP ($r = 0.292$, $n=78$, $p < 0.01$).

Experience of certain technologies may enable users to adopt and engage with many new technologies. Kim (2008) and Castañeda et al (2007) both emphasise the importance of Experience in technology acceptance. For example, a user with experience in using Internet will be able to utilise that experience easily to adopt the internet technology in different mediums e.g. Mobile IPhone. The findings illustrated a significant difference between Experience of WAP and of iTV ($r=0.308$, $n=78$, $p< 0.01$), which suggests that participants with experience of WAP or iTV influence each other's experience. However, the results also emphasised that there was no significant difference in experience among WWW, WAP and iTV.

10.3.3 Evaluation of Attitude Variables

Experience

Attitude consists of many elements. The present aim was to measure and assess the following elements of attitude: Perceived Usefulness, Perceived Ease of Use, Compatibility, Enjoyment and Experience. Previous studies by Cheng et al (2006), Shin (2007), Liao and Lu (2008) and Lin (2007) have demonstrated that such elements are positively associated with Attitude, which further influences the Intention to use technology. Therefore the participants were asked to evaluate a series of questions which captured the different elements of attitude. They were asked whether gathering information (EXP 1) and making purchases (EXP 2) were pleasant experiences. Figure 10.3 illustrates the findings, namely that a majority of participants strongly agreed that gathering information and making purchases are pleasant experiences on the WWW. Also the findings show that the majority had a neutral opinion about the experience of gathering information and purchasing items by means of WAP and iTV. When the findings for the three technologies are compared, it can be seen that only 2.6% (n=2) strongly disagree that purchasing items is a pleasant experience on WWW. But according to the averages for WAP and iTV more participants disagree/strongly disagree that experience of gathering information and purchasing items is a pleasant experience.

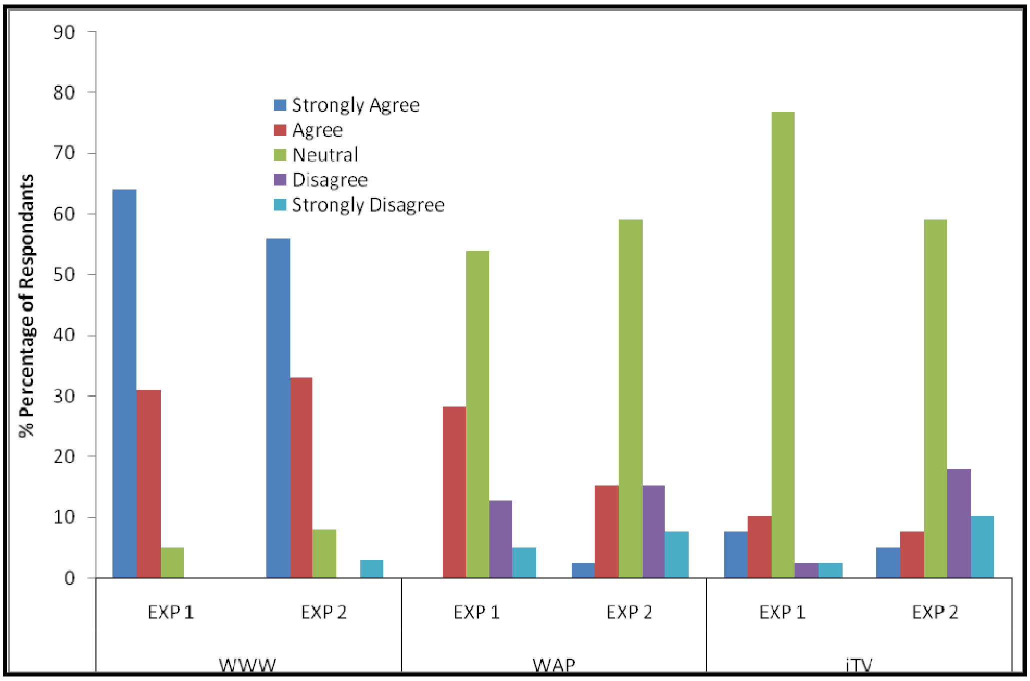


Figure 10.3 Experience Towards Interactive Technology

Overall, according to the findings, a majority of participants agree that gathering information and purchasing items is a better experience on the WWW than on WAP and iTV.

Perceived Usefulness

The literature review established that Perceived Usefulness is an important element for technology acceptance (Cheng et al 2006 and Palvia, 2009). The participants were asked to estimate their perceived usefulness for each technology. They were also asked whether using the technology enhanced the effectiveness of their lifestyle and work style (PU1) and, further, whether the services provided by the technology were useful in their work and lifestyle (PU2). Figure 10.4 illustrates the participants' Perceived Usefulness for each technology. The mean of each Perceived Usefulness item is displayed with a 95% confidence level error bar.

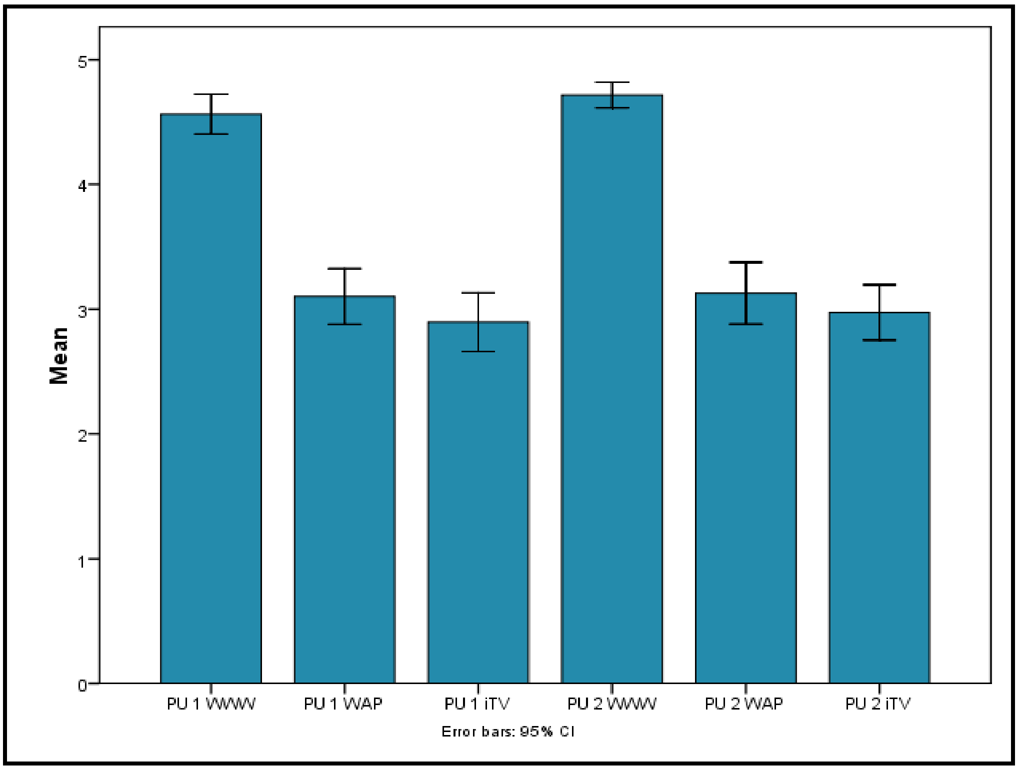


Figure 10.4 Perceived Usefulness Towards Interactive Technology

The results show that participants suggested that WWW is perceived as more useful than WAP and iTV. iTV was perceived as the least useful compared to WWW and WAP. In order for technology to be adopted, it is important that it seem to possess some usefulness.

Perceived Ease of Use

Cheng et al (2006) state that perceived ease of use is important to the adoption of the technology. The participants were asked whether interacting with technology service does not require a great deal of mental effort (PEOU 1) and whether interaction with it is clear and understandable (PEOU 2). Figure 10.5 summarises the findings, according to which the participants agree that WWW is perceived as easier to use than WAP and iTV.

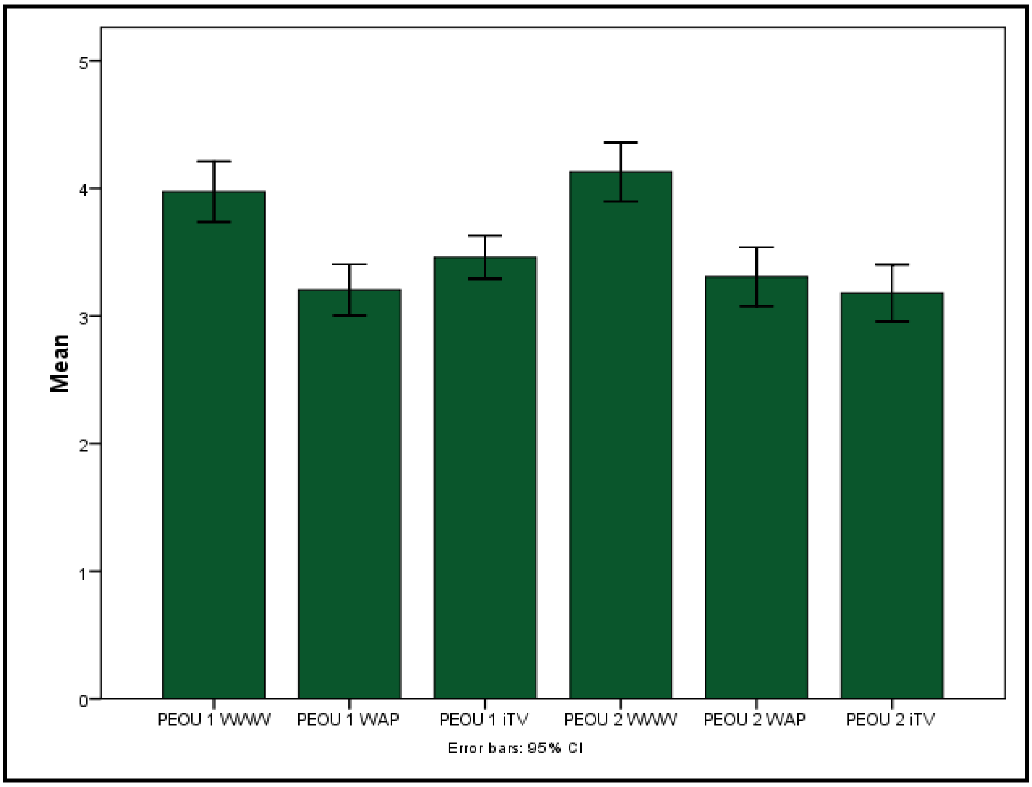


Figure 10.5 Perceived Ease of Use Towards Interactive Technology

The findings show that perceived ease of use is higher for WWW than for WAP and iTV. Therefore participants consider the WWW much easier to use than the other two.

Enjoyment and Compatibility

Shin (2007), Liao and Lu (2008) and Lin (2007) emphasised that enjoyment and compatibility are significantly associated with attitude, which in turn influences the intention to use the technology. The participants were asked whether using the technology services provides more pleasure than watching TV programmes (Enjoy 1) and whether they think that using the technology services fits well with the way they like to shop or seek information (Com 1). Figure 10.6 displays the results of these questions.

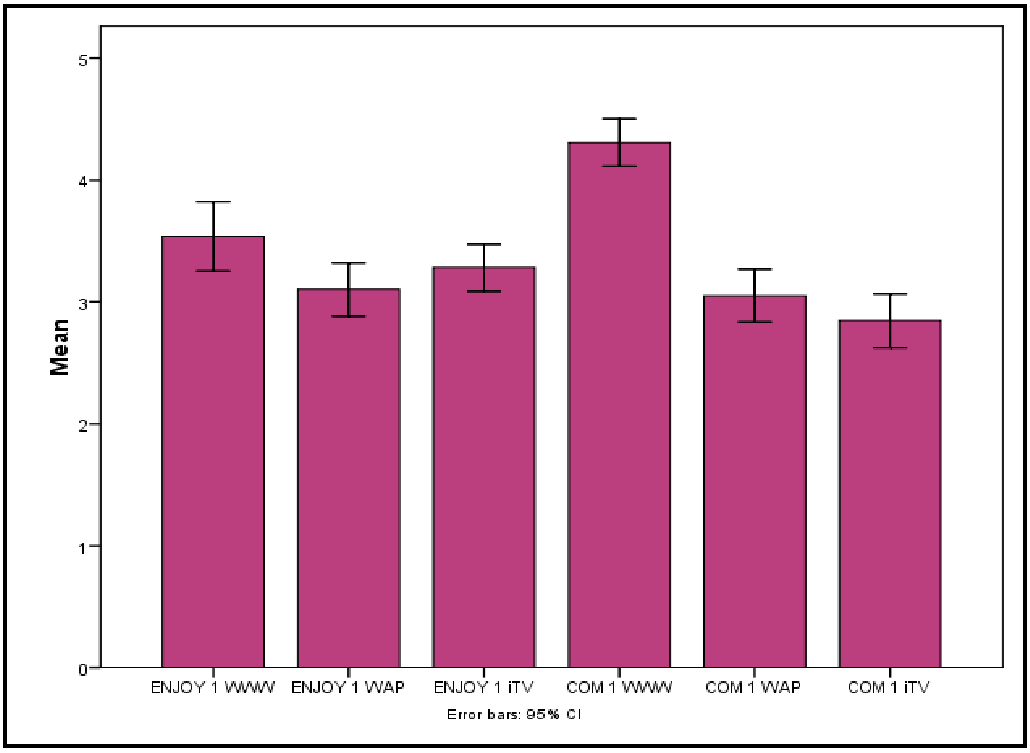


Figure 10.6 Perceived Enjoyment and Compatibility Towards Interactive Technology

The results show that the participants have more confidence in WWW compared to the WAP and iTV. They also had less confidence in iTV than in WAP. The participants also enjoy WWW more than WAP and iTV.

Overall, the findings demonstrate that the participants have a more positive attitude towards the WWW than towards WAP and iTV. It was shown that the WWW has more perceived usefulness, is easier to use, and is more compatible and enjoyable than the WAP and iTV.

10.3.4 Evaluation of Social Influence Variables

Normative and External Influences

The literature review established that Social influences significantly affect the intention to use technology. Social influences consist of many elements such as Normative and External Influences (Wu and Chen, 2005; Shin, 2007; Al-Somali et al, 2009; Lin, 2007). External influences include economic and political factors. Table 10.1 shows the mean of each Social influence variable. The highest reported mean is highlighted to show significant differences among the technologies.

Table 10.1 Analysis of the Social Influence Variables

Item ID	Variable Description	Mean	Std. Error
SI WWW	People whom I look up to expect me to use the technology service.	**3.64**	0.12
SI WAP		2.85	0.12
SI iTV		2.62	0.11
NORM WWW	My Family / Friends think that I should use the technology service.	**3.72**	0.12
NORM WAP		3.05	0.13
NORM iTV		2.85	0.12
MASS 1 WWW	The Mass Media adopt a positive view towards using the technology service.	**4.36**	0.08
MASS 1 WAP		3.69	0.12
MASS 1 iTV		3.49	0.11
MASS 2 WWW	Mass Media reports have influenced me to try the technology services.	**3.13**	0.14
MASS 2 WAP		3.05	0.13
MASS 2 iTV		2.79	0.13
RED ECON WWW	The reducing economy prevents me using the technology services to avoid cost.	2.23	0.12
RED ECON WAP		**2.82**	0.11
RED ECON iTV		2.74	0.12
POL WWW	Digital and Technical Policies prevent me adopting the technology.	2.56	0.12
POL WAP		**2.74**	0.11
POL iTV		2.59	0.11

Overall the findings show that, in the participants' view, WWW adoption is mostly influenced by other people who expect them to use the technology, whereas in the case of the WAP and iTV, the majority of participants disagree with that hypothesis. The findings also demonstrate that WWW usage is greatly influenced by family and friends, the Mass Media further providing positive views and influencing the participants to use the technology. They strongly agree that the reducing economy prevents them from using the technology services because in that situation they want to avoid cost, and that digital and technical policies offer additional disincentives. However, the results also suggest that WAP is greatly affected by the reducing economy and by digital technical policies compared to the WWW and iTV. The findings indicate that participants are considerably affected by social influences as regards the potential intention to adopt and use the technology.

10.3.5 Evaluation of Perceived Behaviour Control

Self-Efficiency, Government Facilitation and Technology Operators

The Perceived Behaviour Control consists of many elements such as Self-Efficiency (Al-Somali et al 2009; Lin, 2007), Government Facilitation (Tan and Teo, 2000; Teo and Pok, 2003) and Technology Operators (Hernandez et al 2008; Teo and Pok, 2003). Table 10.2 shows the mean of each perceived Behaviour control variable. The highest reported mean is highlighted to show the significant differences among the technologies.

