Fast diffusion and broadening use

A research on residential adoption and usage of broadband internet in the Netherlands between 2001 and 2005

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A research on residential adoption and usage of broadband internet in the Netherlands between 2001 and 2005

Snelle diffusie en breder gebruik

Een onderzoek naar residentiele adoptie en gebruik van breedband in Nederland tussen 2001 en 2005

(met een samenvatting in het Nederlands)

Proefschrift

ter verkrijging van de graad van doctor aan de Universiteit Utrecht op gezag van de rector magnificus, prof.dr. J.C. Stoof, ingevolge het besluit van het college voor promoties in het openbaar te verdedigen op dinsdag 20 november 2007 des middags te 12.45 uur

door

Karianne Vermaas

geboren op 5 november 1976 te Hengelo (O)

Promotor: prof. dr. S. Brinkkemper

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Contents

Preface

Writing a dissertation is different from what I expected when I started about four years ago. At times it seemed much easier than I could imagine and I very much enjoyed putting the pieces together for each paper and of course the thrill each time a paper or proposal was accepted. But at other times it was more frustrating and tougher than expected. But as I was told reassuringly, this is a process that every PhD student goes through at some point. Now that it is finished, I find it hard to let go and I am already thinking of new research and papers to write.

Of course this dissertation would never have been completed if it wasn't for some very important help, understanding and support of a number of people. First of all, Lidwien van de Wijngaert, who did not try to get me into a straitjacket, let me find my own ways of doing things. Thank you for this and many other things! I enjoyed doing research together and I hope we will continue our collaboration. Also, at Utrecht University prof. dr. Sjaak Brinkkemper was important for completing this dissertation. He made sure I had all the facilities and conditions I needed to complete my work and he gave me an inspirational pep talk when I needed it. Especially in the last months of the research he made important contributions.
Furthermore, I want to thank all my colleagues at Dialogic, especially Sven Maltha. I sometimes had the feeling that I had stolen your project. Not because you deliberately made me feel that way. On the contrary, you always seem proud that this project had made it this far. In addition, I want to thank Christiaan Holland, Pim den Hertog, Rob Bilderbeek and (again) Sven Malha, the founders of Dialogic, and Frank Bongers very much for this opportunity, your support and contributions to this dissertation. I really appreciate it!
Also a thank you to the organisations that made this research possible: The ministry of Economic Affairs, KPN, The cities of Amsterdam and Almere, Vecai, Nederland Breed and Ex'ovision.
As a PhD student and very close friend Marieke Fijnvandraat knew what I was going through. We shared all the good and bad times a PhD student goes through. The many, many phone calls, msn talks, e-mails, e-cards and diners and drinks at Lust always worked out in a good way, PhD and friendship wise. Thanks, LS!
It felt good to have people around me, that no matter what I did or did not do, were proud of me, like my parents, brother Marnix and grandparents. The one person that would have been most proud of me for completing this work is my grandfather. Unfortunately, he passed away in 2006, but the last words he said to me were about the importance of finishing this PhD thesis.
Last but not least I want to thank Forrest Mars sr. for creating M&M's in 1940. Every time some serious thinking or writing had

to be done, I devoured a family pack of M&M's for comfort and inspiration.
The last thing I want to say about this research here is that the good and nice, but at the same time tough thing about the subject, is that everybody knows (or at least have the impression to know) what they are talking about when discussing the development of the usage of broadband. Everybody knows examples: his own usage experiences, those of aunt Annie, uncle Jos etcetera. I am proud to say that, since March 2007 I can also talk about it from my own experience as I also became a residential broadband user this year....

Karianne Vermaas, November 2007

Chapter 1

The fast diffusion and broadening use of broadband

In the Netherlands the Ministry of Economic Affairs has stated its aim that the Netherlands should be ahead of the world with regard to broadband developments. The Dutch government further argues that broadband can substantially help to strengthen the economy and solve societal problems for example in health care. For this reason the Dutch government issued a Broadband Paper, "the importance of a swift implementation and better use" (2004). In this paper the government expresses its ambition and policy for broadband, based on the drive for structural economic growth. The Broadband Impulse Committee subsequently identified how broadband services could be developed in a durable way (Maltha & Zegveld, 2004). These services are vital and the government acknowledges that although infrastructure is the basis, this is just one side of the coin. The development of services and usage of the infrastructure are considered to be equally important. Just like non-digital infrastructures such as highways, broadband infrastructure is made to be used by large amounts of people. Without the usage of services, infrastructures would resemble empty highways. Moreover, the infrastructure would not be able to recover its investments.

When this research project began in 2001, the developments in broadband adoption and usage were uncertain and the burning question was whether these new infrastructures would ever be used by organizations and end users. The current developments with regard to broadband have proven to be rapid in the Netherlands and the situation is constantly changing. In several cities in the Netherlands such as Amersfoort, Eindhoven, Deventer, Amsterdam and Almere, people have or will soon have access to broadband, more specifically fast fibre connections to their homes. Moreover, when the final surveys for this research took place in 2005, the Netherlands had the second highest broadband penetration of all OECD countries at 22.5 subscribers per 100 inhabitants (OECD, 2005). This rapid diffusion process makes the Netherlands an interesting case for other countries, because some steps that other countries still have to go through have already been taken by Dutch broadband users.

In many cases research into the adoption of broadband is driven by technology. End users of broadband, however, also play an important role in enabling us to gain insight into the adoption and

usage process. So instead of focusing on the technology itself, the *residential internet user* is the main object of study in this research.

In this chapter we will first present the research area in order to give the reader an idea of the broadband domain in which this research took place. The chapter contains the definition for broadband, as well as broadband penetration and usage figures in the Netherlands as these figures are significant for interpreting the results. The actors in the broadband field and their roles are also presented. It is important to know who the major actors are, because this research has relevance for each of them. Subsequently, this chapter will discuss why the user perspective has been chosen in order to study the adoption and usage of broadband. This is followed by a typology of broadband internet functions.
After the research area and the user perspective are described, this chapter goes on to provide the research goals, questions approach and methodology. Finally, the outline of the thesis is presented.

1.1. Research Area - From Internet to Broadband Internet

The developments in broadband have been fast. This becomes apparent when we compare the situation in the Nineties with the current situation. In the Nineties, looking for information on the internet was restricted to a small group of people. Nowadays, the sound of traditional modems, familiar to most people, is becoming more and more extinct. In many households in the Netherlands there seems to be a computer constantly connected to the internet, ready to provide information on all sorts of things or to facilitate communication with other people who are online. Like the developments of broadband usage and roll out, the definition of broadband is shifting. This is why we will explain in this section what is meant by broadband in our research.

1.1.1. Broadband internet

Before presenting results, it is important to get an understanding of what we mean by broadband in this research. Since the Internet was made available to the public in the late Eighties and early Nineties through the World Wide Web, people have been able to go online with modems in combination with an analogue telephone line.
When this research began in 2001, the internet domain was dominated by numerous and fast developments. In previous years there had been boundless faith in technology involving many large investments. While many e-business models were being developed, broadband technology itself was also progressing. Various kinds of infrastructure were introduced at a swift pace. First of all in the late Eighties, Integrated Services Digital Network (ISDN) was introduced as a broadband infrastructure with many possibilities

over and above using the internet via a traditional modem and telephone line. When people were only experimenting with the internet via this infrastructure, another infrastructure was already available: cable. It was cable by which the 'always on' concept was introduced (direct connection at any time; there is no need to dial up). Also, in the same period Asymmetric Digital Subscriber Line (ADSL) was introduced in the Netherlands. This is how the broadband market in the Netherlands came into being and at the moment fibre optics (Fibre to the Home) can be counted as another internet infrastructure with even more possibilities.

Broadband can be defined by exact speeds or bandwidth over which information is transported (in Kbps or Mbps) or it can be defined by the services that it makes possible to use, like downloading music and films (Dijk, Minne, Mulder, Poort & Wiel, 2005). Hence, the definitions of broadband are not always exactly the same and perhaps more importantly, views change over time. What is broadband today will be midband tomorrow (Dijk et al., 2005).
As we do not focus on the technology itself, certain properties are given to distinguish broadband from the traditional 'Dial-up connection' to the research by for example Savage and Waldman (2004) and the OECD (2003). In this research the term narrowband is used for any connection that is established through dial-up access (traditional modems and an analogue telephone line). Therefore the public switched telephone network (PSTN) and also ISDN connections are considered narrowband. Two main features of broadband Internet are 'flat fee' and 'always on'. 'Flat fee' means that the subscribers pay a fixed amount of money per month, regardless of the actual time spent online, as opposed to dial-up access, where people pay per time-unit that they are connected. The definition for broadband that is used in this work is an adopted version of the definition of the Dutch Broadband Expert Group (2002): "*broadband is a connection that is 'always-on', has a "flat fee" and is suitable for good quality video and audio applications and for exchanging extensive data files.*" Based on these characteristics, ADSL, cable and fibre optics are considered broadband in this research.
The focus in this research, thus, is on fixed networks. Wireless connections with a broadband (cable, ADSL) backbone have been taken into account, albeit marginally. Mobile broadband connections such as GPRS and UMTS are not mentioned, because in 2001 when this research began, such connections were not (widely) available. Furthermore, mobile broadband connections on other devices than PC's and laptops may have such different adoption characteristics and consequently different use, that we have chosen to leave these out of the scope of this research.

1.1.2. Penetration and usage figures in the Netherlands

After determining that cable, ADSL and fibre optics are considered broadband, we now turn our attention to broadband penetration

and usage figures in the Netherlands. This is important information as it enables us to determine the state of broadband adoption in the Netherlands, thereby providing indications for the interpretation of the results. In countries that are still in the early stages of broadband adoption, the patterns of adoption and use may not have crystallised yet and therefore may not provide as much insight as countries in later adoption stages.

In 2001 the number of broadband subscriptions in the Netherlands was not overwhelming, with fewer than 4 subscribers per 100 inhabitants. By 2005 however, this figure had increased and broadband became a generally accepted infrastructure by Dutch households. According to OECD figures on broadband penetration between 2001 and 2005, the penetration of broadband in the Netherlands has made rapid progress (*Figure 1*). Korea maintains its lead in OECD broadband penetration, with 25.5 subscribers per 100 inhabitants, but the Netherlands has the second-highest penetration at 22.5 subscribers per 100 inhabitants (2005). In 2006, after the data collection of this research had already been completed, the number of subscribers rose to 28.8 (OECD, 2006). This rapid adoption process makes the Netherlands an interesting case for other countries as research on the Dutch situation can provide insight into the aspects that had a positive influence on adoption.

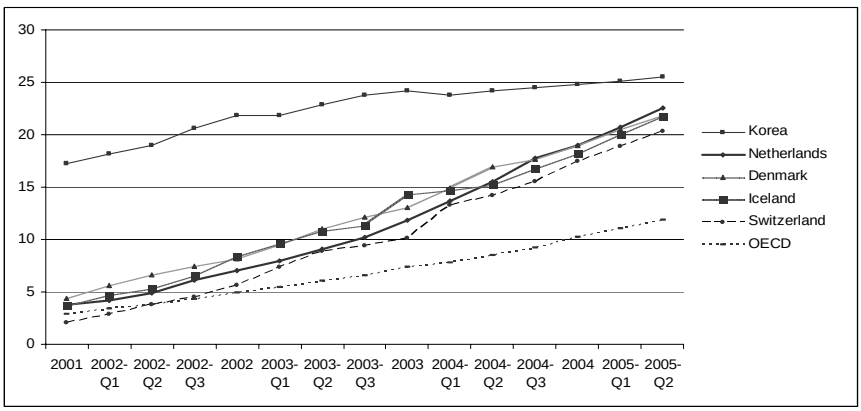


Figure 1 Broadband penetration. Historic top five OECD countries for June 2005 (OECD)

Other details on broadband penetration in Dutch households are provided by Dutch Statistics (CBS). They also found a considerable increase in broadband connections. According to their figures, 55 percent of Dutch households had a broadband connection in 2005. Three years earlier it was only 13 percent (CBS, 2005).

People not only have a subscription to a broadband connection, they also use it. The immense increase in data traffic over the (broadband) internet becomes apparent if you look at the Amsterdam Internet Exchange (AMS-IX), which is the central internet exchange in the Netherlands. A substantial part of the

internet traffic with other countries and between Dutch internet providers is processed through the AMS-IX network. From the usage statistics we see a substantial increase in the amount of gigabytes that go through the AMS-IX.
Figure 2 shows how internet traffic passing through the AMS-IX grew. In 2001 the incoming and outgoing bits were growing, but limited to 6.0 gigabit per second.

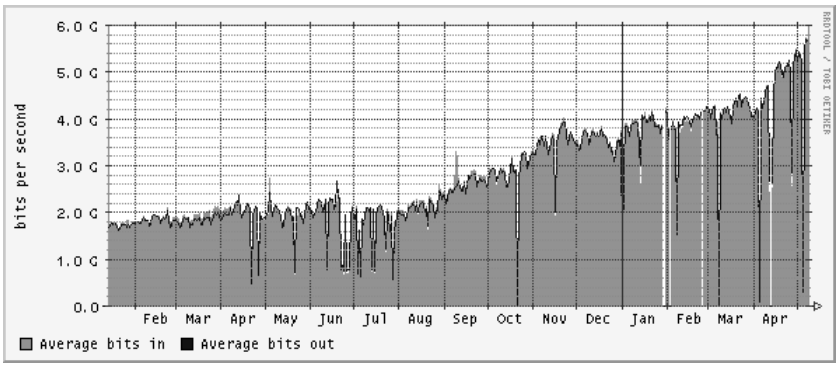


Figure 2 Growth in capacity on the Amsterdam Internet Exchange in the period January 2001 - May 2002. Source: www.ams-ix.org, 8 May 2002

At the end of 2006 and the beginning of 2007, the picture changes even more dramatically. A completely different scale is needed to express the internet traffic. More than 100 gigabits per second were processed compared to the maximum of 6.0 gigabit per second in 2001 (see figure 3). In 2005 the AMS-IX was the first internet exchange in the world to reach a speed of 100 gigabit per second (AMS-IX, 2005). These figures could not have been obtained if the broadband market had not expanded so extensively in the Netherlands in recent years.