Table 10.2 Analysis of Perceived Behaviour Control Variables

Item ID	Variable Description	Mean	Std. Error
PB 1 WWW	I am able to use the technology without any help.	**4.46**	0.12
PB 1 WAP		3.44	0.15
PB 1 iTV		3.46	0.14
PB 2 WWW	Using the technology is entirely within my control.	**4.26**	0.11
PB 2 WAP		3.47	0.12
PB 2 iTV		3.65	0.11
SE WWW	I am confident of using the technology even if I have never used the functionality before.	**4.08**	0.11
SE WAP		3.47	0.13
SE iTV		3.66	0.12
GOV WWW	The government encourages users to adopt the technology services.	**3.66**	0.09
GOV WAP		3.16	0.10
GOV iTV		3.05	0.09
TO 1 WWW	The Technology and Service Providers actively promote their services.	**4.42**	0.07
TO 1 WAP		3.92	0.10
TO 1 iTV		3.76	0.11
TO 2 WWW	I receive enough information about the technology services available to me.	**3.92**	0.11
TO 2 WAP		3.31	0.12
TO 2 iTV		3.00	0.12

According to the findings, the majority of the participants agree, to a greater extent than in the case of the WAP and iTV, that they will be able to use the WWW without any help. The findings further show that they regard the use of WWW as entirely within their control, again more so than in comparison with the WAP and iTV. Participants are more confident of using the WWW technology even if they have never used the functionality before, compared to their expectations of WAP and iTV. In addition, they suggest that the government gives more encouragement to adopt WWW than to adopt WAP and iTV. The participants also believe that WWW promotes its services more actively and makes more information about it available than do WAP and iTV. Overall the results show that the mean for Perceived Behaviour Control for WWW is much higher than the means for WAP and iTV. WWW is considered to be more Self-Efficient and actively promoted by the Government and Technology Operators.

10.3.6 Evaluation of Technological Factors

Access, Availability, Rival and Convergence

Technological Factors include elements such as accessibility, access cost and technology rivals. The literature review identified these as factors which can have an impact on an individual’s decision to adopt technology. Table 10.3 displays the results obtained from the survey, illustrating the key findings. As evident from the results, participants disagree that technological issues with the technology present a major barrier to adopting the service. However, the mean for WAP is slightly higher than those for WWW and iTV. This suggests that a percentage of users do consider technological issues a potential barrier to WAP adoption.

Shin (2004) and Strader (1997) have both emphasised the importance of access cost which can be a significant factor influencing technology adoption. The participants were asked if there are many financial barriers to using the technology. On average there was a neutral attitude towards this question although again WAP had a higher mean than WWW and iTV. Thus it can be generally summarised that the participants agree in considering WAP to present a higher perception of Technological issues and Financial barriers to use of the technology.

Table 10.3 Analysis of Technological Factor Variables

Item ID	**Variable Description**	**Mean**	**Std. Error**
TECH FACT WWW	Technological issues with the technology are a major barrier for me to adopt the service.	2.26	0.12
TECH FACT WAP		**2.74**	0.12
TECH FACT iTV		2.64	0.11
ACCESS WWW	There are many financial barriers to use the technology i.e. Equipment, BT Lines etc.	3.03	0.15
ACCESS WAP		**3.21**	0.12
ACCESS iTV		3.05	0.12
AVAIL 1 WWW	I can access the technology services any time via the associated media i.e. iTV - Digital Box, WWW-Computer, WAP-Mobile Phone.	**4.26**	0.11
AVAIL 1 WAP		3.46	0.13
AVAIL 1 iTV		3.44	0.13
AVAIL 2 WWW	I am gratified with the technology capability that offers real time content and services on a ubiquitous basis.	**3.92**	0.09
AVAIL 2 WAP		3.26	0.10
AVAIL 2 iTV		3.36	0.10
RIVAL 1 WWW	The use of the Technology becomes easily obsolete.	3.10	0.15
RIVAL 1 WAP		**3.28**	0.13
RIVAL 1 iTV		3.18	0.11
RIVAL 2 WWW	Other technology rivals emerge to provide better quality and accessibility to services.	3.31	0.14
RIVAL 2 WAP		**3.54**	0.10
RIVAL 2 iTV		3.44	0.09
CONVEG WWW	Technology convergence innovation provides more and better services compared to the technology.	3.36	0.12
CONVEG WAP		**3.41**	0.09
CONVEG iTV		3.36	0.09

Shin (2007) and Matheson (1991) have indicated that availability is a significant element in technology acceptance. The participants suggest that to gain real time information they can access WWW more easily than WAP and iTV. They further believe that WAP is most likely to become obsolete or supplanted by emerging technology rivals which provide better quality and access to services. The participants also agree that Technology convergence innovation will provide better services than the WAP.

To summarise, the participants regard WWW as superior in accessibility and availability, whereas WAP is most likely to become obsolete and overtaken by technology convergence which will provide a superior service. These Technology factors have a significant effect on technology adoption.

10.3.7 Evaluation of Quality

System, Service and Information

Quality is measured by many dimensions such as service, system and the quality of information. Shin (2004) and Liu (2000) suggest that quality is a significant factor in technology acceptance. The participants were further questioned about the quality of the interactive technologies. The findings are summarised in Table 10.4. Generally WWW is considered to have higher quality dimensions than the WAP and iTV, and to be a more generally accepted technology. In addition, WWW offers more services and has a better chance of improving its quality compared to WAP and iTV.

Table 10.4 Analysis of Quality Variables

Item ID	Variable Description	Mean	Std. Error
QUAL WWW	The technology provides complete product and service information.	**3.56**	0.11
QUAL WAP		3.08	0.09
QUAL iTV		3.21	0.08
SYS 1 WWW	The technology has good functionality relevant to product and information type.	**4.13**	0.08
SYS 1 WAP		3.33	0.09
SYS 1 iTV		3.33	0.08
SYS 2 WWW	Reliability influences my decision to use the technology.	**4.08**	0.10
SYS 2 WAP		3.82	0.10
SYS 2 iTV		3.64	0.10
SER WWW	The technology services provide good privacy protection while using iTV.	**3.26**	0.09
SER WAP		3.03	0.09
SER iTV		3.15	0.07

10.3.8 Evaluation of Risk

Security and Trust

Risk is considered an important factor in technology adoption. Kuisma et al (2007) have highlighted the security risk involved in technology adoption, while Gefen et al (2003) further emphasised that security risk is closely related to potential loss due to fraud and lack of data protection. Also, increasing trust will assist in managing such security risks to the technology. The participants were asked how they evaluate the risk aspects for different interactive technologies. A summary of the results is displayed in Table 10.5. Generally the participants consider WWW to present higher security risks regarding monetary transactions and privacy. On the other hand, WWW is considered more trustworthy than WAP and iTV. Furthermore, the results show that the participants will not feel secure in providing their credit card details over iTV.

Table 10.5 Analysis of Risk Variables

Item ID	Variable Description	Mean	Std. Error
RISK 1 WWW	I think using the technology in monetary transactions has a potential risk.	**3.87**	0.11
RISK 1 WAP		3.82	0.09
RISK 1 iTV		3.59	0.11
RISK 2 WWW	I think using the technology puts my privacy at risk.	**4.00**	0.10
RISK 2 WAP		3.82	0.10
RISK 2 iTV		3.54	0.11
TRUST 1 WWW	The technology service keeps its promises and commitments.	**3.03**	0.13
TRUST 1 WAP		2.87	0.10
TRUST 1 iTV		3.00	0.10
TRUST 2 WWW	The technology services are trustworthy.	**3.21**	0.11
TRUST 2 WAP		3.00	0.09
TRUST 2 iTV		3.05	0.09
SECURE WWW	I do not feel secure providing credit card details over the technology.	3.18	0.12
SECURE WAP		**3.36**	0.11
SECURE iTV		3.26	0.10

10.3.9 Evaluation of Behaviour Intention to Use

Finally the participants were asked about their Behaviour intention to use for the three interactive technologies. The WWW is generally regarded as a more mature technology than WAP and iTV. It has grown rapidly and provides more services and information than the other two technologies. Participants consider using the web more frequently than the WAP and iTV. Also they have suggested that they will continue to do so in future. Summarised in Table 10.6 are the findings for the Behaviour Intention to Use.

Table 10.6 Analysis of Behaviour Intention to Use

Item ID	Variable Description	Mean	Std. Error
BI 1 WWW	Assuming I have access to the technology, I tend to use it frequently.	**4.49**	0.062
BI 1 WAP		3.51	0.141
BI 1 iTV		3.23	0.127
BI 2 WWW	In future, I plan to use the technology often.	**4.46**	0.072
BI 2 WAP		3.28	0.141
BI 2 iTV		3.08	0.124

The foregoing sections have provided a descriptive analysis of the various significant factors which can influence the adoption of technology. These elements were further analysed to determine the ones which significantly affect the adoption of interactive technologies, and to model the relationships among the elements. The next section will evaluate the different competing theories in order to identify the more appropriate theory for application to interactive. The more suitable theory will then be adopted and expanded to model other key elements that influence the Behaviour intention to use.

10.4. Testing of Competing Theories

The literature review has established that there are various theories of technology adoption, so identifying the most appropriate of the recognized theoretical models presents a challenge. This section will compare the three theoretical models, the Technology Acceptance Model (TAM), the Theory of Planned Behaviour (TPB) and the Decomposed TPB model in order to investigate the acceptance of interactive technology.

Structural equation modeling (SME) was used for testing the competing theories and the hypotheses. Anderson and Gerbing (1988) proposed a two-stage approach to analysing the data. In the first stage, the measurement of the model was examined by using confirmatory factor analysis to test the validity and reliability of the constructs. This made it possible to ensure that the data were internally consistent. Secondly the structural model that best fitted the data was identified, after which the hypotheses were tested.

The three competing theories were examined for each technology independently to understand the relationships of different variables to each interactive technology i.e. WWW, WAP and iTV.

10.4.1 Reliability Test

A Reliability test determines the degree to which the components of the scale are all measuring the same underlying attribute. Reliability was assessed by using Cronbach's α. According to Nunnally (1978), if Cronbach α is bigger than 0.7 it is acceptable. The Cronbach's α results for each technology shows that the variables measuring each technology are suitable for further statistical analysis.

10.4.2 Testing Competing Theories

To test the competing theories, initially correlation between the variables was performed to determine whether they were significantly associated for the performance of structural modelling. If the variables were not significantly associated they were not further employed to perform structural modelling. The competing theories TAM, TPB and DTPB assess many different variables. Structurally Modelling Equation was adopted to ascertain the relationships among variables for each model. Table 10.7 shows the proposed hypotheses for each model. Some variables have been tested again in each model as they are significant variables within it. Therefore the same hypothesis for some of the variables was re-tested over the three competing theories to establish which models better explain the proposed hypothesis and variable.

Table 10.7 Testing Hypotheses for Competing Theories

Competing Theories	
TAM	*H1: Perceived Usefulness is positively associated with Attitude* *H2: Perceived Ease of Use is positively associated with Attitude* *H3: Perceived Usefulness is positively associated with perceived Ease of Use.* *H4: Attitude is positively associated with Intention to use Technology.* *H5: Perceived Ease of Use is positively associated with Intention to use Technology.*
TPB	*H4: Attitude is positively associated with the Intention to use Interactive Technology.* *H6: Social Influence is positively associated with the Intention to use interactive technology.* *H7: Perceived Behaviour Control is positively associated with the Intention to use interactive technology.*
DTP	*H4: Attitude is positively associated with the Intention to use Interactive Technology.* *H2: Perceived Usefulness is positively associated with Attitude* *H3: Perceived Ease of Use is positively associated with Attitude* *H8:Compatibility is positively associated with Attitude* *H7: Perceived Behaviour Control is positively associated with Intention to use Technology.* *H9: Self- Efficiency is positively associated with Perceived Behaviour Control.* *H10: Government Facilitation is positively associated with Perceived Behaviour Control.* *H11: Technology Operators is positively associated with Perceived Behaviour Control.* *H6: Social Influence is positively associated with the Intention to use interactive technology.* *H12: Normative Influences are positively associated with Social Influences.* *H13 Intention to use interactive technology is positively associated with actual use of technology.*

10.4.3. Testing Competing Theories for WWW

The correlation results for WWW technology were examined. The results for the WWW variables are presented in Table 10.8. They demonstrate that most of the variables are significant for further statistical analysis, except for Social Influences (SI WWW). No significant relationship was found between SI WWW and Intention WWW. Therefore no further statistical analysis was performed for the SI WWW variable and it was excluded from SEM analysis. However, a significant relationship was identified between Normative Influences (Norm WWW) and Social Influences (SI WWW). If Social Influences were to be included for SEM analysis it would decrease the quality and good fitness of the model.

On further analysis of the correlation table, no significant relationship between Government Facilitation (Gov WWW) and Perceived Behaviour Control (PBC WWW) was found, so this also was removed from additional statistical analysis. But significant relationships were identified among all the remaining variables for WWW.

Table 10.8 Correlation for Testing Competing Theories for WWW

Correlations

		TOPWWW	PBCWWW	Intension WWW	PEOU WWW	PU WWW	Attitude WWW	Experience of WWW	GOV WWW	SE WWW	NORM WWW	SI WWW
PBCWWW	Pearson Correlation	.318**										
	Sig. (2-tailed)	.005										
	N	76										
Intension WWW	Pearson Correlation	.414**	.471**									
	Sig. (2-tailed)	.000	.000									
	N	76	76									
PEOU WWW	Pearson Correlation	.228*	.481**	.600**								
	Sig. (2-tailed)	.048	.000	.000								
	N	76	76	78								
PU WWW	Pearson Correlation	.165	.218	.587**	.397**							
	Sig. (2-tailed)	.154	.058	.000	.000							
	N	76	76	78	78							
Attitude WWW	Pearson Correlation	.199	.309**	.575**	.319**	.270*						
	Sig. (2-tailed)	.084	.007	.000	.004	.017						
	N	76	76	78	78	78						
Experience of WWW	Pearson Correlation	.243*	.482**	.326**	.328**	.012	.037					
	Sig. (2-tailed)	.035	.000	.004	.003	.920	.745					
	N	76	76	78	78	78	78					
GOV WWW	Pearson Correlation	.331**	.214	.391**	.267*	.426**	.166	.016				
	Sig. (2-tailed)	.003	.063	.000	.020	.000	.152	.892				
	N	76	76	76	76	76	76	76				
SE WWW	Pearson Correlation	.542**	.506**	.452**	.398**	.160	.282*	.406**	.175			
	Sig. (2-tailed)	.000	.000	.000	.000	.167	.014	.000	.132			
	N	76	76	76	76	76	76	76	76			
NORM WWW	Pearson Correlation	.127	.021	.154	.173	.253*	.021	-.102	.205	.019		
	Sig. (2-tailed)	.276	.858	.179	.130	.025	.857	.376	.075	.869		
	N	76	76	78	78	78	78	78	76	76		
SI WWW	Pearson Correlation	.341**	.393**	.076	.102	.071	.020	.092	.395**	.285*	.581**	
	Sig. (2-tailed)	.003	.000	.511	.374	.536	.862	.421	.000	.013	.000	
	N	76	76	78	78	78	78	78	76	76	78	
COM 1 WWW	Pearson Correlation	.150	.226*	.273*	.165	.316**	.568**	.239*	.190	.379**	-.078	.037
	Sig. (2-tailed)	.197	.049	.016	.148	.005	.000	.035	.100	.001	.498	.745
	N	76	76	78	78	78	78	78	76	76	78	78

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

*. Correlation is significant at the 0.05 level (2-tailed).

To test the hypotheses further and establish how well the model fits, SEM was adopted. The observed Normalised χ^2 was used to measure the overall fit of the model. Bagozzi and Yi (1988) have recommended that the value be smaller than three. Other indexes were utilised to show the fitness of the model. The GFI goodness of fit index determines what proportion of the variance in the sample variance–covariance matrix is accounted for by the model. This should exceed 0.9 for a good model. The adjusted goodness of fit index (AGFI) is an alternate GFI index in which the value of the index is adjusted for the number of parameters in the model. The recommended value for this is above 0.9 (Hair et al 1998 and Joreskog et al 1993). The Normalised Fit Index (NFI) is the difference between the independence model and the default model. The Comparative Fit Index model (CFI) is said to be a good index for use even with small samples (Bagozzi and Yi, 1988); it ranges from 0 to 1 and its recommended value is 0.9 or higher.

The root mean square residual is an index of the amount by which the estimated variances and covariance differ from the observed variances and covariance. The smaller the value the better it is, the recommended value being less than 0.05. The root mean square error of approximation (RMSEA) estimates lack of fit compared to the saturated model; its recommended level is below 0.06 (Hu and Bentler, 1999), while that of the Tucker Lewis index (TLI) is above 0.9. Utilising these good fit indexes helped in comparing the competing theoretical models for each interactive technology.

In addition to measurement of the goodness of fit models, the paths coefficients were analysed to determine the variance of the variables in the models. Table 10.9 shows the fit statistics for each structural model for all three interactive technologies. The results demonstrate that the data did not fit well with the models. Analysis of the TAM models for each technology yielded a GFI value just below 0.9. This could be due to limited data or, since the technology is influenced by many factors as it becomes more advanced in the market, while more factors influence the actual use of technology, to the difficulty of determining its potential acceptance. However, the results also show that the models are significant and that there is an underlying relationship between the variables, as the p-value for each model was below 0.05. Therefore the path analysis was continued and the relationship between values further examined to determine which model is better at explaining variance for different variables. Following the satisfactory results of the model evaluations, the three models were employed to predict the actual use of WWW, which was measured by the level of experience of WWW. Table 10.10 further summarises the path coefficients significance of each model, the degree to which each model fits the data and the Explanatory power of each model. In terms of path coefficients significance not all paths were significant. The Explanatory power was used to determine which model is superior in predicating the actual use of WWW.

Table 10.9 Competing Theories Fit Indices and Path Analysis for WWW

Fit Index	Recommended Criteria	WWW		
		TAM	**TPB**	**DTPB**
Chi Square		29.669	24.567	175.491
Degree of Freedom		4	3	28
Normalised $\chi 2$	**<3**	7.41	8.19	6.26
p-value	**>0.05**	0.000	0.000	0.000
GFI	**>0.9**	0.883	-	-
AGFI	**>0.9**	0.559	-	-
CFI	**>0.9**	0.765	0.671	0.386
RMR	**<0.05**	0.030	-	-
RMSEA	**<0.05**	0.289	0.306	0.262
NFI	**>0.9**	0.751	0.675	0.384
TLI	**>0.6**	0.411	-.097	0.013
Parsimony Fit Measures				
AIC		51.669	46.57	227.49
BCC		53.528	48.09	235.25
PCFI		0.300	0.201	0.240
PNFI		0.306	0.202	0.239
Paths Analysis				
Paths		**TAM**	**TPB**	**DTPB**
Attitude(Technology) <--- PU(Technology)		0.17		0.015
Attitude(Technology) <--- PEOUSE(Technology)		0.25*		0.232*
Intention(Technology) <--- Attitude(Technology)		0.43**	0.501**	0.493**
Intention(Technology) <--- PEOUSE(Technology)		0.46**		
PEOUSE (Technology) <--- PU(Technology)		0.40**		
EXP(Technology) <--- Intention(Technology)		0.33**	0.312**	0.310**
Intention(Technology) <--- SI(Technology)				
Intention(Technology) <--- PBC(Technology)			0.336**	0.333**
Attitude(Technology) <--- PU(Technology)				
Attitude(Technology) <--- COM(Technology)				0.538**
PBC(Technology) <--- SE(Technology)				0.497**
PBC(Technology) <--- GOV(Technology)				
PBC(Technology) <--- TOP(Technology)				0.064
SI(Technology) <--- NORM(Technology)				
Intention(Technology) <--- SI(Technology)				
Explanatory Power (R^2)				
PEOUSEWWW		0.158		
Attitude WWW		0.126		0.344
Intention WWW		0.524	0.364	0.354
EXPWWW		0.106	0.097	0.096
PBCWWW				0.234
$^{*}p<0.05$, $^{**}p<0.01$				

Table 10.9 shows that none of the three models was a good fit with the data. However the overall model did suggest an underlying relationship with the

variables. Examination of the relationship between the variables and the models demonstrates that the TAM model was better for explaining Intention to use WWW than the TPB and DTPB models. In the TAM model, Intention to use WWW was influenced by PEOU WWW, whereas in the other models it was not. However, the results also show that in predicating the actual use of WWW, the TAM model performed slightly better than TPB and DTPB. The results also show that Attitude WWW was better explained by the DTPB model than by the TAM model. Rust et al (1995) suggest that for this type of model comparison, measures such as the Akaike information criterion (AIC) and the Browne–Cudeck criterion (BCC) are appropriate for model comparison because they assess model parsimony and fit. The results show that for TAM, ACI is 51.67 and BCC is 53.53. In the TPB, ACI is 46.567 and BCC is 48.095, and in the DTPB, ACI is 227.49 and BCC 235.252. Since smaller values of these criteria indicate a better fit of the model, these results suggest a preference for TPB over the TAM and DTPB. As the models did not fit well with the data, considering the path analysis and Explanatory Power, it would seem that the TAM model is better than the TPB and DTPB for explaining the Intention use of WWW. Actual use of WWW is influenced by many factors. The variables under examination did not explain actual use of WWW very well. There were significant relationships between variables which in turn did influence intention to use WWW and would have made the model appropriate for predicting the future of WWW. These and other variables will be further examined in the later section to establish an overall model for technology acceptance of WWW.

10.4.4. Testing Competing Theories for WAP

The correlation results for WAP were examined. Table 10.10 shows the WAP variables. The results demonstrate that most of the variables are significant for further statistical analysis, except for Perceived Behaviour Control (PBC WAP) with Intention WAP. PBC WAP is a significant variable in the TPB and DTPB model, as the literature review suggests that that PBC WAP is significantly associated with Intention to use the technology. The DTPB model proposes that Self-Efficiency, Government Facilitators and Technology

Operators are associated with PBC WAP. However, analysis of the correlation between these variables and PBC WAP discloses that Self-Efficiency (SI WAP) is significantly associated with PBC WAP. The shared variance between SI WAP and PBC WAP is 50%, which is a significant shared variance. The Government Facilitators (GOV WAP) showed no significant association with PBC WAP. The correlation results also demonstrated that there is a significant relationship between Technology Operators (TOP WAP) and Perceived Control Behaviour, with a shared variance of 20%. All the other variables which were significant were further analysed using SEM to test the competing theories for WAP.

Table 10.10 Correlation for Testing Competing Theories for WAP

Correlations

		TOPWAP	PBCWAP	Intension WAP	PEOU WAP	Attitude WAP	Experience of WAP	GOV WAP	SE WAP	NORM WAP	SI WAP	COM 1 WAP
PBCWAP	Pearson Correlation	.453**										
	Sig. (2-tailed)	.000										
	N	76										
Intension WAP	Pearson Correlation	.520**	.164									
	Sig. (2-tailed)	.000	.158									
	N	76	76									
PEOU WAP	Pearson Correlation	.566**	.553**	.665**								
	Sig. (2-tailed)	.000	.000	.000								
	N	76	76	78								
Attitude WAP	Pearson Correlation	.486**	.074	.522**	.481**							
	Sig. (2-tailed)	.000	.524	.000	.000							
	N	76	76	78	78							
Experience ofWAP	Pearson Correlation	.459**	.394**	.447**	.507**	.236*						
	Sig. (2-tailed)	.000	.000	.000	.000	.038						
	N	76	76	78	78	78						
GOV WAP	Pearson Correlation	.423**	.152	.507**	.425**	.679**	.227*					
	Sig. (2-tailed)	.000	.190	.000	.000	.000	.049					
	N	76	76	76	76	76	76					
SE WAP	Pearson Correlation	.522**	.709**	.459**	.777**	.302**	.481**	.215				
	Sig. (2-tailed)	.000	.000	.000	.000	.008	.000	.062				
	N	76	76	76	76	76	76	76				
NORM WAP	Pearson Correlation	.369**	.064	.509**	.417**	.475**	.150	.456**	.231*			
	Sig. (2-tailed)	.001	.583	.000	.000	.000	.191	.000	.045			
	N	76	76	78	78	78	78	76	76			
SI WAP	Pearson Correlation	.325**	.463**	.295**	.523**	.329**	.455**	.363**	.461**	.503**		
	Sig. (2-tailed)	.004	.000	.009	.000	.003	.000	.001	.000	.000		
	N	76	76	78	78	78	78	76	76	78		
COM 1 WAP	Pearson Correlation	.426**	.150	.446**	.468**	.767**	.180	.641**	.333**	.577**	.430**	
	Sig. (2-tailed)	.000	.196	.000	.000	.000	.115	.000	.003	.000	.000	
	N	76	76	78	78	78	78	76	76	78	78	
PU WAP	Pearson Correlation	.453**	.144	.700**	.581**	.602**	.341**	.545**	.255*	.579**	.312**	.600**
	Sig. (2-tailed)	.000	.215	.000	.000	.000	.002	.000	.026	.000	.005	.000
	N	76	76	78	78	78	78	76	76	78	78	78

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

*. Correlation is significant at the 0.05 level (2-tailed).

Following the satisfactory results of the model evaluations, the three models were used to predict the actual use of WAP, which was measured by the level of experience of WAP. Table 10.11 further summarises the path coefficients significance of each model, the degree to which each model fits the data and the Explanatory power of each model. In terms of path coefficients significance, not all paths were significant. The Explanatory power was used to determine which model is superior in predicating the actual use of WAP.

It can be seen from Table 10.11 that none of the three models was a good fit with the data. However, the overall model did suggest an underlying relationship with the variables. Examination of the relationship between the variables and the models reveals that the TAM (R^2=0.496) model was better for explaining Intention to use WAP than the TPB (R^2=0.257) and DTPB model (R^2=0.220). But the results also show that for predicating actual use of WAP, the TAM (R^2=0.200) model performed slightly better than the TPB model (R^2=0.193) and DTPB model (R^2=0.186). It was also found that Attitude WAP was better explained by the DTPB model (R^2=0.530) than by the TAM model. According to the results, for TAM the ACI is 47.07 and BCC is 48.92. For the TPB, ACI is 43.28 and BCC is 44.80, and for the DTPB, ACI is 247.36 and BCC 253.451. As smaller values of these criteria indicate a better fit of the model, these results suggest a preference for TPB over the TAM and DTPB. As the models did not fit well with the data, and considering the path analysis and Explanatory Power, it seems that the TAM model is better for explaining the Intention use of WAP than the TPB and DTPB models. Actual use of WAP is influenced by many factors, and the variables under examination did not explain its actual use very well. There was a significant relationship between variables which in turn did influence Intention to use WAP, and would have made the model appropriate to forecast the future of WAP. These and other variables will be examined later in the section to determine an overall model for the technology acceptance of WAP.

Table 10.11 Competing Theories Fit Indices and Path Analysis for the WAP

Fit Index	**Recommended Criteria**	**WAP**		
		TAM	**TPB**	**DTPB**
Chi Square		25.07	21.282	175.491
Degree of Freedom		4	3	28
Normalised $\chi 2$	**<3**	6.27	7.09	6.26
p-value	**>0.05**	0.00	0.00	0.00
GFI	**>0.9**	0.891		
AGFI	**>0.9**	0.593		
CFI	**>0.9**	0.864	0.689	0.386
RMR	**<0.05**	0.088		
RMSEA	**<0.05**	0.262	0.281	0.262
NFI	**>0.9**	0.848	0.672	0.384
TLI	**>0.6**	0.659	0.378	0.013
Parsimony Fit Measures				
AIC		47.07	43.282	247.362
BCC		48.92	44.809	253.451
PCFI		0.346	0.345	0.320
PNFI		0.339	0.336	0.310
Paths Analysis				
Paths		**TAM**	**TPB**	**DTPB**
Attitude(Technology) <--- PU(Technology)		0.488**		0.204*
Attitude(Technology) <--- PEOUSE(Technology)		0.197		0.097
Intention(Technology) <--- Attitude(Technology)		0.263*	0.487**	0.446**
Intention(Technology) <--- PEOUSE(Technology)		0.539**		
PEOUSE (Technology) <--- PU(Technology)		0.581**		
EXP(Technology) <--- Intention(Technology)		0.477**	0.439**	0.431**
Intention(Technology) <--- SI(Technology)			0.142	0.145
Intention(Technology) <--- PBC(Technology)				
Attitude(Technology) <--- PU(Technology)				
Attitude(Technology) <--- COM(Technology)				0.692**
PBC(Technology) <--- SE(Technology)				
PBC(Technology) <--- GOV(Technology)				
PBC(Technology) <--- TOP(Technology)				
SI(Technology) <--- NORM(Technology)				0.503**
Intention(Technology) <--- SI(Technology)				
Explanatory Power (R^2)				
PEOUSEWAP		0.338		
Attitude WAP		0.389		0.530
Intention WAP		0.496	0.257	0.220
EXPWAP		0.200	0.193	0.186
SIWAP				0.253
PBCWAP				
$^{*}p<0.05$, $^{**}p<0.01$				

10.4.5 Testing Competing Theories for iTV

The correlation results for iTV were examined. Table 10.12 shows the iTV variables. The results demonstrate that most of the variables are significant for further statistical analysis, except for Perceived Behaviour Control (PBC iTV) with Intention iTV. PBC iTV is a significant variable in the TPB and DTPB model, as the literature review suggests that PBC iTV is significantly associated with Intention to use the technology. The DTPB model proposes that Self-Efficiency, Government Facilitators and Technology Operators are associated with PBC iTV. However, analysis of the correlation between these variables and PBC iTV shows that Self-Efficiency (SE iTV) is significantly associated with PBC iTV. The shared variance between SE iTV and PBC iTV is 63%: a significant shared variance. The Government Facilitators (GOV iTV) displayed no significant association with PBC iTV. The correlation results also showed that there was no significant relationship between Technology Operators (TOP iTV) and Perceived Behaviour Control. All the other variables which were significant were further analysed using SEM to test the competing theories for iTV.

Table 10.12 Correlation for Testing Competing Theories for iTV

Correlations

		Experience of iTV	TOPiTV	PBCiTV	Intension iTV	PEOU iTV	PU iTV	Attitude iTV	GOV iTV	SE iTV	NORM iTV	SI iTV
TOPiTV	Pearson Correlation	.147										
	Sig. (2-tailed)	.204										
	N	76										
PBCiTV	Pearson Correlation	.342**	.116									
	Sig. (2-tailed)	.003	.327									
	N	74	74									
Intension iTV	Pearson Correlation	.379**	.238*	-.088								
	Sig. (2-tailed)	.001	.038	.456								
	N	78	76	74								
PEOU iTV	Pearson Correlation	.484**	.366**	.277*	.345**							
	Sig. (2-tailed)	.000	.001	.017	.002							
	N	78	76	74	78							
PU iTV	Pearson Correlation	.195	.173	-.221	.509**	.237*						
	Sig. (2-tailed)	.087	.135	.058	.000	.036						
	N	78	76	74	78	78						
Attitude iTV	Pearson Correlation	.272*	.197	-.276*	.486**	.263*	.623**					
	Sig. (2-tailed)	.016	.088	.017	.000	.020	.000					
	N	78	76	74	78	78	78					
GOV iTV	Pearson Correlation	.123	.416**	.012	.142	.279*	.269*	.373**				
	Sig. (2-tailed)	.290	.000	.916	.221	.015	.019	.001				
	N	76	76	74	76	76	76	76				
SE iTV	Pearson Correlation	.294**	.157	.639**	-.132	.203	-.245*	-.163	-.111			
	Sig. (2-tailed)	.010	.174	.000	.254	.079	.033	.161	.339			
	N	76	76	74	76	76	76	76	76			
NORM iTV	Pearson Correlation	.090	.124	-.208	.472**	.013	.595**	.441**	.426**	-.253*		
	Sig. (2-tailed)	.432	.288	.075	.000	.911	.000	.000	.000	.028		
	N	78	76	74	78	78	78	78	76	76		
SI iTV	Pearson Correlation	.265*	.087	.023	.541**	.305**	.480**	.408**	.236*	-.064	.635**	
	Sig. (2-tailed)	.019	.453	.844	.000	.007	.000	.000	.040	.585	.000	
	N	78	76	74	78	78	78	78	76	76	78	
COM 1 iTV	Pearson Correlation	.028	.038	-.397**	.337**	.014	.627**	.730**	.222	-.234*	.589**	.543**
	Sig. (2-tailed)	.810	.747	.000	.003	.901	.000	.000	.054	.042	.000	.000
	N	78	76	74	78	78	78	78	76	76	78	78

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

*. Correlation is significant at the 0.05 level (2-tailed).

Following the satisfactory results of the model evaluations, the three models were employed to predict the actual use of iTV, which was measured by the level of Experience of iTV. Table 10.13 further summarises the path coefficients significance of each model, the degree to which each model fits the data and the Explanatory power of each model. In terms of path coefficients significance, not all paths were significant. The Explanatory power was used to determine which model is superior in predicating the actual use of iTV.

Table 10.13 shows that all three models were not a good fit with the data. However, the overall model did indicate an underlying relationship between the variables. Examination of the relationship between the variables and the models shows that the TPB (R^2=0.302) model was better for explaining Intention to use iTV than the TAM (R^2=0.287) and DTPB model (R^2=0.289). But the results also show that in predicating the actual use of iTV, the TAM (R^2=0.144) model performed slightly better than the TPB model (R^2=0.130) and DTPB model (R^2=0.128). In addition, the results demonstrate that Attitude iTV was better explained by the DTPB model (R^2=0.540) than by the TAM model (R^2=0.402). It can be seen from the results that for the TAM, ACI is 43.378 and BCC is 45.237. In the TPB, ACI is 37.20 and BCC is 38.73, and in the DTPB, ACI is 187.032 and BCC 193.120. Since smaller values of these criteria indicate a better fit of the model, these results indicate the superiority of TPB over the TAM and DTPB. Because the models did not fit well with the data, and considering the path analysis and Explanatory power, it appears that the TPB model is better for explaining the Intention use of iTV than the TAM and DTPB models. Actual use of iTV is influenced by many factors, and the variables under examination did not explain its actual use very well. There was a significant relationship between variables which in turn did influence Intention to use iTV, and would have made the model appropriate for forecasting the future of iTV. Later in the section, these and other variables will be further examined to ascertain an overall model for technology acceptance of iTV.