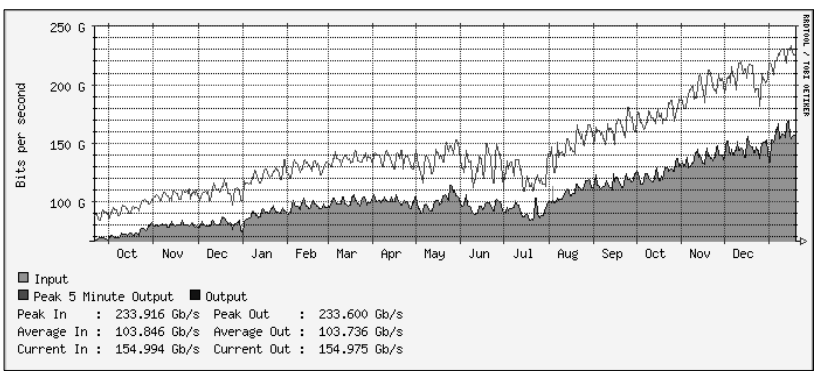


Figure 3 Growth in capacity on the Amsterdam Internet Exchange in the period October 2005 – December 2006. Source: www.ams-ix.org, 20th of January 2007.

1.1.3. Actors and their roles

In the previous sections we identified that broadband is developing and its adoption and usage are growing in the Netherlands. The question now is which actors are involved in the development of broadband, because the results of this research are of interest for these actors as will be explained in 1.3 (*Relevance for policy and businesses*). We identify three main actors in the development of broadband: national and local governments, Internet Providers (Access, Service and Content) and end users.

Government

Like the Ministry of Economic Affairs, various Dutch cities and provinces share the ambition to be ahead of the world with regard to broadband in 2010. But despite the wide availability of cable and ADSL connections, the Netherlands is lagging behind other countries in the provision and use of public and commercial broadband applications (Maltha & Zegveld, 2004). On the one hand, there will be no service development if there is no infrastructure. On the other hand, investments in infrastructure must offer some prospect of profitable services. To prevent the chicken-egg impasse from prevailing, the government was advised by the Broadband Impulse Committee (Maltha & Zegveld, 2004) to encourage private investment in infrastructure as well as service development. Broadband can play an important role in improving the quality and effectiveness of service provision in public sectors (health care, education, security and mobility),. The strategy the Committee suggests is one in which the government and the market unite to elaborate on durable development towards a next generation of electronic infrastructure and services. The Committee further argues that a programmatic approach is needed as well as specific pilot projects in order to create the right conditions for new national applications. The success of the next step in the process will depend on the commitment and a financial impulse from the government (resulting in 80 million euros for the Action Programme Public Sectors and ICT). However, the government has been advised to continue pursuing a technology-independent policy, in which the primary responsibility for investments in new infrastructure such as broadband and services lies with the market. The government has a stimulating and facilitating role in the roll-out of broadband.

Dutch cities and provinces can also play different facilitating and initiating roles in the roll-out of broadband infrastructure and service development, for example as an investor, as a guarantee, as a party to bundle the demand of end users, as a booster for service development, as a service provider, and as a launching customer.

Internet Access, Service and Content Providers

An Internet Access Provider (IAP) is an organisation that allows people and organisations to connect their computers to the internet. They employ a range of technologies to enable customers

to connect to their network. For residential users, the most popular options include dial-up, ADSL, cable, and ISDN, while fibre optics are on the move. But this connection to the internet itself is not enough to offer end users the possibility to actually use their internet connection at home. For that, Internet Service Providers (ISP) are needed. These organisations make services available such as the World Wide Web and FTP (File Transfer Protocol). Also, in many cases they give access to email or 'triple play' (Radio/television, telephony and internet). The fact that more and more Access Providers also offer services makes it harder to distinguish between the two. New service providers are found among construction companies and housing corporations. The third chain is formed by Internet Content Providers (ICP). They offer products and services on the internet. Content providers focus on the actual content of services, whereas IAPs and ISPs focus on offering internet access.

End users

ISPs and ICPs are connected to end users by services. The providers offer (among other services) broadband services to the end user. Without end users there would be no need for an infrastructure such as broadband. For example, in order to be able to use broadband services to the advantage of health, telework, education and personal and public safety, a large part of the Dutch population has to have and use a broadband connection.

We can of course think of many end users of broadband, for example corporate and organizational users. The internet users in this research, however, are residential users, with different needs which they try to gratify by going online: from people looking for online entertainment to patients looking for online health information. In the next section we explain why it is important to maintain a user perspective when investigating the adoption and usage of new technologies such as broadband.

1.2. The user perspective

Much research into the adoption of innovations and new technologies focuses on the technological aspects of the new technology or innovation. Strengthened by the findings of for example Goldenberg et al. (2001), who found that the technical attributes of inventions predict their financial success, but the focus remains on the technological aspects. One limitation of studies like the one of Goldenberg, however, is that only those innovations which successfully reached the market are considered. Unsuccessful and discontinued innovations were not taken into account, which might have shone more light on the importance of the demand side, because part of the reason why innovations fail is lack of demand. Like Nelson (1959) already did at an early stage, we

acknowledge that supply and demand together determine expected profits and adoption.
With regard to broadband, in the first years after its introduction, a lot of research was also focused on the technological possibilities of this innovation (Davis, 1998; Monro, Bennett, Broderick, Richardson, 2000; Spruijt et al., 2001; Nilsson, 2001). The year 2001 was the moment to consider the party that had been overlooked for such a long time: the user of the infrastructure. Infrastructures were not developed to only serve the business market, but also the consumer market. What does the user do online, what does he want, how does he see the future of broadband, what are his expectations and needs? Until 2001 these questions had not been truly investigated with regard to broadband, but since 2001, the notion of the importance of the user has been recognized more and more. For example, the Broadband Expert Group (2002) and the Broadband Impulse Committee identified the importance of user demand (Maltha & Zegveld, 2004): "Today, digital development is almost entirely driven by demand from the consumer market." In order to get broadband developments moving and break through the existing vicious circle (no infrastructure, no possibilities for services, no services, no need for infrastructure) the Broadband Expert Group (2002) suggested a broadband flywheel, where the emphasis is on the user rather than the provider (*Figure 4*).

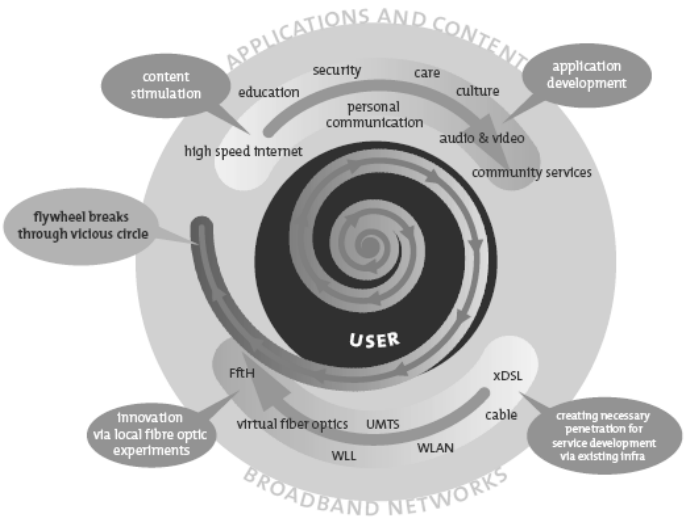


Figure 4 Driving the Broadband Flywheel. Source: Broadband Expert Group (2002)

From a theoretical point of view, the role of users of innovations is also considered to be important. In literature, addressing the concept of diffusion and adoption of technological innovations is seen as dependent on one's innovativeness, or willingness to try

new products (Rogers, 1995; Atkin, et al., 1998; Neuendorf, et al., 1998). According to Rogers (1995), the diffusion of innovations is 'the process by which an innovation (new idea) is communicated through certain channels over time among the members of a social system' and 'an innovation' is an idea, practice, or object that is perceived as new by an individual or another unit of adoption. He further regards 'innovativeness' as 'the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of a system'. From a Uses and Gratifications point of view, Katz, Blumler and Gurevitch (1974) stress the need for researchers to examine individuals' needs and behaviours to more completely understand what media contributes to "creation and satisfaction". Urban, & Von Hippel (1988) and Von Hippel (2005) also acknowledge the importance of studying needs and solutions from (lead) users.
Additionally, the theory of Social Construction of Technology (SCOT, Pinch & Bijker, 1984) claims the importance of the user. This theory implies that technology does not determine human behaviour, but that rather, human behaviour shapes technology. It also argues that the ways in which technology are used cannot be understood without understanding how that technology is embedded in its social context. In order to understand the reasons for adoption of a technology, the social world is crucial.

The above make it clear that the individuals who are to adopt (or reject) the innovation play a crucial role in the diffusion process. It is therefore important to study the adoption and usage process from a user perspective. But despite the fact that many service providers, network operators and researchers claim to maintain such a user perspective, a lot of research and service development is still inherently technology driven. By maintaining a technology driven approach, technology development does not address the question of whether people actually need that technology and whether they are using it. So instead of looking at what technology can do for people, this research puts user behaviour, wishes, and frustrations into a daily context as a starting point in order to find out how people adopt and use broadband. Especially in the domain of broadband adoption there is little scientific research from a user perspective. Although such research has been conducted for example in the UK (Choudrie & Dwivedi, 2004; Anderson, 2004), in the Netherlands it is less frequently performed. This urges the need for such research in which the adoption and usage of broadband is studied from a user perspective.

In this work we speak specifically of the *users* of broadband. According to Rice (1997) there is a difference between 'consumers' and 'users'. Consumers are those who pay for services and goods, whilst users are individuals who are affected by or who affect the product or services. In other words, the users are those who use the product and services but do not pay for it (Rice, 1997). For

example, a child can be categorised as a user since he/she uses broadband for online gaming and to undertake homework; however, the child does not pay for the service. In contrast, the parents are consumers since they pay for the service. In this research both the paying users as well as the non-paying users are involved. Furthermore, we note that broadband users or potential broadband users are hard to identify as one group. It is likely that different users have different reasons to adopt broadband. For example, people with a medical condition may use broadband services that enhance the accessibility of medical information, whereas people with families abroad may want to use video conferencing services to interact with their family members.

1.3. Internet functions: the ICET typology

From the preceding section it becomes clear why it is important to involve end users when investigating the adoption and use of new technologies. But what possibilities do these end users have with broadband and how can the functions of broadband internet be captured in a comprehensive typology?
Firstly, we will take a look at the range of possibilities of broadband for end users.

> *"I send e-mails to my friends on a daily basis. Just checking how they are doing"*
> "*My daily portion of music*"
> "*The internet is fantastic. You can find everything about anything*"

These answers given in the diary research conducted in 2003 (Vermaas & Van de Wijngaert, 2004) are just a few of the many things one can do on the Internet; sending e-mails to friends, looking for information on butterflies, downloading folk music or drama films, etc. The Internet has revolutionized the way people gather and use information, how they communicate and the ways people like to be entertained. Internet technology integrates the capabilities of media such as the telephone, the radio, the television and the computer. Thanks to broadband, even more services and applications are being invented and developed. In recent years quite a lot of broadband services have been developed for residential users. A number of cities in the Netherlands have set up experimental environments in order to be able to experiment with broadband networks (e.g. Kenniswijk in Eindhoven and Cyburg in Amsterdam). In certain parts of these cities, inhabitants were able to use optical fibre connections from an early stage (2001). Broadband service and content providers as well as inhabitants were encouraged to develop new broadband services and applications. Some broadband services have been developed within and outside these environments. Some of them, however, did not get past the pilot or brainstorm phase. Also, many services were discontinued after they had been available to end users for a few

months. To get an impression of which kinds of end user services are possible with broadband, we present a (not exhaustive) list of Dutch broadband services in *Table 1*.