Table 10.13 Competing Theories Fit Indices and Path Analysis for iTV

Fit Index	**Recommended Criteria**	**iTV**		
		TAM	**TPB**	**DTPB**
Chi Square		21.378	15.209	141.032
Degree of Freedom		4	3	21
Normalised $\chi 2$	**<3**	5.344	5.06	6.71
p-value	**>0.05**	0.00	0.05	0.00
GFI	**>0.9**	0.904		
AGFI	**>0.9**	0.642		
CFI	**>0.9**	0.814	0.788	0.564
RMR	**<0.05**	0.093		
RMSEA	**<0.05**	0.238	0.230	0.272
NFI	**>0.9**	0.793	0.761	0.535
TLI	**>0.6**	0.535	0.576	0.418
Parsimony Fit Measures				
AIC		43.378	37.20	187.032
BCC		45.237	38.73	193.120
PCFI		0.326	0.394	0.423
PNFI		0.317	0.380	0.401
Paths Analysis				
Paths		**TAM**	**TPB**	**DTPB**
Attitude(Technology) <--- PU(Technology)		0.594^{*}		0.212^{*}
Attitude(Technology) <--- PEOUSE(Technology)		0.122		0.228^{*}
Intention(Technology) <--- Attitude(Technology)		0.425^{**}	0.337^{**}	0.310^{*}
Intention(Technology) <--- PEOUSE(Technology)		0.233^{*}		0.228^{**}
PEOUSE (Technology) <--- PU(Technology)		0.237^{*}		
EXP(Technology) <--- Intention(Technology)		0.379^{**}	0.361^{**}	0.358^{**}
Intention(Technology) <--- SI(Technology)			0.435^{**}	0.439^{**}
Intention(Technology) <--- PBC(Technology)				
Attitude(Technology) <--- PU(Technology)				
Attitude(Technology) <--- COM(Technology)				0.665^{**}
PBC(Technology) <--- SE(Technology)				
PBC(Technology) <--- GOV(Technology)				
PBC(Technology) <--- TOP(Technology)				
SI(Technology) <--- NORM(Technology)				0.635^{**}
Explanatory Power (R^2)				
PEOUSEiTV		0.056		
Attitude iTV		0.402		0.540
Intention iTV		0.287	0.302	0.289
EXPiTV		0.144	0.130	0.128
SIiTV				0.403
PBCiTV				
$^{*}p<0.05$, $^{**}p<0.01$				

10.5. Interactive Technologies Acceptance Model for UK

The competing theories analysis established that there is significant variation within each model. Overall, the TAM model performed much better in predicting the actual use of the technology compared to other models, although Attitude was better explained in the DTPB model for all three technologies compared to TAM and TPB. However, Intention to use the technology was better explained in the TAM model for all three technologies compared to DTPB and TPB. The competing theories also made it possible to determine the relationship between some of the variables and explain their variance in the endogenous variables. This section has analysed the remaining variables which were measured to determine the Interactive Technology acceptance model for the UK. Table 10.14 lists the variables and the hypotheses which will be further analysed in this section. Initially Pearson's correlation of the variables was examined to discern whether there is an underlying relationship between the endogenous and exogenous variables, and also whether these identified endogenous variables influence the intention to use the technology.

Interactive Technologies Analysis Attitude Variable (s)

The only remaining variable the correlation of which with Attitude needed to be assessed was Enjoyment. The correlation results showed that there was no significant relationship between the Attitude of technology and enjoyment except from the attitude and enjoyment of WAP. The correlation results also show that Attitude WAP ($r=0.515$, $n=78$, $p<0.01$) was significantly associated with Attitude iTV. The results have also demonstrated that Attitude WAP is significantly associated with Enjoy 1 WWW ($r=0.381$, $n=78$, $p<0.01$) and Enjoy 1 iTV ($r=0.335$, $n=78$, $p<0.01$). It was found moreover that enjoyment of each technology influences the enjoyment of other interactive technologies. To perform path analysis only the Enjoy 1 WAP variable will be analysed further as there was a strong correlation between the variables. However, for the other interactive Technologies, WWW and iTV, correlation between the Attitude to technology and Enjoyment of technology was not significant.

Table 10.14 Summary of Influencing Factors for Technology Adoption

Item ID	Variable Description	Hypotheses
Attitude Variable(s)		
ENJOY 1 (Technology)	Enjoyment	H2 (h): Enjoyment of Technology is positively associated with Attitude.
Technological Factors		
TECH FACT (Technology)	Technology Factors	H4:Technology Factors is significantly associated with Intention to use the technology.
ACCESS(Technology)	Accessibility of Technology	H4(a): An increase in Technology Rivals is significantly associated with with Intention to use the technology.
AVAIL (Technology)	Availability of Technology	H4(b): Accessibility is significantly associated with Intention to use the technology.
RIV(Technology)	Rival of Technology	H4(c): Price is significantly associated with Intention to use interactive technology.
CONVEG(Technology)	Technology Convergence	H4(d): Technological Convergence is significantly associated with Intention to use the technology.
Quality Factors		
QUAL(Technology)	Quality	H5: Quality is significantly associated with Intention to use interactive technology.
SYSTEM(Technology)	System Quality	H5(a): System Quality is significantly associated with Quality of interactive technology.
SERVICE(Technology)	Service Quality	H5(b): Service Quality is positively associated with Quality of interactive technology.
Risk		
RIS(Technology)	Risk	H6 Risk is significantly associated with Intention to use interactive technology.
SECURE(Technology)	Security	H6(a) Security is significantly associated with Intention to use interactive technology. .
TRUS(Technology)	Trust	H6(b): Trust is significantly associated with Intention to use interactive technology.
Social Influences – External Influences		
POL(Technology)	Political Issues	H7 (a) Political Stability is significantly associated with social influences.
REDECON (Technology)	Reduced Economy	H7(b)Reduced Economy is significantly associated with social influences.
MASS(Technology)	Mass Media	H 7(c) Mass Media is significantly associated with social influences

Interactive Technologies Analysis Technological Factors Variable(s)

Technology factors consist of many elements such as Accessibility, Availability, Technology Rivals and Technology Convergence. The literature review has established that these variables significantly influence the intention to use the technology. Pearson's correlation was performed to identify the significant variables for further path analysis. The results show that only ACCESSWWW, AVAILWWW and RIVWWW were significantly associated with Intention to use WWW. The results also show that ACCESSWWW and RIVWWW were negatively associated with Intention to use WWW. On further analysis of the Technological Factors for WAP, the Pearson's correlation results show that AVAILWAP and RIVWAP were significantly associated with Intention to use WAP. RIVWAP was negatively associated with Intention to use WAP. Analysing the Technological factors for iTV, none of the factors was significantly associated with the Intention use of iTV. Therefore during path analysis for the iTV technology acceptance model, no further examination of the Technological factors was considered.

Interactive Technologies Analysis Quality Factors Variable(s)

The literature review determined that Quality factors influence the Intention to use the technology. The quality of a technology is influenced by the quality of the service and system. Pearson's correlation was utilised to enquire whether there was an underlying relationship between the variables for each interactive technology. The results showed that the SYSTEMWWW and SERWWW were significantly associated with QUALWWW. The results also showed that SYSTEMWWW and SERWWW were significantly associated with Intention to use WWW.

Similar correlation results were found for the WAP variables. SYSTEMWAP and SERWAP were significantly associated with QUALWAP. However, no significant association was found between the Quality factors for iTV and the Intention to use iTV.

Interactive Technologies Analysis Risk Factors Variable (s)

Risk, Security and Trust are elements regarded as significantly associated with the Intention to use the technology. The correlation results for all the three technologies showed that Risk and Security were not significantly associated with Intention to use the technology, but Trust was significantly associated with it for all the three technologies.

Interactive Technologies Analysis Social Factors Variable(s)

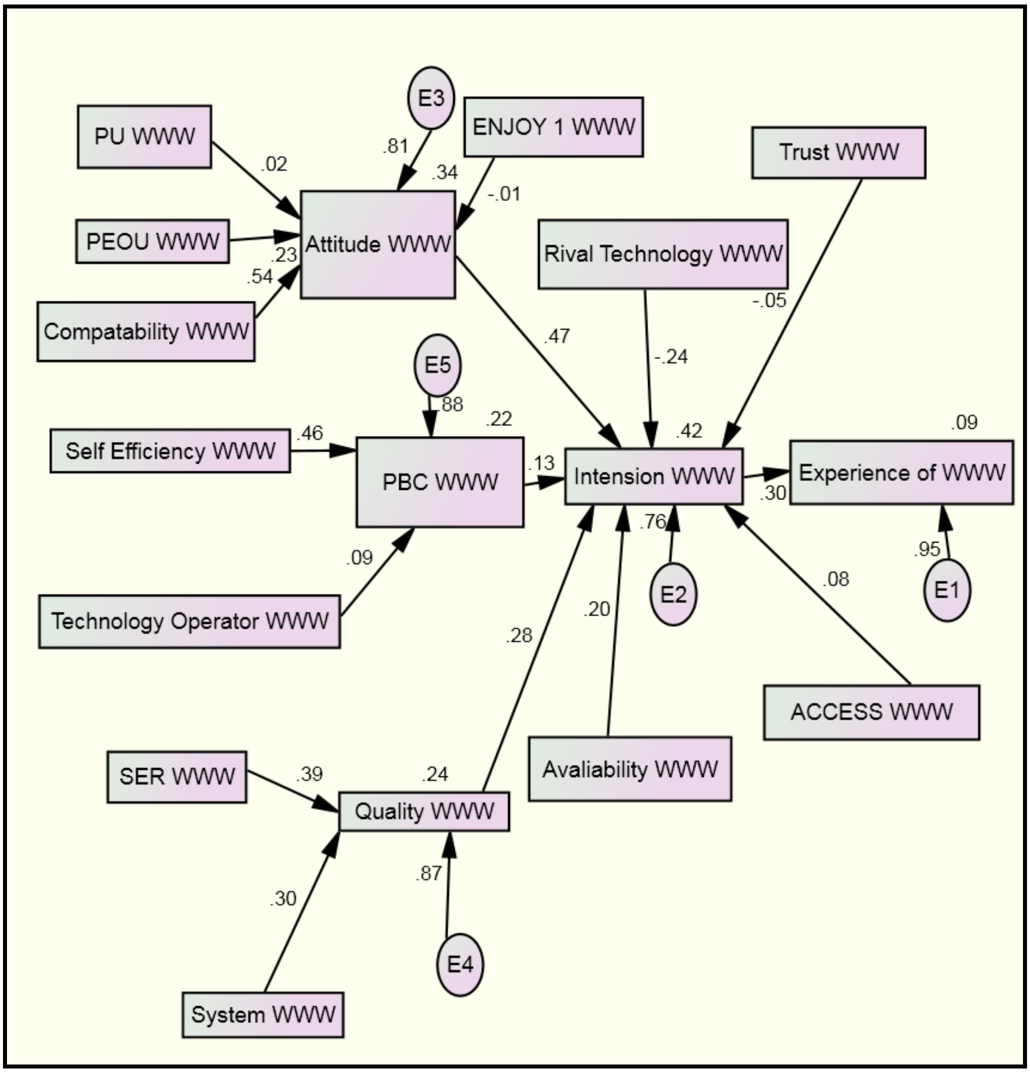
Social Factors include Normative and External Influences. Social Factors were considered to influence the Intention to use the technology. External Influences are factors such as Mass Media, Reduced Economy and Political Issues. Analysis of the relationship between the variables disclosed no significant relationship between the MASS WWW or RED ECON WWW and SI WWW. However, POL WWW had a negative significant association with SI WWW. Upon analysis, the variables for the WAP technology, RED ECON WAP and POL WAP were not significantly associated with SI WAP; only MASS WAP was associated with social factors. When the iTV variables were analysed, again only MASS iTV was associated with Social Factors. The variables which were identified as significant and which fitted the proposed research model were further interpreted, using AMOS to perform SEM, in order to understand the underlying relationship between the variables. Summarised in Table 10.15 are the significant variables identified for Path Analysis to establish an overall model.

Table 10.15 Summary of Significant Variables for Path Analysis

Item ID		**WWW**	**WAP**	**iTV**
Attitude Factors				
ENJOY 1 (Technology)	Enjoyment	0.117	0.433**	0.148
Technological Factors				
TECH FACT (Technology)	Technology Factors	-0.199	0.160	0.165
ACCESS(Technology)	Accessibility of Technology	-0.224*	-0.036	0.029
AVAIL (Technology)	Availability of Technology	0.488**	0.544**	0.056
RIV(Technology)	Rival of Technology	-0.392**	-0.381**	-0.146
CONVEG(Technology)	Technology Convergence	-0.029	0.158	-0.116
Quality Factors				
QUAL(Technology)	Quality	0.339**	0.533**	-0.027
SYSTEM(Technology)	System Quality	0.473**	0.493**	0.107
SERVICE(Technology)	Service Quality	0.434**	0.524**	-0.216
Risk				
RIS(Technology)	Risk	-.115	0.150	0.003
SECURE(Technology)	Security	-0.104	0.047	-0.143
TRUS(Technology)	Trust	0.451**	0.453**	-0.243*
Social Influences				
POL(Technology)	Political Issues	-0.233*	-0.086	0.051
REDECON (Technology)	Reduced Economy	-0.134	0.148	0.149
MASS(Technology)	Mass Media	0.032	0.247*	0.316**

10.6. Technology Acceptance Model for WWW

After identification of the significant variables which influence Intention to use WWW and endogenous variables, AMOS was further to used to analyse the paths between the variables. Overall the model did not have a good fit to the data. However, the model did reveal significant underlying factors which influence the actual use of WWW. Figure 10.7 shows the Technology Acceptance Model for WWW.



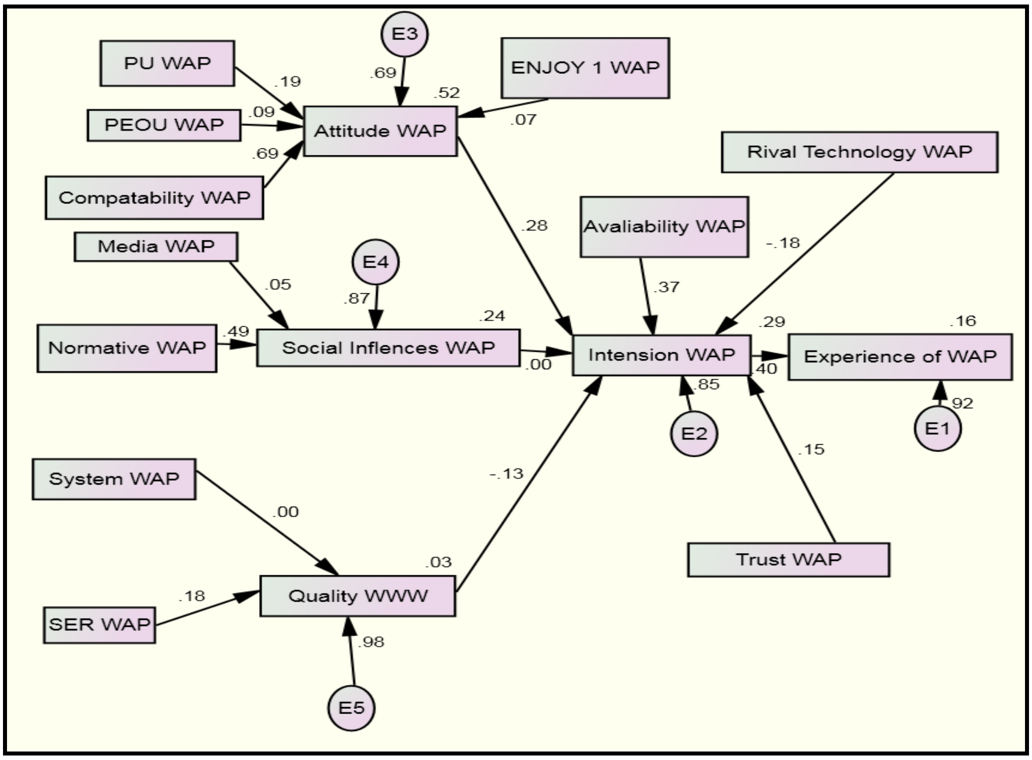
(X^2= 559.324 DF= 120, Normalized X^2= 4.66, p-value < 0.000, CFI =0.214, RMSEA=0.218, NFI=0.215, TLI=-0.002)

Figure 10.7 Technology Acceptance Model for WWW

The following were considered endogenous variables: Attitude WWW, PBCWWW, EXPWWW, QUALWWW and INTENTIONWWW. The results show that this model only explained 24% variance in Attitude WWW, 22% variance in PBCWWW, 24% variance in QUALWWW, and 41.7% variance in Intention to use WWW. Overall the variables in the model have only managed to explain 9% actual use of WWW. The relationship between INTENTIONWWW and EXPWWW is not great according to this model. However, significant variables have been identified with which to predict the Intention use of WWW.