Table 1 Examples of broadband services

Name of service	Description	Status	Source
Leefstijl TV (Lifestyle TV)	Leefstijl TV is an internet television program with the goal to motivate young people to live healthier. The boy/girl is shown a program that fits his/her profile and video, images, text and audio are played synchronised.	Live	http://www.leefstijltv.nl/
Pientere Peuter (smart toddler)	Pientere Peuter offers pedagogic games for young children.	Live	http://www.samenslim.nl
Web-school	Online school for chronic or long-term ill children.	Live	http://www.webschool.nl/
Videocon-ferencing	Video conferencing is possible with the ABN AMRO bank in an agency without employees, on the high-Tech Campus in Eindhoven. Clients get advise from employees at a branch in an other part of the city.	Live	Teleportel, ABN AMRO
Hotline to home	Communication between people in hospital and people at home with microphones, webcams, laptops or videophone.	Live	http://www.hotlinetohome.nl/
Democra-Shock	Young people and politicians are brought in contact with each other on the website DemocraShock.nl. There, online debates are organised about social topics.	Live	http://www.democrashock.nl
I-Meel Kiosk	Email system for elderly with only one button, for those who find emailing and computers too difficult to handle.	Discontinued	
Vereni-gings-wereld	Offline communities, such as sports clubs, can with this service create a very active community by using a virtual meeting place and also collect money for the community.	Discontinued	
MoviePlus	Downloading films legally via internet and watching them via computer or tv	Live	http://www.movieplus.nl/
Dream-Recorder	With an advanced profile system tv programs are recorded and tv programs can be watched whenever the user wants.	Live	http://www.dreamrecorder.nl/
DigiLeen	Searching for, downloading and renting digital music online. Music is of high quality (256 Kbps). Because the music is coded no copies can be made. The downloaded music can be listened to during a week or 70 times.	Live	http://www.muziekweb.nl/
Wallie	The Wallie-card is a prepaid means of payment. The ease of paying with credit card and the safety of paying with accept giro slip are combined.	Live	http://www.wallie.com/
E-wallet / Way2Pay	Means of online payment	Discontinued	
Bol.com	Webshop for books, cd's, dvd's, games, mobile phones, electronics	Live	http://www.bol.com
Kadoline	Ordering products at home at local stores and delivery within three hours.	Discontinued	

Sources: www.nederlandbreedbandland.nl; www.kenniswijk.nl; www.stedenlink.nl

The above overview of services already indicates that many services or functions of broadband internet revolve around information gathering, communicating, transactions and entertainment. For this mainly exploratory research we have identified these four basic broadband internet functions. Most of the needs for these functions can also be deduced from literature on needs underlying media use. The four functions are mainly derived from Uses and Gratifications research (Katz, Blumler and Gurevitch, 1974, Katz, Gurevitch and Haas, 1973). The needs from Uses and Gratifications are translated to activities that can be carried out online or functions of the internet. Based on these needs, we introduce the ICET (pronunciation: ice tea) typology[1] that takes into account Information (gathering), Communication, Entertainment and Transactions. We acknowledge that many services converge more and more as entertainment services are combined with transactions; information and communication services are also often integrated. This typology, however, is used as a way to group four distinct, but not mutually exclusive activities. Ultimately, the distinction between the four functions of broadband internet in our typology helps researchers to prepare questionnaires and interpret results. The ICET typology in a broadband framework that is used as a basis for this research is presented below (*Table 2*).

Table 2 The ICET typology

I (information)	search engines, portals, websites (url or favourites), reference works, streaming audio/video, newsletter, newsgroup, discussion groups, own website, information forms				
C (communication)	Messenger, chat website, IP-telephony, webcams, reading of a web log, writing/publishing a web log, e-mail, SMS (from computer to mobile), newsgroups				
E (entertainment)	Gaming, watching films, downloading films, uploading films, owning/maintaining a community, participating in communities, downloading/watching tv, downloading/watching video clips, sharing video clips, listening to music, downloading music, sharing music, downloading photos, sharing photos, e-mail, fun surfing				
T (transactions)	buying service or product from provider, online marketplaces for individuals, auction website, tele banking, making reservations				
Special domains	health, telework/mobility and safety				
Broadband as technological basis	Narrowband		Broadband		Broadband+
	PSTN	ISDN	Cable	ADSL	Fibre optics
					> 10 Mbps

[1] In earlier work we have also referred to this typology as the ICET-model

The first broadband internet function is information. This relates to the U&G approach as follows: Researchers in the needs and uses of internet have mentioned in one way or the other the need for Information. In terms of Katz et al. (1974) this need is a cognitive one. McQuail (1987), Rubin (1994) and Papacharissi & Rubin (2000) also mention this need. Information is made more accessible by the internet and an abundant amount of information can be found online. It is often found in research that information gathering is an important reason to go online (Maltha, Schuurman, Vermaas, Vandeberg, Bongers, Bekkers & Van de Wijngaert, 2002; Maltha, Bongers, Schuurman, Vandeberg, Vermaas & Van de Wijngaert, 2003).

Besides a cognitive need for information, resulting in using the information function of broadband internet, communication as a function of broadband is related to the U&G approach. Social interactive needs (Katz, 1974), social Interaction (McQuail, 1987), social Companionship (Rubin, 1994), Interpersonal utility (Papacharissi & Rubin 2000), all refer to the need people feel to be in contact with other people. Besides supplying this need, the internet has brought about tremendous changes. It is now possible to be in contact with almost everybody, independent of time and place. Internet connections in the Netherlands are indeed used quite often for communication (Maltha et al., 2002; Maltha et al., 2003). In addition, entertainment is an important need that many people have to gratify. U&G researchers also focus attention on this need in terms of entertainment (McQuail, 1987), escape (Rubin, 1994), affective and tension release needs (Katz, 1974), pastime and entertainment (Papacharissi & Rubin, 2000). Via the internet and especially broadband, new forms of entertainment are possible, for example playing online games with people from all over the world. The fourth function of broadband internet is not directly related to the U&G approach, but as completing online transactions is an increasingly important driver to go online, it is incorporated in the ICET typology. A few of the many examples are: tele banking, making reservations for theatre shows, buying online tickets, books and getting travel or car insurance. However, no specific attention is paid to the need people have to complete transactions. This need might be more like an obligation, because some things have to be bought and paid, but apparently people feel the need to complete transactions online (and not through traditional media).

Apart from the approach of underlying needs, we also see resemblances with other models and typologies. The categories of our ICET typology are comparable to the ones Aronsson et al. (2003) distinguish: (1) information services, (2) entertainment services, (3) e-commerce, (4) communication services, and (5) telemetric services. Since telemetric services such as medical video surveillance are not offered on a large scale yet, these services are not explicitly part of our survey on actual usage. Also, our model is comparable to Angerhn's (1997) ICDT-model (information,

communication, distribution and transaction), although this is used for ICT usage within organisations (for companies wanting to develop Internet business strategies).
Furthermore, the communication, information, transaction and even entertainment functions also become apparent in broadband services developed or to be developed for social domains, such as health, telework and personal or public safety. Because of the anticipated significance of broadband for these social domains, attention is focussed on these special domains of broadband internet in chapters 7 and 8.

1.4. Research goal, questions and relevance

The abovementioned shows that the field and market of broadband are rather complex, with many actors and roles; even the definition of broadband is often unclear. In recent years some new information, communication, entertainment and transaction (ICET) services have been developed and the possibilities in technological terms are abundant. But the question now is what people actually do with their broadband connections. And moreover, why are people motivated to adopt broadband in the first place. Thanks to high broadband penetration in the Netherlands, this country is a good starting point for exploring that question.

The definition of diffusion that Rogers (1995) provides suggests that diffusion involves the adoption of new innovation, its usage and the subsequent impact of usage. In this research we focus on the adoption (acceptance of and subscription to broadband) and the usage of broadband in residential areas. These adoption and usage patterns are likely to be dynamic. The reasons for adoption might change over time. For example, in the initial stages of broadband development, a reason for adopting may be more speed, while in later stages it may be because it becomes cheaper than other options. Thresholds at first may be that there is no need and later it may appear that it is too expensive. Also, usage patterns are likely to change as there is a constant interaction between technology and its users (Silverstone & Haddon, 1996; Pinch & Bijker, 1984). As adoption and usage patterns are not likely to be static, it is important to monitor developments over time.
The *main goal* of this thesis therefore is to gain insight in and to understand the adoption and usage patterns of broadband internet from a user perspective.
The accompanying main research question is:

MRQ *To what extent can developments of residential adoption and usage of broadband internet be recognized over the course of 2001 to 2005 and how can these developments be understood from a user perspective?*

This question falls into four research questions. Apart from the dynamic nature, adoption and usage processes are rather complex. A research approach is required in which several research methods are performed in order to obtain better information. Each of these research methods and designs may have certain advantages and disadvantages. For that reason it is important to investigate what the possibilities and impossibilities are of various research methods to explore the adoption and usage processes of broadband from a user perspective.
The *sub goal* of this research therefore, is to gain insight into the possibilities and limitations of various research methods for measuring and monitoring the adoption and usage of broadband. This is done by literature reviews and the experiences gained during this research project, because combining the insights from literature and these experiences provides a more valuable picture than when each is viewed separately. The research question that relates to this sub goal is:

RQ1 *What are the possibilities and limitations of (combinations of) various research methods to gain insight into the adoption and use of new technologies?*

As indicated before, the main research question has two aspects: adoption and usage. The adoption patterns are investigated by looking at reasons and thresholds people experience for switching to broadband, while changes over time are considered. The relevant research question is:

RQ2 *Which developments can be recognized with regard to reasons and thresholds for residential adoption of broadband internet between 2001 and 2005 and how can these developments be understood from a user perspective?*

The usage of broadband is first explored by monitoring what ICET functions of the internet people use. The relevant research question is:

RQ3 Which developments in residential broadband usage patterns can be recognized between 2001 and 2005, with regard to information, communication, entertainment and transaction functions and how can these developments be understood from a user perspective?

ICET functions and especially information and communication functions can be used in several domains such as health, telework, safety and education. These topics are considered important and socially desirable domains with regard to broadband, for example by the Dutch government. Because the adoption and usage of broadband in education have already been monitored in other

research (Vermaas, De Groot, Maltha, 2005; Vermaas, Verhagen, Zijderveld & Kaashoek, 2006), it is beyond the scope of this research, but health, safety and telework are considered. The research question that is focussed on in this research is:

RQ4 *Which developments in residential broadband usage patterns can be recognized between 2001 and 2005, with regard to health, safety and telework services and how can these developments be understood from a user perspective?*

Scientific and methodological relevance

The results of this research contribute to the body of knowledge on the adoption and use of new technologies. This is of interest to researchers in various domains such as social sciences and information science, because it provides not only insights into the content of longitudinal empirical research based on several research methods, but also new conceptual ideas which will supplement existing theory and knowledge. These insights may be used to further model the adoption and usage processes of new technologies. This is important as appropriate and tested theoretical or conceptual models specific to the adoption of broadband are lacking (Choudrie & Dwivedi, 2004). Because research into the adoption of broadband, especially from a user perspective is rather scarce, we consider this research as descriptive and of an exploratory nature. Although we take several theories and models as stepping stones for our empirical investigations, our presumption is not to test existing theories. This is because the theoretical framework for the explanation of residential adoption and use of broadband is not fully fledged yet. However, we do aim to provide new conceptual ideas which will supplement existing theory and knowledge.

There will also be more insight into the advantages and disadvantages of research methods for collecting data on adoption and use of new technologies. Over the years many methods have been used to study user behaviour regarding new media such as the Internet. Online surveys are probably mostly used to study what people do on the Internet in their daily lives. These surveys typically result in large amounts of quantitative data that can be analysed through various statistical methods. There is also a need for more in-depth, qualitative information. To address this, we will also discuss diary research, in which people denote their daily activities as a means to collect data on the usage of new technologies such as broadband.
In addition, a new method of performing a literature review of meta analysis is presented, which may be used by various researchers, because literature reviews are important sources of information in all research areas.

Relevance for policy and businesses

Previously, we identified three actors in the broadband domain: government, Internet (Access, Service and Content) Providers and end users. This research is of interest for these actors.

The insights gained by this research can serve as guidelines for both policy makers and businesses. They are concerned with questions such as: is it feasible to construct a broadband network or upgrade an existing network to one with more bandwidth? Are people going to use this network and its services in such a way that our society will change dramatically? And what is the real added value for society and the economy? Businesses such as Internet Access, Service and Content Providers such as telecom companies and cable organizations are interested in knowing more about what drives and motivates people to use broadband Internet, how they can predict the adoption and use of technologies, and what services they will use. With the information about their customers they can provide services that better fit the needs of their target groups. For example, are all customers likely to use one single service or can groups of broadband users be identified that have specific needs, for example to communicate via news groups or to exchange films or music. With the results of this research we aim to find implications for service development.

For the Dutch government that is concerned with improving the quality and effectiveness of service provision in public sectors (health care, education, security and telework), broadband adoption and use are important issues (Maltha & Zegveld, 2004). This is because without end users for the infrastructure and services which the government initiates or helps to develop, those services are bound to fail and the investments for the infrastructure seem questionable.

For the third actor, the end users, this research is also of importance. By gaining insight into the factors that influence the adoption and usage of new technologies, it is more likely that future developments will be better tuned to user's wishes. Also, thresholds that users experience can be identified and possibly resolved so that users face fewer thresholds while going online. Additionally, by asking (potential) end users more often what they do and why they do it, they may feel more empowered.

1.5. Research approach and methodology: repeated cross-sectional study with parallel research methods

This section will discuss the research approach and methodology, with special attention given to the online questionnaires (in 2001, 2003 and 2005), our main source of information. Besides the online questionnaires, also diary research was performed and focus groups were organised. Apart from the empirical part of this research, a literature study was performed using a combination of meta analysis and network analysis. These methods will, however,

not be examined in this chapter. This seemingly imbalance in attention to the other research methods is counterbalanced in chapter 2 and 3 where we elaborate on other methods used: the meta analysis/network analysis and diary research.