10.7. Technology Acceptance Model for WAP

The Technology Acceptance Model for WAP was amended to include more variables which were significant for the intentional use of WAP. The overall model fit statistics indicated that the model was not a good fit to the data. But the model did identify an underlying relationship between the variables, as the p-value was very significant. To improve the model further, the following variables were included: Enjoyment variable, associated with Attitude and Availability, Technology Rival, Quality Variables, Trust, and Mass Media variable. However, the Technology Acceptance Model for WAP explains only 16% variance in actual use of the WAP technology. Figure 10.8 shows the Technology Acceptance Model for WAP.

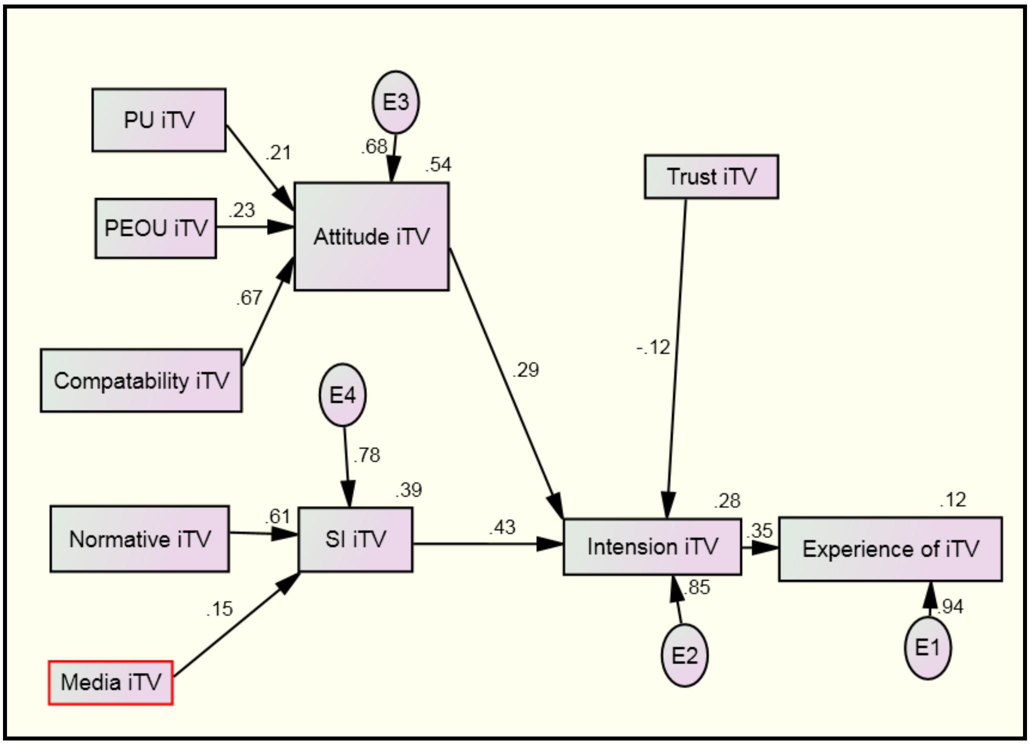


(X^2= 672.517 DF= 105, Normalized X^2= 6.40, p-value < 0.000, CFI =0.208, RMSEA=0.265, NFI=0.196, TLI=0.095)

Figure 10.8 Technology Acceptance Model for WAP

10.8. Technology Acceptance Model for iTV

To improve the Technology Acceptance Model for iTV, Trust (Trust iTV) and Mass Media influence (Media iTV) were identified as significant variables further influencing the Intention to use interactive TV. The model fit statistics indicated that the models were not a good fit with the data. However, significant relationships were identified through the path analysis; therefore this model was further analysed, although it can explain only 12% variance in actual use of iTV and 28% variance in Intention to use iTV. Figure 10.9 shows the Technology Acceptance Model for iTV.



(X^2= 253.729 DF= 36, Normalized X^2= 7.04, p-value < 0.000, CFI =0.419, RMSEA=0.280, NFI=0.396, TLI=-0.274)

Figure 10.9 Technology Acceptance Model for iTV

This section has constructed a technology acceptance model for each technology and has further identified some significant and non-significant relationships between variables for each model. The next section will discuss the findings and establish whether they satisfy the hypotheses proposed in Chapter 5: Research Model.

10.9. Discussion and Conclusion

This study compares three competing theoretical models (TAM, TPB and DTPB model) in order to explain the actual use of interactive technologies. Thus it has been possible to establish a new model for each interactive technology by adding additional significant variables to the model. The literature research identified many significant variables which influence the adoption of interactive technologies. These variables were measured by means of a technology adoption questionnaire distributed to Edinburgh Napier University students and various organisations. The questionnaire measured elements of Attitude, Social Influences, Perceived Behaviour Control, Technological Factors, Demographics, Risk and Quality, the variables being assessed for each interactive technology. Further descriptive analysis was carried out to ascertain the characteristics of the data and the audience's preferences in choosing interactive technology. Evaluating the relationships between the variables permitted the determination of significant variables which will assist in the actual use of interactive technologies.

10.9.1 Competing Theories (TAM, TPB, DTPB)

The present study performed a model comparison among the three competing theories, TAM, TPB and DTPB, in order to explain the actual use of interactive technologies. Based on previous model comparison studies by Akaike (1987), Browne and Cudeck (1989), Hung and Chang (2005), Taylor and Todd (1995), Gentry et al (2002) and Shin (2004), this study adopted the recommended model fit and explanatory powers to evaluate the three competing theories and identify the best model. Table 10.16 provides a summary of the Competing and New models for WWW, WAP and iTV fit indices. The results showed that none of the models fit very well. This could be due to the small size of the sample obtained. However, the models did disclose significant relationships between variables which permitted assessment of the hypotheses proposed in Chapter 5. Table 10.17 provides a summary of the path analysis for the models and the hypothesis results.

Table 10.16 Competing Theories and New Models Fit Indices

Fit Index	Recommended Criteria	WWW				WAP				iTV			
		TAM	TPB	DTPB	Model WWW	TAM	TPB	DTPB	Model WAP	TAM	TPB	DTPB	Model WAP
Chi Square		29.67	24.57	175.49	559.32	25.07	21.28	175.49	672.52	21.38	15.21	141.03	253.73
Degree of Freedom		4.00	3.00	28.00	120.00	4.00	3.00	28.00	105.00	4.00	3.00	21.00	36.00
Normed $\chi 2$	**<3**	7.41	8.19	6.26	4.66	6.27	7.09	6.26	6.40	5.34	5.06	6.71	7.04
p-value	**>0.05**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00
GFI	**>0.9**	0.88	-	-		0.89				0.90			
AGFI	**>0.9**	0.56	-	-		0.59				0.64			
CFI	**>0.9**	0.77	0.67	0.39	0.21	0.86	0.69	0.39	0.21	0.81	0.79	0.56	0.42
RMR	**<0.05**	0.03	-	-		0.09				0.09			
RMSEA	**<0.05**	0.29	0.31	0.26	0.22	0.26	0.28	0.26	0.27	0.24	0.23	0.27	0.28
NFI	**>0.9**	0.75	0.68	0.38	0.22	0.85	0.67	0.38	0.20	0.79	0.76	0.54	0.40
TLI	**>0.6**	0.41	-0.10	0.01	0.00	0.66	0.38	0.01	0.10	0.54	0.58	0.42	-0.27
AIC		51.67	46.57	227.49	659.32	47.07	43.28	247.36	766.52	43.38	37.20	187.03	311.73
BCC		53.53	48.09	235.25	689.83	48.92	44.81	253.45	793.15	45.24	38.73	193.12	321.40
PCFI		0.30	0.20	0.24	0.17	0.35	0.35	0.32	0.18	0.33	0.39	0.42	0.32
PNFI		0.31	0.20	0.24	0.17	0.34	0.34	0.31	0.17	0.32	0.38	0.40	0.34

Table 10.17 Path Analysis for Competing Theories and New Models and Hypothesis Results

Hypothesis	Paths Analysis (*p<0.05, **p<0.01)			WWW				WAP				iTV				Hypothese Results
				TAM	TPB	DTPB	Model WWW	TAM	TPB	DTPB	Model WAP	TAM	TPB	DTPB	Model iTV	
H2 (b)	Attitude(Technology)	<---	PU(Technology)	0.17		0.015	0.015	0.488**		0.204*	0.192*	0.594*		0.212*	0.212*	Supported
H2(c)	Attitude(Technology)	<---	PEOUSE(Technology)	0.25*		0.232*	0.233*	0.197		0.097	0.087	0.122		0.228*	0.228*	Supported
H2(d)	Attitude(Technology)	<---	COM(Technology)			0.538**	0.538**			0.692**	0.687**			0.665**	0.665**	Supported
	PEOUSE(Technology)	<---	PU(Technology)	0.40**				0.581**				0.237*				Supported
H3(a)	PBC(Technology)	<---	SE(Technology)			0.498**	0.465**									Supported
H3(c)	PBC(Technology)	<---	TOP(Technology)			0.064	0.092									Rejected
H3(b)	PBC(Technology)	<---	GOV (Technology)													Rejected
H2(h)	Attitude(Technology)	<---	Enjoy(Technology)				-0.006				0.065					Rejected
H5(b)	QUAL(Technology)	<---	SER(Technology)				0.392**				0.181					Supported
H5(a)	QUAL(Technology)	<---	SYSTEM(Technology)				0.295*				-0.003					Supported
H7	Intension(Technology)	<---	SI(Technology)						0.142	0.145	0.001		0.435**	0.439**	0.426**	Supported
H3	Intension(Technology)	<---	PBC(Technology)		0.336**	0.333**	0.126									Rejected
H2(a)	Intension(Technology)	<---	Attitude(Technology)	0.43**	0.501**	0.493**	0.466**	0.263*	0.487**	0.446**	0.28*	0.425**	0.337**	0.310*	0.292*	Supported
H2(c)	Intension(Technology)	<---	PEOUSE(Technology)	0.46**				0.539**				0.233*		0.228**		Supported
H5	Intension(Technology)	<---	QUAL(Technology)			0.497**	0.28*				-0.134					Supported
H6(b)	Intension(Technology)	<---	TRUS(Technology)				-0.047				0.153				-0.125	Rejected
H4(b)	Intension(Technology)	<---	AVAL(Technology)			0.064	0.198*				0.366**					Supported
H4(a)	Intension(Technology)	<---	ACC(Technology)				0.084									Rejected
H4(c)	Intension(Technology)	<---	RIV(Technology)				-0.239**				-0.176**					Supported
H2(i)	EXP(Technology)	<---	Intension(Technology)	0.33**	0.312**	0.310**	0.297*	0.477**	0.439**	0.431**	0.402**	0.379**	0.361**	0.358**	0.353**	Supported
H7(a)	SI(Technology)	<---	NORM(Technology)							0.503**	0.486**			0.635**	0.608**	Supported
H7(b)	SI(Technology)	<---	MAS(Technology)								0.052				0.149*	Supported
Explanatory Power (R^2)																
Attitude(Technology)				0.126		0.344	0.34	0.389		0.53	0.52	0.402		0.54	0.54	
Intention(Technology)				0.524	0.364	0.354	0.42	0.496	0.257	0.22	0.29	0.287	0.302	0.289	0.28	
EXP(Technology)				0.106	0.097	0.096	0.09	0.2	0.193	0.186	0.16	0.144	0.13	0.128	0.13	
QUALWWW(Technology)							0.24				0.03					
SI(Technology)										0.253	0.24			0.403	0.39	
PBC(Technology)						0.234	0.22									
PEOUSEWWW				0.158				0.338				0.056				

10.9.2. Attitudinal Beliefs

Lai and Li (2005), Chen et al (2002) and Roger (1995) argue that attitude towards an innovation is a significant variable in determining the adoption decision. In addition, for each technology a significant relationship was found between Attitude and Intention to use interactive technology. Comparison of the competing models with Model WWW shows that the TPB model was better at explaining the relationship between Attitude and Intention to use, compared to the new model for WWW. The TPB model explained 25% variance in Intention to use WWW, whereas Model WWW explains only 21% variance. On assessment of results for the WAP, the best competing theory identified was again TPB as it explained 23% variance between Attitude and Intention to use WAP. Model WAP only explained 8% of variance between Attitude and Intention to use WAP. The TAM model was better at explaining the variance between Attitude and Intention to use WWW, as it explained 18% of this variance. However, the Model iTV only explained 8.52% variance between Attitude and Intention to use iTV. Therefore it can be concluded that, for WWW and WAP, TPB is a better model with which to analyse Attitude and Intention to use the technology, while TAM is a better model for iTV. The new proposed models do not explain the variance between Attitude and Intention to use very well compared to the existing competing theories.

This finding confirms the following hypothesis: H2(a) Individuals' Attitude towards interactive technology is positively associated with their use of the technology.

Sun and Zhang (2006) and Davis (1989) have established that Perceived Usefulness is a significant factor in affecting users' acceptance of technology. The TAM model identifies that PU is significantly associated with Attitude as well as PEOU. The competing theories showed that TAM was a better model than DTPB with which to explain the relationship between Attitude and PU. However, for the WWW no significant relationship was found between Attitude and PU. The Model WWW also failed to establish a significant relationship between the variables. But for WAP and iTV, a significant relationship was identified between these two variables; here the TAM model was superior to DTPB. The TAM model explained 23% variance between the two variables for WAP and 35% of variance for iTV. Model WAP and Model iTV displayed a smaller variance than the TAM model. Overall the following hypothesis can be supported: Perceived Usefulness towards interactive technology is positively associated with Attitude. For the WWW, however, the results showed a limited relationship between Perceived Usefulness and Attitude. This suggests that as the individual who has started using the technology gains experience, Perceived Usefulness may become non-significant.

Davis (1986) and Park (2010) argued that users will be more attracted to a technology which is less complex to use. Therefore PEOU is considered a factor significantly affecting both Attitude and Intention to use the technology. Of the competing theories, DTPB was judged a better model with which to explain the variance between Attitude and PEOU for WWW and iTV. No relationship was identified between the WAP variables in the competing theories or in Model WAP. However, Model WWW and Model iTV showed a better variance in explaining the relationship between Attitude and PEOU. Individuals gain more experience with their mobile phones than with WWW and iTV, since the mobiles accompany the person. As an individual gains experience with the WAP phone, the PEOU may become a less significant determinant of use.

Chen et al (2002) and Moore and Benbasat (1991) defined Compatibility as the degree to which the innovation is found consistent with the existing values, needs and past experience of potential adopters. The Compatibility variable was introduced for DTPB and Model WWW, Model WAP and Model iTV. The results were significant for all the three technologies and explained a large percentage of Compatibility and Attitude variance. The results also show that, for each technology, DTPB performed slightly better than the new models. This confirms hypothesis H2(d): Compatibility towards interactive technology is positively associated with Attitude.

Interactive technology such as WAP or Internet is not used entirely for educational or work reasons, but also for entertainment and pleasure. Younger individuals use such technologies purely for enjoyment. According to Agarwal and Karahanna (2000), Moon and Kin (2001) and Teo et al (1999), perceived Enjoyment is significantly associated with Attitude and Behavioural Intention in using the technology. This variable was measured in the Model WWW, Model WAP and Model iTV, but no significant relationship was identified after SEM, although one was found during Pearson's correlation.

10.9.3. Perceived Behaviour Control

Ajzen (1991), Lu et al (2009) and Yi et al (2006) refers to Perceived Behaviour Control as the perceived ease or difficulty of performing a particular behaviour. The Perceived Behaviour Control is comprised of two factors: efficacy, and facilitation by government and technology providers. The results showed that DTBP was better than the new model in explaining the variance between PCB and Self-Efficiency. Teo and Pok (2003) argue that Government Facilitation is significantly associated with Perceived Behavioural Control. However, during this investigation no significant relationship was found between Government Facilitation and PBC for any of the three technologies. The technology operators play an important role, as they are in charge of promoting the new innovation as well as supporting it once adopted. (Lee 2009). Raising awareness of the product can indirectly increase the likelihood of adoption. Nevertheless, Technology Operators were no longer significant after SEM analysis, even though a significant association was identified during Pearson's correlation.

10.9.4. Technological Factors

Increase in Technology Rivals is a significant inhibitor of interactive technology uptake. Technology rivals such as the internet and mobile may provide a better and cheaper service, as well as offering more technology convergence, than interactive TV. Technology adopters enjoy using a device which will provide more services and functionality than its rivals. A significant relationship was identified between Technology Rivals and Intention to use WWW. However, no relationship was found for WAP and iTV.

Shin (2007), Mathieson (1991) and Venkatesh and Brown (2001) determined that Availability plays an important role in individual's acceptance of technology.

A significant relationship was identified between Availability and Intention to use WWW and WAP, although no such relationship was found for iTV. This would suggest that Availability is positively associated with Intention to use interactive technology.

10.9.5. Quality

Information, service and system quality can all contribute to the overall quality of interactive TV, and these three elements of Quality contribute significantly to interactive TV uptake. DeLone and McLean (1992) argue that information quality is a significant factor in the development of intriguing information systems. In various studies, Lin and Lu (2000), Beyah (2003) and Cheong and Park (2005) established that Quality is a significant factor which can determine the acceptance of a technology. An increase in Quality will result in higher user satisfaction. The quality of information is usually measured by dimensions such as accuracy, completeness and understandability (Huizingh, 2000; Ranganathan et al 2002). Ahn et al (2007), Lin (2008) and Ha et al (2009) have all emphasised that Quality affects users' intention to uptake technology. The findings show that System Quality and Service Quality were significantly associated for Model WWW, whereas for Model WAP and Model iTV no relationship was identified. The results demonstrate that Quality explains 8% variance in Intention to use WWW. This would suggest that Service and System Quality are significantly associated with overall Quality, which further influences Intention to use the technology.