1.5.1. Context and approach of the empirical research

When the empirical part of the research started in 2001, the focus on technology and technology alone had gradually shifted to a focus that included the notion that the user of these new technologies such as cable and ADSL was also important. The question was, what were the user's expectations of broadband internet and its future services and how did the user evaluate his internet connection and usage at that time. In order to answer these questions, Dialogic innovation & interaction in Utrecht, the Netherlands initiated the research project *Broadband and its Users* in the summer of 2001 (Maltha et al., 2002). The research aimed at mapping the experiences, needs and visions of (future) internet users in the Netherlands and providing answers to burning questions from the government and market organizations involved in this project. In numerous sessions with these organizations, questionnaires were set up, making sure that relevant questions with regard to broadband internet usage at that time were included. After 2001 the developments in the field of broadband did not slow down. Instead, more and more people in the Netherlands connected to the internet and especially to broadband (cable and ADSL at that time). This called for new surveys in 2003 and 2005, again supported and financed by a wide range of parties. The parties that were involved and co-financed the project were: The Dutch Ministry of Economic Affairs, the cities of Almere and Amsterdam, KPN (Dutch Telecom company), Vecai (the association of cable companies) and Ex'ovision (developer of video services). Although financed by government and the market, the research maintained its scientific objectivity. The interpretation of the results and conclusions are those of the researchers and not necessarily the opinions of the financing parties. The data for the largest part of this dissertation are collected within the project *Broadband and its Users*. We have used a repeated cross sectional and parallel method approach. Three different groups of respondents were approached in the three surveys in 2001, 2003 and 2005. Each survey consisted of three research methods: online questionnaires, diary research and focus groups (*Figure 5*). In several chapters we refer to this study as longitudinal, but we stress the fact that no panel was surveyed three times.

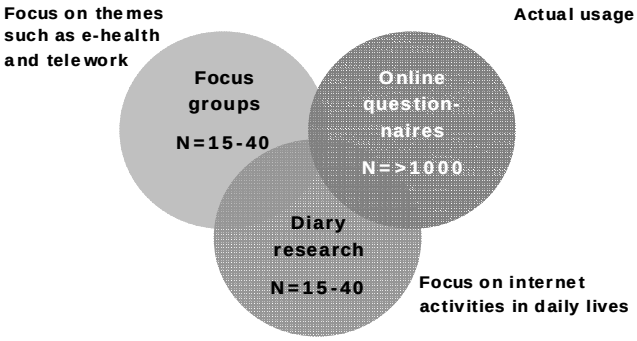


Figure 5 The three main research methods

In 2001 people noted their daily internet usage behaviour in a paper diary and in 2003 and 2005 in an online diary. The goal of this research method is to gain insight into the role internet plays in people's daily lives. Again, ICET activities were central in these diaries. Insight into the daily internet usage patterns and related experiences (wishes and frustrations) are important in order to recognize the possibilities and impossibilities of broadband internet. The respondents for the diary research were recruited via flyers that were put in over 500 mail boxes (for each survey) and via advertisements in local media. In chapter 3 we will elaborate on diary research as a method of collecting data on online activities.
The focus groups were used to gain more insight into the future possibilities of certain special uses of broadband, such as e-health, mobility (tele work) and safety from a user perspective. With the aid of an Electronic Meeting System, small groups of people were encouraged to extensively debate the role of broadband in certain domains in the years to come. We also consulted the respondents in the focus groups on the outcomes from the questionnaires. If the outcomes were not clear or hard to interpret, the respondents from the focus groups could often clarify things.
Large groups of internet users contributed to this study which involved the three research methods as shown in Table 3.

Table 3 Number of respondents per research method, per year

	N =2001	N =2003	N =2005
Online surveys	1072	2325	1102
Diary research	17	36	26
Focus groups	34	25	16

The online questionnaires included topics about broadband in telework, health and safety. But as the questions, especially on health matters did not provide enough in-depth information, an additional survey was set up to investigate the way the internet is

used to search for health information. The data was gathered through a pencil-and-paper questionnaire (N=123). The respondents for this study were recruited between August and October 2003. In order to reach respondents from different sections of society with a (likely) need for health information, the respondents were taken from several locations: a Dutch academic hospital, a fitness club and a women's union. The last location was chosen because women were initially underrepresented.

Besides the empirical part of the research, a literature study with meta analysis and network analysis was conducted looking at the literature on empirical investigations that use Diffusion of Innovations (Rogers, 1995) and the Technology Acceptance Model (TAM) (Davis, 1989) as a starting point. For the meta analysis, we concentrate on the differences between hypothetical and empirically tested variables of these theories. As this method of performing meta analysis is rather new, we concentrate on the method itself as well as the results.

1.5.2. Online questionnaires

The introduction of new survey methods often evokes initial reservations with regard to effectiveness and validity. This was also the case when the telephone was introduced as a method to collect data in the late Sixties.. In this day and age, however, telephone surveys are considered an effective means to collect correct and meaningful data. Over the years several methods have been used to study user behaviour regarding new media such as the internet. Nowadays, online surveys are frequently used to study very diverse topics. In order to find out what people do on the internet in their daily lives, online questionnaires seem to be even more appropriate than for other topics. This method of data collection complements and in more and more cases replaces postal, telephone and mail surveys. It enables us to reach many users but there are still some weaknesses.
Addressing the theoretical and practical issues of research methods such as online questionnaires, diary research and meta analysis, may help to establish useful guidelines to conduct the different research lines as solid and reliable methods for research into the adoption and usage of technologies from a user perspective.

Since the Nineties, more and more people have started using the internet and email. Not surprisingly, an increasing amount of data collection for research was done online by means of various computer-assisted data collection techniques (Ilieva, Baron and Healey, 2002). At the same time research into online data collection methods increased significantly during the late Nineties. In 2001 Ray et al. conducted a research project on web-based surveys. This research points out that online surveys are used in the fields of marketing (70%), information systems (27%), management (2%), and economics (1%). Online data collection is

becoming more and more popular. However, some issues remain unresolved regarding the quality of data collected through the internet.
When evaluating an online survey, one should do so in the context of that survey. Each survey, also online surveys, has its own goals and populations for example (Couper, 2000). While many researchers were afraid that the advent of online questionnaires as methods of data collection would be the end of good and decent research, Couper (2000) states: "No longer is it just "quick and dirty" in one corner and "expensive but high quality" in the other; rather, there is a wide array of approaches representing varying levels of quality and cost."
Here, first some general strengths and weaknesses of online questionnaires (compared to for example telephone and postal surveys) are presented as well as some context dependent aspects.

1.5.2.1. Advantages of online data collection

Regardless of the context in which a survey is conducted, there are some general advantages of online questionnaires, such as minimal costs, time and the possibility of visual aspects. Response rates and data quality are more context dependent because of varying populations and sample frames.

Costs

Self administered postal surveys are often very expensive, especially when a large sample is approached. Every questionnaire has to be printed or photocopied, which implies material costs and personnel costs. Furthermore, every envelope that goes out needs a stamp and a return stamped envelope has to be enclosed. After the questionnaires have been returned by the respondents, the data has to be entered into a system for data analysis. A disadvantage of telephone surveying is that it is a relatively costly way to collect and process data due to telephone costs and interviewers' wages. All these costs are not associated with online surveys (Ilieva, Baron and Healey, 2002; Taylor, 2000).