10.9.6. Social Influences

Social interaction plays a very important role in technology adoption. Socially interactive activities determine individuals' habits, making it possible to determine their receptiveness to innovation. Social influence plays a significant role in the acceptance and usage of new technology. Several studies have identified the importance of Social Influences in understanding technology adoption (Compeau and Higgins, 1991; Hartwick and Barki, 1994; Mathieson, 1991 and Taylor and Todd, 1995). According to Taylor and Todd (1995), Social Influences are equivalent to subjective norms and are defined as other people's opinions, superior influences and peer influences.

The DTPB demonstrated a significant association of Social Influences with Intention to use iTV, but no association was identified between the WAP and WWW variables. This suggests that Social Influences are less significant for a more widely accepted technology than for a less accepted one. The results also showed that Mass media affects Social Influences, although this relationship was not identified for the WAP or WWW.

This chapter has described the new models for WWW, WAP and iTV. Overall the model fitness was not good, although significant relationships were identified between the variables, and the variance was explained. The results overall suggest that to predict Attitude towards interactive technologies, the DTPB is a better model than TAM and TPB, as it was able to explain 53% of variance in Attitude. Similar results were found with the new models, in that the variance explained in Attitude was the same as for DTPB. However, to predict the Intention to use of interactive technology, the TAM model performed better than the others, explaining 52% of the variance in Intention to use. These models did not explain the actual use of interactive technologies very well. The cause may have been an issue with the data collection, or the measures of actual use of the technology may not have been correctly identified. The DPB model was better at explaining Social Influences and Perceived Behaviour Control, whereas the TAM model was better at explaining PEOU. The new proposed model can be improved considerably by merging the TAM and DTPB models together with the new models. During correlation, significant relationships between variables were identified. If these are taken into consideration, the model may be further improved for the purpose of predicting the actual use of interactive technologies.

Chapter 11 Summary, Conclusion and Future Research

11.1. Introduction

The concept of interactivity has been around in the market place since the early 1960s. The remote control was the first step towards interactivity, giving the audience greater control of their viewing (Katz, 2004). Now the concept has grown considerably, as many ICT have entered their digital phase which has increased their interactivity capacities. Expectations of interactivity expand daily and there is ever greater demand to meet these expectations. Currently much interactivity is experienced through Gaming Consoles such as Wii, Play Station and now Kinect by Microsoft, which permits control-free gaming by capturing the individual's 3D moves then reconstructing these moves in order to play the game. Further to this, smart phones such as IPhones have raised the level of interactivity, providing improved interaction through the features and functions of the mobile phone. Television, also, has increased its interactivity level, initially by means of iTV which allows users to interact with live TV, make purchases and search for information. The latest advance in television interactivity is the TV Internet. TVs are now released with the ability to connect to the internet through a wireless internet dongle. Thus the concept of interactive technology has greatly expanded in this day and age; nevertheless, the development and acceptance of iTV within the industry is still at an early stage.

The main purpose of the present research has been to forecast the future of interactive technologies and identify the significant factors which inhibit and promote their adoption, especially that of iTV. Towards this end, a Cross-Cultural study was conducted to identify suitable growth models and to understand the cultural influences on technology acceptance.

The core aim of this chapter is to bring together and highlight the primary conclusions related to the research objectives set out in Chapter 1. A summary of the research aims and the approach adopted in achieving these aims are outlined. The conclusions drawn from the main findings of the research and their contribution to the literature on interactive technologies are summarised.

Next, key limitations of the research are identified. Finally, further areas that could potentially be explored are discussed in the section on future research.

11.2. Overview

The thesis has adopted various research methods in order to forecast the future of interactive technologies. Quantitative and qualitative methods have been used to analyse existing and new data trends in the adoption of new communication products in different societies and cultures. The literature research identified various key elements which influence the acceptance of technology. These elements were analysed by applying different techniques and approaches. The technological forecasting method was adopted to determine a suitable technological forecasting model which can be applied to predict the future growth of interactive technologies, especially that of iTV. Various growth models were applied to ICT secondary data for the UK, Hong Kong and Pakistan, to identify for each country an appropriate growth model which can be adopted to forecast the future of interactive technologies.

Then a judgemental technology forecasting method, namely, the Delphi study, was used to examine the future of interactive technologies by evaluating the drivers and inhibitors of interactive TV as an example. The characteristics of optimistic and pessimistic individuals were analysed and identified. Further to this the relationships among various drivers and inhibitors were assessed, making it possible to justify a future growth in market share for interactive TV.

The Cross-Cultural study was carried out to determine the acceptance of interactive technologies in three diverse cultures: Western Culture, through the UK, and Eastern Culture through Pakistan and Hong Kong. The UK is a developed high-tech country. Pakistan is a developing country with low acceptance of innovative technology, whereas Hong Kong is thriving in the production of innovative technology but its actual use there is uncertain. The cross-cultural study examined the cultural differences and assessed the impact they might have on technology acceptance.

Finally, a Technology acceptance model was established for interactive technologies which facilitated initial evaluation of the three competing theories so as to determine the most appropriate model. This was further enhanced by identifying significant elements contributing to a technology acceptance model for interactive technologies.

11.3. Conclusions

11.3.1 Technological Forecasting

The findings of the present study confirmed that the process of technological adoption and diffusion varies for different technologies and for different nations. It was shown that after forecasting the future of PCs, Mobile Phones and Satellite by applying technological forecasting methods, different Growth Curve models could be identified with which to forecast the future growth of interactive technologies in each country. The study demonstrated that the Simple Logistic Model, Bass Model and Gompertz models are more appropriate models to forecast the future of interactive technologies, as they reported smaller RMSE and MAPE values.

11.3.2 Factors Influencing Interactive Technologies Adoption

The level of technology diffusion and adoption is influenced by many factors, such as culture, economics, politics and sociology. This study has identified the most significant factors affecting the acceptance of interactive technologies. Through the Judgmental, Cross-Cultural and Technology Acceptance approaches, it has confirmed that there are significant relationships between acceptance of interactive technologies and demographic, social economic, social influence and interaction factors, attitude factors, Perceived Behaviour Control factors, Technological and Quality factors and risk factors.

11.3.3 Cultural Differences

The UK, Hong Kong and Pakistan have diverse cultural values. The study found that the acceptance of interactive technology is different in each culture as it is affected by different cultural dimensions, as identified by Hofstede (1991). It is most likely that interactive technologies will be accepted first in the UK and then in Hong Kong and Pakistan. The Cross-Cultural study established that each culture is influenced by different contributing factors. Hong Kong and Pakistan are influenced by power; their cultures inhibit individualism and are less innovative; thus, as shown by the cross-cultural study, the ownership of technology is lower in those countries than in the UK. The study also demonstrated that there are significant differences in the knowledge, confidence and usage of interactive technologies for each country.

11.3.4 Demographic and Social Economic Variables

This study has confirmed that Gender is a significant factor in determining the usage of interactive technologies. The results suggest that males are more dominant than females in this respect. Age, Education, Number of occupants and House status are additional factors which significantly affect interactive technology acceptance. The research showed that increasing age is negatively associated with usage of interactive technologies. Education is also considered a significant influence on prospective users' attitudes, as it affects individuals' learning capacities. This study has determined that the less the person is educated, the less likely he or she is to accept and use interactive technologies. In addition, the research confirmed that house status and number of occupants have an impact on technology adoption, since they affect the decision-making process in regard to the adoption of innovation. Further to this, marital status is considered a significant factor influencing the adoption of interactive technology.

The increase in hedonism has an impact on democracy, since hedonists enjoy freedom and are outspoken about political strategies. The study identified that the increase in hedonistic lifestyle is significantly associated with the future growth of interactive technologies. Besides this, the population is generally becoming less physically active because of a more convenient way of life, and the research confirmed that this factor has a significant effect on the acceptance of interactive technologies.

11.3.5 Attitude and Perceived Behaviour Control

Attitude towards interactive technology is considered to be a significant factor influencing its adoption. The research established that Perceived Usefulness and Perceived Ease of use are significantly associated with the Attitude favourable to the acceptance of interactive technology. Enjoyment of the technology further enhances acceptance. Perceived behaviour control is comprised of two factors: efficacy and facilitation, such as by government and technology providers. The technology operators play an important role, as they are in charge of promoting the new innovation as well as supporting it once adopted. Increasing awareness of the product can indirectly increase the likelihood of adoption. In fact, this study found that Government facilitation and Technology Operators were not significantly associated with perceived behaviour control; however, self-efficacy was associated with it.

11.3.6 Social Influences and Interactions

Social influences and interactions play a highly important role in the acceptance of interactive technologies. Socially interactive activities determine the individual's habits, which can indicate their receptiveness to innovation. This research confirmed that social influences and interactions affect interactive technology acceptance. The study has disclosed that the number of hours spent with family is one of the most significant factors influencing interactive technology usage. However, the research also found that Social Influences become less significant for a widely accepted technology than for a less accepted one; for example, the results showed that Mass media affect the Social Influence, whereas this relationship was not discerned for the WAP or WWW. Decrease in Political Stability and Economic Growth were identified as significant factors inhibiting the acceptance of interactive technologies, since a decrease in Political Stability and Economic Growth will result in a less competitive market, allowing small players to enter the market and offer new, enhanced interactive technology services.

11.3.7 Technological, Quality and Risk Factors

An increase in Technology Rivals allows potential adopters choices and this will increase competition in the market. Technology rivals such as the internet and mobile may provide a better and cheaper service than interactive TV. Technology adopters enjoy using a device which will provide more services and functionality than its rivals. The findings showed that this was one of the main market inhibitors for the adoption of interactive technologies. TV is a well adopted technology and on average Britons spend 4 hours per day watching it. As the main advertising medium, it creates many sales opportunities, more of which can be generated by an increase in television commerce. The findings confirmed that Increasing Television Commerce will promote the adoption of interactive TV.

Information quality or service and system quality can contribute to the overall quality of interactive TV. All these elements add significantly to the uptake of interactive TV and other interactive technologies. An increase in quality will result in higher user satisfaction. The findings suggest that System and Service quality were significantly associated with the acceptance of interactive technologies.

Improved security usually gives the users the perception that their personal data are protected and stored in a safe location. The findings of this study suggest that improved security and trust are most likely to promote the acceptance of interactive technologies, especially iTV. Greater speeds of access plus decrease in price are additional significant factors in its uptake. This study confirmed that Increased Speed and lower price promote interactive technology.

Ownership of ICT determines the individual's experience of using other technologies and thus furthers technology adoption. The cross-cultural study showed that Technology ownership was a significant factor influencing the usage of interactive technology. According to this study, the more technology an individual owns, the more likely the person is to use interactive technologies. In addition, Knowledge and Confidence were identified as factors contributing to the acceptance and usage of interactive technologies.

This study has ascertained many factors which inhibit or promote the acceptance of interactive technologies. It has successfully projected the future for these technologies, especially iTV. A summary of the hypothesis results for this thesis is presented in Table 11.1

Table 11.1 Summary of Hypothesis Results

ID	Hypothesis	Hypothesis Results
	Demographic and Social Economic Factors	
H1	Demographic and Social Economic differences significantly influence technology adoption.	Supported
H1(a)	Culture differences significantly influence technology adoption.	Supported
H1(b)	Gender is significantly associated with Intention to use interactive technology.	Supported
H1(c)	Increasing Age is negatively associated with the future growth of interactive technologies	Supported
H1(d)	Educational attainment is significantly associated with the adoption of interactive technology.	Supported

ID	Hypothesis	Hypothesis Results
	Demographic and Social Economic Factors	
H1	Demographic and Social Economic differences significantly influence technology adoption.	Supported
H1(a)	Culture differences significantly influence technology adoption.	Supported
H1(b)	Gender is significantly associated with Intention to use interactive technology.	Supported
H1(c)	Increasing Age is negatively associated with the future growth of interactive technologies	Supported
H1(d)	Educational attainment is significantly associated with the adoption of interactive technology.	Supported
H1(e)	Income will be significantly associated with the acceptance of interactive technology adoption.	Unsupported
H1(f)	Employment Status will be significantly associated with the adoption of interactive technology.	Unsupported
H1(g)	A growing number of Household Occupants will be positively associated with the adoption of interactive technology	Supported
H1(h)	Marriage Status will be significantly associated with the acceptance of interactive technology adoption.	Supported
H1(i)	Decrease in the Physically Active Population is positively associated with the future growth of interactive TV	Supported
H1(j)	Increase in Hedonistic Lifestyle is significantly associated with the future growth of interactive TV	Supported
	Attitude Factors	
H2	Individuals' Attitude towards interactive technology is positively associated with their use of the technology.	Supported
H2(a)	Perceived Usefulness is significantly associated with attitude.	Supported
H2(b)	Perceived Ease of Use towards interactive technology is significantly associated with attitude and use of the technology.	Supported
H2(c)	Perceived Usefulness is significantly associated with Perceived Ease of Use	Supported
H2(d)	Compatibility of interactive technology is positively associated with attitude.	Supported
H2(e)	Increasing Knowledge of interactive technology is positively associated with its use.	Supported
H2(f)	Increasing Confidence in one's ability to use interactive technology is positively associated with its adoption.	Supported
H2(g)	Increasing Usage of interactive technology is positively associated with its Future Use.	Supported
H2(h)	Enjoyment of interactive technology is significantly associated with attitude.	Supported
H2(i)	Experience and Ownership of Technology is positively associated with individuals' use of interactive technology.	Supported
	Social Infleunces and Interaction	
H3	Social Influences and Interaction are significantly associated with individuals' use of interactive technology.	Supported
H3(a)	Normative Influences is significantly associated with individuals social influences.	Supported
H3(b)	A decrease in Political Stability is significantly assoicated with Social Influences.	Supported
H3(c)	A decrease in Economic Growth is significantly associated with Social Infleunces	Supported
H3(d)	Mass Media is significantly associated with Social Influences.	Supported
	Perceived Behaviour Control Factors	
H4	Perceived Behaviour Control is positively associated with Intention to use interactive technology.	Rejected
H4(a)	Self-Efficacy is significantly associated with perceived behaviour control.	Supported
H4(b)	Government Facilitation is significantly associated with perceived behaviour control.	Rejected
H4(c)	Technology Operators are positively associated with perceived behaviour control.	Rejected
	Technological Factors	
H5(a)	An increase in Technology Rivals is significantly associated with the future growth of Interactive Technology.	Supported
H5(b)	The increase in Technology Commerce is significantly associated with the future growth of interactive technology.	Supported
H5(c)	Accessibility is significantly associated with Intention to use interactive technology.	Supported
H5(d)	Decreased price is significantly associated with Intention to use interactive technology.	Supported

11.4. Contributions

The main contribution of this research is that’s is provides an mixed methodology framework to forecast the future of interactive technologies. This research shows that’s adopting mixture of methodologies such as Technological and Judgmental forecasting techniques and then to further evaluate the promoters and inhibitors by applying different statically analysis such as Factor Analysis, Logistic Regression and Structured Equation Modeling to develop Technology acceptance model has been significant to forecast the future of interactive technologies. This methodology framework can to adopted to forecast the future of any new interactive Technologies.

The present research contributes to the existing literature in several ways. First, there is limited literature reviewing the concept of interactive technologies. Also, very few studies have discerned that WWW and WAP can now be categorised as interactive technologies by virtue of their increasing interactivity. This research fills the gap in the literature by providing a comprehensive review of interactive technologies and identifying significant factors, growth models and adoption models which can explain and promote interactive technology acceptance. These findings have permitted more in-depth examination of trends in acceptance while taking cultural differences into consideration.

Second, this research has applied technological forecasting models to identify suitable Growth Models with which to predict the future growth of interactive technologies. The Gompertz, Simple Logistic Model and Bass Model are considered superior to competing models for the purpose. Thus, this study adds to the existing research by highlighting the significance and competence of these models.

A third contribution is that, through the judgemental forecasting method, the research was able to project the future of interactive technologies, especially iTV. It also identified its potential growth and the key inhibitors and promoters of the technology. The study has determined that iTV will reach its adolescent phase in the product life cycle within the next 2 to 5 years, and has indicated the likelihood that, within the next 5 to 10 years, the market share for iTV will increase by at least 10 to 40%. In addition, the findings have disclosed that technology rivals and the decrease in political stability and economic growth will be significant inhibitors of the technology. The main promoter of iTV technology is considered to be its ease of use, which will help to expand its market share.

Fourth, this research enhances understanding of the underlying factors that influence the adoption of interactive technologies. It also underlines the variance of significant factors affecting their growth and usage.

Finally, the research has identified the overall technology acceptance model for interactive technologies. This model will support marketing activities which promote the growth and usage of these technologies. One of the most important contribution is to the methodology. This thesis successfully demonstrates that a mixed methods approach can be adopted to forecast the future of interactive technologies.

In conclusion, it is argued that this research makes a positive contribution by expanding our knowledge of interactive technologies and helping to identify the significant elements which influence their acceptance. It has further been able to identify a suitable growth model with which to forecast the growth of interactive technologies, as well as to establish an overall technology acceptance model for them.

11.5. Implications

Examining and identifying the significant factors will assist consumers in assessing elements of potential influence on the growth of interactive technologies, thus improving the technologies' marketing possibilities by targeting the prospective audience. Identifying the factors which inhibit the growth of interactive technologies will allow consumers to manage the perception of these technologies better.

Understanding cultural differences in the acceptance of interactive technologies will enable consumers to tailor and identify the services which are more suitable for each culture. This development will help the interactive technologies to grow more efficiently through better knowledge of the cultures' particular service requirements.

Identifying the suitable Growth Models with which to forecast the future growth of interactive technologies will help the consumers and other vendors to determine the maximum market growth of the interactive technologies. This will ensure that they gain the maximum return on their investments in innovation and services.

From this study recommendations can be made to technology developers and marketers. Then have another set of recommendations to academics, to use proposed mixed method approach around future research for example to investigate different countries consider other technologies such as iPhones.

11.6. Limitations

This research extends the empirical knowledge of technology acceptance, technological and judgemental forecasting of interactive technologies. The results, however, have their own limitations that have to be considered when interpreting the findings.

The research has adopted many methodologies in order to forecast the future of interactive technologies. The data were collected from primary and secondary sources. To obtain actual data for iTV was challenging, so to overcome this obstacle, data were selected from different sources who have either performed an independent study or collected data through users of their iTV services. Therefore, analysing and forecasting the penetration of new products has been demanding and complex, with fewer data being available for market analysis and technology forecasting. Applying technological forecasting methods to predict the future of interactive technologies, and especially iTV, was problematic because of the quality of data. Thus there may be an issue with the

data collection so that measures of actual use of the technology may not have been identified correctly.
This research mostly non probability sampling has been adopted. This can also be identified as a limitation of this research as the subjectivity of non-probability sampling prevents representing the entire population. Mostly Convenience sampling and Purposive Sampling techniques were selected.

The fact that the Cross-Cultural study respondents in all three countries were mostly students has considerably limited identification of those significant factors which might influence the acceptance of interactive technologies in a wider audience with different demographic profiles. For example, a broader sample would reveal significant elements affecting interactive technology acceptance by older males and females, as well as introducing factors such as income and occupation. In addition, the cross-cultural study found limited exposure to WAP and iTV technologies among these respondents. Therefore, identification of significant technology attributes and attitudes regarding WAP and iTV were restricted. The data collection process for the cross-cultural study could have been improved by administering an e-survey rather than a paper-based one as this would have permitted more efficient management of the questionnaire and interpretation of the results. The sample size of the survey could have been considerably increased by this means, as e-surveys make it possible to attract a larger sample size with respondents being more dispersed in each culture.

The Technology acceptance model assesses various contributing factors in order to produce the interactive technology acceptance model. This model first analysed the competing theories to identify the best model with which to forecast the future growth of interactive technologies. The sample size for this process was just below 80 respondents; increasing it would have produced greater reliability and increased the validity of the findings. A larger sample size would also have markedly improved the quality of the SEM modelling.

This study takes iTV, WWW and WAP as representative of interactive technologies. As there have been many recent advances in interactive technology, such as IPhones and gaming controls, to understand the true potential of interactive technologies the study should have included these in the research and evaluated their potential.

11.7. Future Research

To pursue this research and further establish the future of interactive technologies, in as much as respondents had limited exposure to technologies such as iTV and WAP, a study should be carried out to capture their experience while using the technology. This could be a cross-cultural study for the purpose of evaluating users' experience from a cultural perspective, thus helping consumers to identify and improve the functions and features which actually affect the respondents' usage experience.

In addition, iTV users' data need to be obtained and analysed by applying growth models so as to understand the true market potential of iTV. Acquiring these secondary data will truly improve the quality of the forecast made for iTV in this thesis.

To enhance further the growth of interactive technologies, a study should be carried out which captures potential users' image of these technologies in the future. Such research would help consumers to invest efficiently and thus secure a maximum return. A judgemental approach can be adopted for this study in order to establish a clear vision of interactive technologies.

This research has utilized three countries (UK, Hong Kong and Pakistan) to access the cultural difference in the adoption of interactive technologies and did not assess or measure any cultural dimensions. The future research should be to adopt various cultural dimensions for various other counties and evaluate the acceptance of interactive technologies. This will further determine the relationship and bridge this knowledge gap to understand the cultural difference which will promote the adoption of interactive technologies.

Future research with a larger random sample is necessary to investigate to understand the key inhibitors and promoters of Interactive technologies. Also such study should also evaluate the individual innovative characteristics which will lead to the adoption of interactive technologies.

Finally this research has provided a comprehensive methodology framework to forecast the future of interactive technologies. As digitalization has introduced the convergence of many existing analogue technologies and enhance the converged technologies with more interactivity. Therefore this methodology framework can be further adopted to forecast the further of other interactive technologies such as Smart phones and Gaming consoles and further prove the validity of the mixed methodology framework.

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Appendix 1 Delphi Study

Appendix 1(a) Delphi Study Participants

Here is a list of Delphi Study participants who contributed to first or both rounds of the Delphi questionnaire.

Name	Surname	Organisation	Position	Location	Country	Email Address	Participated In (First / Both) Rounds
Martin	Gude	Nexum AG	Consultant	KOELN	Germany	martin.gude@nexum.de	1st
Ric	Top	K3	Research Assistent	Malmö	Sweden	richard.topgaard@mah.se	1st
Ai-Ru	Lee	NCCU (National Chengchi University)	Graduate Student	Taipei	Taiwan (R.O.C.)	greencrew@hotmail.com	Both
Andrea	Miotto	Goldsmiths, University of London	Researcher	London	UK	a.miotto@gold.ac.uk	Both
Ana Vitoria	Joly	University of Brighton	Researcher	Brighton	UK	A.V.B.Joly@brighton.ac.uk	Both
Mark	Rice	University of Dundee	Researcher	Dundee	Angus	mrice@computing.dundee.ac.uk	1st
Jonathan	Freeman	i2 media research	Managing Director	London	UK	j.freeman@gold.ac.uk	Both
Zbigniew	Hulicki	AGH University of Science and Technology	Professor	Krakow	Poland	hulicki@kt.agh.edu.pl	1st
Joe	Tullio	Motorola, Inc.	Senior Research Engineer	Schaumburg, IL	USA	joe.tullio@motorola.com	1st
Duane	Varan	Interactive Television Research Institute	Executive Director	Perth	Australia	varan@itri.tv	Both
Pablo	Cesar	The National Research Institute for Mathematics and Computer Science	Researcher	Amsterdam	The Netherlands	p.s.cesar@cwi.nl	Both
Marina	Geymonat	Telecom italai Lab	Researcher	Turin	Italy	marina.geymonat@telecomitalia.it	1st
Wendy	Van den Broeck	IBBT-SMIT, Vrije Universiteit Brussel	Researcher	Brussels	Belgium	wvdbroec@vub.ac.be	Both
Alex	Carmichael	University of Dundee	Research Fellow	Dundee		acarmichael@computing.dundee.ac.uk	Both
Robert	Raeside	Napier University	Professor	Edinburgh	Scotland	r.raeside@napier.ac.uk	Both
David	Stevenson	Edinburgh Napier University	Lecturer	Edinburgh	United Kingdom	d.stevenson@napier.ac.uk	Both
Michael	Lewrick	Swisscom IT Services	Senior Strategy Manager	Zürich	Switzerland	michael.lewrick@swisscom.com	1st
Peter	Stein				Germany	hpwa@mx.net	1st
Malte	Reßin	TVU London	Phd student	London	United Kingdom	malte.ressin@freenet.de	Both
Monica	Perrero	Universita di Torino	Temporary Researcher	Turin	Italy	perrero@di.unito.it	Both
Hokyoung	Ryu	Massey University	Senior Lecturer	Auckland	New Zealand	h.ryu@massey.ac.nz	1st
Dimitri	Schuurman	MICT - IBBT - Ghent University	Researcher	Ghent	Belgium	dimitri.schuurman@ugent.be	Both
Peter	Bates	PJB Associates	Senior Partner	Ely	United Kingdom	pjb@pjb.co.uk	Both
Michael	O'Dwyer	Midlothian Council	Physics Teacher	Edinburgh	Midlothian	mkodwyer@talktalk.net	Both
Gunnar	Harboe	Motorola	Senior Research Engineer	Schaumburg	USA	gunnar.harboe@motorola.com	Both
Moira	Hughes	Edinburgh Napier University	Senior Lecturer	Edinburgh	Scotland	m.hughes@napier.ac.uk	Both
James	Gallagher	Edinburgh Napier University	lecturer	Edinburgh	UK	jim@napier.ac.uk	Both
Rodrigo	Laiola	CWI	Phd student	Amsterdam	The Netherlands	rlaiola@cwi.nl	1st
William	Cooper	informitv	Founder and Chief Executive	London	United Kingdom	william.cooper@informitv.com	Both
Phil	Darby	Napier University	Lecturer	Edinburgh	United Kingdom	p.darby@napier.ac.uk	Both
Jesus	Canduela	Edinburgh Napier University	Researcher	Edinburgh	United Kingdom	J.canduela@napier.ac.uk	1st
David	Bueno Vallejo	Universidad de Málaga	Associate Professor	Málaga	Spain	bueno@lcc.uma.es	Both
Tsai-Yen	Li	National Chengchi University	Professor	Taipei	Taiwan	li@nccu.edu.tw	1st
Bruce	Klopfenstein	University of Georgia	Professor	Athens, GA	USA	drbrucek@gmail.com	Both

Appendix 1(b) Delphi Study First Round Questionnaire

Delphi Forecasting - iTV

Page 1 - Contact Information

1. Please enter your contact information

First Name	
Surname	
Company	
Job Title	
City	
Country	
Email Address	

Page 2 - Future Growth of iTV

2. At the moment in terms of growth, the iTV market is possibly best described as in its infancy (in Product Life Cycle term). When do you think it might make it to adolescent phase (quick growth)?

- < 2 Years
- 2 - 5 Years
- 5 -10 Years
- > 10 Years
- Never

3. Currently the share of the ICT market attributed to iTV is considered to be less than 5%. What percentage do you think it might be in 5, 10 or 20 years? Please enter a numeric value for each year.

5 Years	
10 Years	
20 Years	

Page 3 - Inhibitors and Promotors of iTV

4. Rate the importance of drivers of iTV technology uptake

	Strong Inhibitor	Inhibitor	Neutral	Promotor	Strong Promotor
More Single People Therefore More Households					
Less Physically Active Population					
More Hedonistic Lifestyle					
Decreasing Price					
Increasing Quality					
Increasing Quantity					
Increasing Speed					
Simple and Easy to Use					
Improved Reliablity					
Improved Security					
More Opportunities of Television Commerce					
increase of Technology Rivals (i.e. WWW, WAP etc.)					
Reduced Economic Growth					
Reduced Political Stability					
Increase in the proportion of the population aged over 65					

Page 4 - Future of iTV

5. What do you think the main future inhibitors and promoters of iTV technology uptake will be?

Inhibitors	
Promoters	

6. Which services do you think will generate most of the growth for iTV? Please rank in order. (1 - biggest contributor to the growth).

Rank the following items using numbers from 1 to 6.

Text Services (e-mailing)	
Enhanced TV (Voting, Competitions, Quizzes, Sky Active)	
Bidding Games	
Downloads (books, flims, music etc.)	
Games	
Televison Commerce (Interactive Advertising, Banking, Retailing etc).	

Page 5 - Share of iTV Services

7. In 20 years time how big a share of the following will iTV services hold? Please enter a numeric value for each iTV service.

	iTV Share (%)
Communication i.e mail, live chat	
Post School Education	
Entertainment	
Games	
Advertising	
Retailing i.e. Food, Clothes, Books	
Financial Service i.e. Banking, Paying Bills	
Betting & Gambling	
News /Weather	
Travel Industry	

8. What platform do you think will be the dominant media provider for the following services?

	iTV	WWW	WAP	Face to Face / Communal	Catalogue	Other
Communication i.e mail, live chat						
Post School Education						
Entertainment						
Games						
Advertising						
Retailing i.e. Food, Clothes, Books						
Financial Service i.e. Banking, Paying Bills						
Betting & Gambling						
News /Weather						
Travel Industry						

Page 6 - Technology Convergence

9. Please indicate the likely future Market Share of iTV as a technology in 10 and 20 years time?

	Decrease	Stay Same	Slightly Increase	Increase
10 Years	☐	☐	☐	☐
20 Years	☐	☐	☐	☐

10. Do you think WWW, WAP and iTV will exhibit technological convergence?

	No	Likely	Very Much Likely
10 Years	☐	☐	☐
20 Years	☐	☐	☐

11. If you think there will be technological convergence which platform will they converge to?

- ○ WWW
- ○ WAP
- ○ iTV
- ○ Other

12. Generally what do you think the future of iTV will be?

Appendix 1(c) Delphi Study Second Round Questionnaire

Acceptance of Interactive Technology

Page 1 - Innovatiness

1. Your Gender

   ◯ Male ◯ Female

2. Your Age Group

   ◯ <20
   ◯ 20-29
   ◯ 30-39
   ◯ Over 40

3. How would you describe your individual innovatiness towards new technology

   ◯ Innovator- You are experimentalist who are generally interested in new innovation.
   ◯ Early Adopter- You are technically knowledgeable and interested in technology for resolving professional and academic problems.
   ◯ Early Majority - You are pragmatists, first mainstream of adopters
   ◯ Late Majority - You are less comfortable with adopting new innovation
   ◯ Laggard - You may never adopt new innovation.

4. State your level experience for the following interactive technologies

	iTV	WWW	WAP
None	☐	☐	☐
Less than 1 Year	☐	☐	☐
1 - 5 Years	☐	☐	☐
Over 5 Years	☐	☐	☐

Page 2 - Attitude

"Technology" is used as a generic name for the three leading technologies (WWW, WAP and iTV). Please when answer the questions by assess each statement for the three technologies.

5. Using the technology for *"gathering information is a pleasant experience"*. Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

6. Using the technology for *"purchasing items is a pleasant experience"*. Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

7. *"Using the technology enhances my effectivness in my life and work style"*. Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

8. *"The services provided by the technology is useful in my work and life style"*. Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

Page 3 - Attitude Cont..

9. *"Interacting with technology services does not require a lot of my mental effort."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

10. *"My interaction with technology services is clear and understandable."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

11. *"Using the technology services provides more pleasure than just watching TV program."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

12. *"I think that using the technology services fits well with the way i like to shop or seek information."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

Page 4 - Social Influences

13. *"People who I look up to expect me to use the technology services."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	◯	◯	◯	◯	◯
WAP	◯	◯	◯	◯	◯
iTV	◯	◯	◯	◯	◯

14. *"My Family / Friends think that I should use the technology services."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	◯	◯	◯	◯	◯
WAP	◯	◯	◯	◯	◯
iTV	◯	◯	◯	◯	◯

15. *"The mass media adopts a positive view towards using the technology services".* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	◯	◯	◯	◯	◯
WAP	◯	◯	◯	◯	◯
iTV	◯	◯	◯	◯	◯

16. *"Mass media reports have influenced me to try the technology services."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	◯	◯	◯	◯	◯
WAP	◯	◯	◯	◯	◯
iTV	◯	◯	◯	◯	◯

17. *"The reducing economy prevents me using the technology services to avoid cost."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	◯	◯	◯	◯	◯
WAP	◯	◯	◯	◯	◯
iTV	◯	◯	◯	◯	◯

18. *"Digital and Technical Policies prevent me adopting the technology".* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	◯	◯	◯	◯	◯
WAP	◯	◯	◯	◯	◯
iTV	◯	◯	◯	◯	◯

Page 5 - Perceived Behavioural Control

19. *"I am able to use the technology without any help"*. Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

20. *"Using the technology is entirely within my control"*. Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

21. *"I am confident of using the technology even if I have never used the functionality before."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

22. *"The goverment encourgaes users to adopt the technology services"*. Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

23. *"The Technology and Service Providers actively promote their services"*. Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

24. *"I recieve enough information about the technology services available to me."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

Page 6 - Technological Factors

25. *"Technological issues with the technology is a major barrier for me to adopt the services."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

26. *"There are many finanical barriers to use the technology, i.e. Equipment, BT line etc."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

27. *"I can access the technology services any time via the associated media i.e. ITV -Digital box, WWW- Compter, WAP- Mobile Phone."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

28. *"I am gratified with the technology capability that offers real time content and services in a ubiquitous basis."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

29. *"The use of the Technology becomes easily obselete."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

30. *"Other technology rivals emerge to provide better quality and accessilibility to services."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

31. *"Technology convergence innovations provide more and better services compared to the technology"*. Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW					
WAP					
iTV					

Page 7 - Quality

32. *"The technology provides complete product and service information."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW					
WAP					
iTV					

33. *"The technology has good functionality relevant to product and information type."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW					
WAP					
iTV					

34. *"Reliability influences my decision to use the technology"*. Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW					
WAP					
iTV					

35. *"The technology services provide good privacy protection while using iTV."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW					
WAP					
iTV					

Page 8 - Risk & User Intention

36. *"I think using the technology in monetary transactions has a potential risk".* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW					
WAP					
iTV					

37. *"I think using the technology puts my privacy at risk."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW					
WAP					
iTV					

38. *"The technology services keeps its promises and commitments."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW					
WAP					
iTV					

39. *"The technology services are trustworthy."* Please state your strength of agreement for each technology

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW					
WAP					
iTV					

40. *"I do not feel secure providing credit card details over the technology".* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW					
WAP					
iTV					

41. *"Assuming i have access to the technology, i intend to use it frequently."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW					
WAP					
iTV					

42. *"In future, i plan to use the technology often."* Please state your strength of agreement for each technology.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW					
WAP					
iTV					

Appendix 2 Cross Cultural Study

Appendix 2(A) Cross Cultural Study Questionnaire

Glossary

ITV Interactive Television is TV with interactive content and Enhancements. Interactive Television provides richer entertainment, Interaction and more information pertaining to the shows, props and people involved in its creation. In a sense, it combines traditional TV viewing with the interactivity enjoyed by those communicating through a network, such as the WWW.

WAP Wireless Application Protocol, standard for accessing the WWW with wireless devices, e.g. mobile phones.

WWW World Wide Web - An easy-to-use hypertext document system developed for the WWW allowing users to access multimedia documents.

Catalogue Catalogue, a publication (paper based) such as book, pamphlets containing a list of items.

Section 1 - Demographic Section

1.1 What is your gender? (Mark ☑ ONE box)

Male ☐

Female ☐

1.2 What is your Age Group? (Mark ☑ ONE box)

<15	☐	15 –20	☐
21-30	☐	31-40	☐
41-60	☐	>60	☐

1.3. In your household please list: (Print number as applicable)

(a). Total Number of occupants: ☐

(b). Number of pre-teenagers: ☐

(c). Number of teenagers: ☐

(d). Number of adults: ☐

1.4 What is your marital status? (Mark ☑ ONE box)

Married ☐

Widowed ☐

Divorced ☐

Separated ☐

Single ☐

1.5 What is your housing status? Are you (Mark ☑ ONE box)

Living Alone ☐

Living with Partner ☐

Living with Parents ☐

Sharing ☐

Other ☐

If other please print your status ……………………………..

1.6 What is your Ethnic origin? (Mark ☑ ONE box)

White ☐

Black -Caribbean ☐

Black- African ☐

Black – Other ☐

Indian ☐

Pakistani ☐

Bangladeshi ☐

Chinese ☐

Other ☐

If other please print your Ethnic origin………………………

Section 2: Education

2.1 What is your highest qualification? (Mark ☑ ONE box)

None ☐

O' Grades/Standard Grades/GCSE ☐

NCVQ/Scotvec ☐

A'Levels/ Highers ☐

NC/HNC/HND ☐

Degree ☐

Masters/Professional ☐

PhD ☐

Section 3: Employment & Income

3.1 What is your main Occupation? (Print name of Occupation)

……………………………………………………………………….

3.2 How many hours a week do you work?
(Print number of hours) ☐

3.3 What is your annual Income? (Mark ☑ ONE box)

< £9999 ☐

£10000 - £14999 ☐

£15000 - £19999 ☐

£20000 - £24999 ☐

£25000 - £29999 ☐

£30000 - £34999 ☐

£35000 - £39999 ☐

>£40000 ☐

How many jobs do you hold? (Print number of Jobs) ☐

Section 4: Social Interactions

4.1 How many hours do you typically spend watching TV per week?
(Print number of hours)

4.2 How many hours do you spend socializing with Friends/Family per week? (Print number of hours)

4.3 How many hours do you spend reading for leisure per week?
(Print number of hours)

4.4 How many hours do you spend playing games per week?
(Print number of hours)

4.5 If applicable, how many hours do you spend studying per week?
(Print number of hours)

4.6 How many hours do you spend shopping in traditional methods per week? i.e. Outdoor shopping, shopping malls? (Print number of hours)

4.7 Do you gamble? (Mark ☑ ONE box which best fits your experience)

Never	Occasionally	Sometimes	Most of the time	All the time

Section 5: Technology Interaction

5.1 What Telecommunications Technology do you have in your household? (Print the number of quantity)

Telecommunication	Quantity
TV/Video/DVD	
Sky Digital /Sky Plus	
Computer/WWW	
Fax Machine	
Land line Phone	
Mobile	
Mobile with WAP	

5.2 How much knowledge do you have of the following technologies?

Technologies	Low	Below average	Average	Above average	High
WWW					
WAP					
iTV					

5.3 How often do you use the following technologies?

Technologies	Never	Occasionally	Sometimes	Most of the time	All the time
WWW					
WAP					
iTV					

5.4 How confident are you using the following technologies?

Technologies	Not at all	Very little	Somewhat	Quite	Extremely
WWW					
WAP					
iTV					

5.5 What method do you currently use to do different types of shopping? (Please select from the following methods and print abbreviation in the method column)

Abbreviation

I	=	WWW
P	=	Phone (Land Line)
W	=	WAP (Mobile)
ITV	=	ITV
C	=	Catalogue (Paper-based)

Shopping	Method
Clothes/Food	
Entertainment i.e. Cinema	
Music/CD/Books	
Adult Entertainment	
Holidays	
Prestige Products i.e. Cars/Jewellery	
Electronic Goods	
Financial Products	
Games	
Education/ General Information	
Betting	
E-mail	
SMS – Messaging Service	
General News	
Sport News	
Paying Bills/Bank Transactions	
Bank	
Weather	
Customer Services/ Customer care	
Product Information	

5.6 Which of following methods do you use to pay bills? (Enter your choice for each method: most likely (1) - least likely (7))

- Phone ☐
- Post ☐
- Post Office ☐
- Bank ☐
- WWW ☐
- WAP ☐
- ITV ☐

If you have not used the following please state why?

WWW--

WAP ---

ITV--

If you use the WWW please fill in the following. If you have never used the WWW then please go to 5.11.

5.8 Do you feel WWW has the following features?

Attribute	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Quick					
Easy to Use					
Cheap					
Reliable					
Secure					
Content quality					
Content quantity					

5.9 Why do you prefer using the WWW?

Attribute	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Find something unique					
Cheaper					
Greater Variety					
More secure					
Convenience					

5.10 Have you used any of the following technologies to make transactions? (Tick ☑ boxes as applicable)

WAP Yes ☐ No ☐

iTV Yes ☐ No ☐

If other please state ……………………………………..

If you use the WAP please fill in the following if you have never used WAP then please go to 5.15.

5.11 Do you feel WAP has the following features?

Attribute	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Quick					
Easy to Use					
Cheap					
Reliable					
Secure					
Content quality					
Content quantity					

5.12 Why do you use WAP?

Attribute	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Find something unique					
Cheaper					
Greater Variety					
More secure					
Convenience					

5.13 If you use the iTV please fill in the following; if you have never used iTV then please go to Section 6.

5.13 Do you feel iTV has the following features?

Attributes	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Quick					
Easy to Use					
Cheap					
Reliable					
Secure					
Content quality					
Content quantity					

5.14 Why do you use the iTV?

Attribute	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Find something unique					
Cheaper					
Greater Variety					
More secure					
Convenience					

Section 6: Communication

6.1 What is your preferred method of communication? (Mark ☑ ONE box for communication method 1 Most Preferred – 5 Least Preferred)

Communication Method	1	2	3	4	5
Web Email					
Fax					
Phone					
SMS					
ITV Email					
Letter					

6.2 What do you think the main communication device of the future is going to be? Please order each of the following six options from most likely (1) to least likely (6), enter number in boxes below (1 –6).

TV ☐

Mobile ☐

Computer ☐

Phone ☐

Fax ☐

Letter ☐

6.3 What would you like the future communication device to be like?

Section 7: Future

7.1 What do you think the main communication / purchase methods be in five years time, for the following: (Please select from the following methods and print abbreviation in the method column)

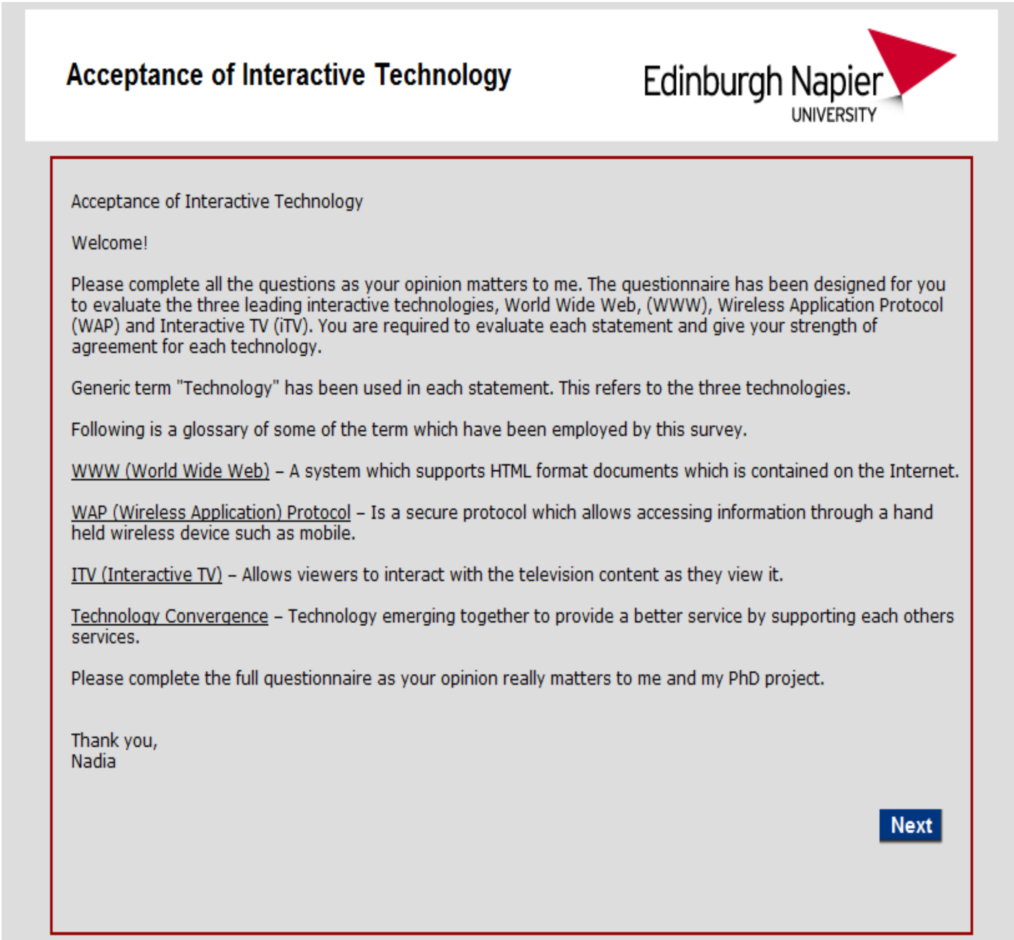
Abbreviation

I	=	WWW
P	=	Phone (Land Line)
W	=	WAP (Mobile)
ITV	=	ITV
C	=	Catalogue (Paper-based)

Shopping	Method
Clothes	
Food	
Entertainment i.e. Cinema	
CD/Books	
Holidays	
Adult Entertainment	
Music	
Jewellery	
Prestige Products i.e. Cars/Jewellery	
Electronic Goods	
Financial Products	
Games	
Education	
Betting	
General Information	
E-mail	
SMS – Messaging Service	
General News	
Sport News	
Paying Bills	
Bank Transactions	
Weather	
Customer Services/ Customer care	
Product Information	

Appendix 3 Technology Acceptance Study

Appendix 3(A) Technology Acceptance Study Questionnaire



Acceptance of Interactive Technology

Edinburgh Napier UNIVERSITY

Acceptance of Interactive Technology

Welcome!

Please complete all the questions as your opinion matters to me. The questionnaire has been designed for you to evaluate the three leading interactive technologies, World Wide Web, (WWW), Wireless Application Protocol (WAP) and Interactive TV (iTV). You are required to evaluate each statement and give your strength of agreement for each technology.

Generic term "Technology" has been used in each statement. This refers to the three technologies.

Following is a glossary of some of the term which have been employed by this survey.

WWW (World Wide Web) – A system which supports HTML format documents which is contained on the Internet.

WAP (Wireless Application) Protocol – Is a secure protocol which allows accessing information through a hand held wireless device such as mobile.

ITV (Interactive TV) – Allows viewers to interact with the television content as they view it.

Technology Convergence – Technology emerging together to provide a better service by supporting each others services.

Please complete the full questionnaire as your opinion really matters to me and my PhD project.

Thank you,
Nadia

Next

Acceptance of Interactive Technology

* 1. **Your Gender**

- Male
- Female

* 2. **Your Age Group**

- <20
- 20-29
- 30-39
- Over 40

3. **How would you describe your individual innovatiness towards new technology**

- Innovator- You are experimentalist who are generally interested in new innovation.
- Early Adopter- You are technically knowledgeable and interested in technology for resolving professional and academic problems.
- Early Majority - You are pragmatists, first mainstream of adopters
- Late Majority - You are less comfortable with adopting new innovation
- Laggard - You may never adopt new innovation.

4. **State your level experience for the following interactive technologies**

	ITV	WWW	WAP
None	☐	☐	☐
Less than 1 Year	☐	☐	☐
1 - 5 Years	☐	☐	☐
Over 5 Years	☐	☐	☐

"Technology" is used as a generic name for the three leading technologies (WWW, WAP and ITV). Please when answer the questions by assess each statement for the three technologies.

5. **Using the technology for "*gathering information is a pleasant experience*". Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
ITV	○	○	○	○	○

6. **Using the technology for "*purchasing items is a pleasant experience*". Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
ITV	○	○	○	○	○

7. ***"Using the technology enhances my effectivness in my life and work style"*. Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
ITV	○	○	○	○	○

* 8. ***"The services provided by the technology is useful in my work and life style"*. Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
ITV	○	○	○	○	○

* 9. ***"Interacting with technology services does not require a lot of my mental effort."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	O	O	O	O	O
WAP	O	O	O	O	O
iTV	O	O	O	O	O

* 10. ***"My interaction with technology services is clear and understandable."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	O	O	O	O	O
WAP	O	O	O	O	O
iTV	O	O	O	O	O

* 11. ***"Using the technology services provides more pleasure than just watching TV program."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	O	O	O	O	O
WAP	O	O	O	O	O
iTV	O	O	O	O	O

* 12. ***"I think that using the technology services fits well with the way i like to shop or seek information."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	O	O	O	O	O
WAP	O	O	O	O	O
iTV	O	O	O	O	O

* 13. ***"People who i look up to expect me to use the technology services."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 14. ***"My Family / Friends think that i should use the technology services."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 15. ***"The mass media adopts a positive view towards using the technology services".*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 16. ***"Mass media reports have influenced me to try the technology services."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 17. ***"The reducing economy prevents me using the technology services to avoid cost."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 18. ***"Digital and Technical Policies prevent me adopting the technology".*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 19. ***"I am able to use the technology without any help"*. Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

20. ***"Using the technology is entirely within my control"*. Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 21. ***"I am confident of using the technology even if i have never used the functionality before."* Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 22. ***"The goverment encourgaes users to adopt the technology services"*. Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 23. ***"The Technology and Service Providers actively promote their services"*. Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 24. ***"I recieve enough information about the technology services available to me."* Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 25. ***"Technological issues with the technology is a major barrier for me to adopt the services."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 26. ***"There are many finanical barriers to use the technology, i.e. Equipment, BT line etc."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 27. ***"I can access the technology services any time via the associated media i.e. iTV -Digital box, WWW- Compter, WAP- Mobile Phone."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 28. ***"I am gratified with the technology capability that offers real time content and services in a ubiquitous basis."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 29. ***"The use of the Technology becomes easily obselete."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 30. ***"Other technology rivals emerge to provide better quality and accessilibility to services."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 31. ***"Technology convergence innovations provide more and better services compared to the technology".*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 32. ***"The technology provides complete product and service information."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 33. ***"The technology has good functionality relevant to product and information type."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 34. ***"Reliability influences my decision to use the technology".*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 35. ***"The technology services provide good privacy protection while using iTV."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 36. ***"I think using the technology in monetary transactions has a potential risk"***. **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 37. ***"I think using the technology puts my privacy at risk."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 38. ***"The technology services keeps its promises and commitments."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 39. ***"The technology services are trustworthy."*** **Please state your strength of agreement for each technology**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 40. ***"I do not feel secure providing credit card details over the technology"***. **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 41. ***"Assuming i have access to the technology, i intend to use it frequently."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○

* 42. ***"In future, i plan to use the technology often."*** **Please state your strength of agreement for each technology.**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
WWW	○	○	○	○	○
WAP	○	○	○	○	○
iTV	○	○	○	○	○