Time saving

As previously pointed out, online surveys can save time because no time is spent sending envelopes, printing or photocopying. Moreover, the answers supplied by the respondents feed automatically into the data analysis software. Apart from the time saving aspect, this also avoids transcription errors etc. (Ilieva, Baron and Healey, 2002; Taylor 2000). Also online questionnaires generally have a shorter response time. In the study performed by Dillman (2000) over 80% of the electronic responses were collected within three days. Furthermore, it is easy for the researcher to form and send the survey, and it is a simple task for the respondent to answer and return it (Ilieva, Baron and Healey, 2002; Taylor, 2000).

Visual aspects and routing

The internet is a richer medium compared to the traditional paper and pencil questionnaire (Coyle and Thorson 2001). Online questionnaires can for example use still and moving images (Taylor 2000), which in some cases are important for the respondent's understanding of the subject. Also an automatic question filtering function or routing can help to even out the path for respondents, because only questions relevant for that respondent are presented.

Response rates

Although overall response rates for e-mail and online surveys are known to be somewhat lower than paper and pencil surveys (Anderson & Gansneder, 1995; Kittleson, 1995), response rates of telephone and postal surveys are on the decline (Stoop, 2005). Many users are unreachable or unwilling to participate in a survey. Given this decline in response rates, it is a logical step to consider the possibilities the internet has to offer for data collecting for research from a user perspective.

Quality of the collected data

The quality of the collected data can be considered a strength as well as a weakness of online questionnaires. As mentioned earlier, transcription errors are avoided thanks to the direct and automatic entering of the data, although systematic errors can be made (for example by coding errors). Furthermore, already in some of the first studies into online surveys, evidence appeared that online questionnaires are as effective or even more effective than traditional methods of data collection (Kiesler, Siegel & McGuire, 1984; Kiesler & Sproull, 1986; Komsky, 1991). One of the findings is that online respondents showed an increased tendency to use the entire range of answer possibilities compared to other data collection methods. This could be due to the fact that, for example in telephone surveys, people best remember the last given answer option, especially when feeling pressured by the interviewer. In a more recent study Dillman et al. (2001) found that respondents in a telephone survey were more likely than those in an online survey to select the extreme positive response category.

Kwak and Radler (2002) conclude their study with the remark that online surveys turn out to have lower item non-response and longer open-ended response (even after controlling for demographic and technology related characteristics). This can also be forced in online questionnaires by making some or all questions mandatory. Moreover, studies show evidence that data collected via online questionnaires may have fewer measurement errors. Krosnick and Chang (2002) found that the data of respondents to online questionnaires contained fewer random and systematic measurement errors than respondents to telephone surveys (higher reliability coefficients).

1.5.2.2. Disadvantages of online data collection

Technical failures, spam filters, pop up blockers

Technology makes many things possible, also for data collection for research, but also has disadvantages. Technical failures and programming faults might make people reluctant to participate in research and again may influence the quality of data. Furthermore, the extensive use of spam filters and pop-up blockers will prevent people from receiving notification of the research. Even if the notification is not blocked by a filter, sending emails to potential respondents of online surveys who have not agreed beforehand to participate in online research would look like 'spamming,' and be unacceptable to many people (Taylor, 2000).

Respondents' computer skills

Online data collection assumes that the respondent has the equipment and ability required to complete the online questionnaire. People that do not know how to use a computer or the internet will often not respond to an online questionnaire. Also, a lack of computer expertise can be a source of errors, resulting in a low quality of data.

External validity

Although the practical benefits of online questionnaires may outweigh those of telephone and postal questionnaires, the question remains whether valid conclusions can be drawn from the data and whether we can generalize from the data. This fit between the research sample and the target population from which generalizations are to be made, is of course very dependent on the population of that research.

Internet adoption and usage developments may be increasing rapid, but household penetration is not the same as that of telephones and (of course) physical addresses, thus making sample representation and generalization difficult. However, in our research the population consists of internet users. A sample frame for this population is not available and this is discussed in the following section.

Table 4 summarizes the previously discussed advantages and disadvantages.

Table 4 The advantages and disadvantages of different methods of data collection

	Telephone	Post	E-mail	Online
Main advantages	- Control over sample (sampling frame; respondents are known)	- Control over sample (sampling frame respondents are known)	- Relatively cheap - fast - Control over sample (sampling frame respondents are known)	- relatively cheap - fast - data quality - design/visual aspects - routing
Main disadvantages	- Expensive (telephone costs and labour) - Increasing non-response - focus on last answering possibility (memory)	- Time consuming - Costs - Increasing non response - errors entering data	- potentially false addresses, because of changing accounts	- Little control over sample, no sampling frame

1.5.2.3. Experiences with online questionnaires in this project

The online questionnaires were available via various newsletters, buttons and links on websites. In order to get as many internet users and a varied group, we placed buttons and links on special websites for women and the elderly (generally the groups of people lagging behind in research into topics such as internet). Although exact questions and answers sometimes varied (for example due to developments in the broadband market), all three online questionnaires followed similar categories as shown in *Table 5*..

Table 5 Structure of the online questionnaires

Items	Type of information
Access at home	Kind of connection, provider, other devices such as PDA's etc.
Internet experience and skills	Skills, years of experience, frequency and duration of internet use etc.
Internet usage at home	Online information, communication, entertainment and transactions: frequency, type of service/application, vision on future etc.
Special uses	E-health, telework, safety etc.
Reasons and thresholds	Reasons for adopting or rejecting broadband and certain services etc.
Effects of internet usage	Positive and negative effects, effect on usage of other media, cost savings
Demographical characteristics	Gender, date of birth, education, income, household situation etc.

In our project we could not make a direct comparison with what the survey would have cost if it was done by post or telephone, but indeed there were no such costs for stamps, envelopes, copying etc.

However, the time and effort needed to create the questionnaire and, perhaps more importantly, to test it, were quite extensive, resulting in more costs than foreseen. As the online questionnaires allow a researcher to use routing extensively, the questionnaire almost imperceptibly becomes very complex, possibly resulting in failures and unusable data at the end. Also a considerable amount of time (and accompanying costs) was spent on putting out all the buttons, links and invitations in order to reach internet users to fill out the questionnaire.
The data did not have to be typed from pen and paper questionnaires into a digital system, which indeed saved a considerable amount of time. However, because of the very accessible nature of the questionnaire (on various websites), the data had to be checked very carefully and some data were deleted because the researchers seriously doubted whether the answers were genuine. In 2003 for example, 2325 of the 2404 filled out questionnaires were actually used for further analysis. It is seemingly very easy to just play around with the questionnaire and push the button to send it, whereas having to send back a postal questionnaire is possibly a threshold for this 'playing around'.

In 2001 approximately 30 percent of the respondents who started to fill out the questionnaire finished it. In 2003 and 2005 this percentage was lower (respectively 22 and 20 percent). The item non-response was very small in all three questionnaires, because all closed questions were mandatory.

Gathering the respondents once the link, buttons and invitations were sent out, happened quickly at first, but after a two week period, almost no new respondents filled out the questionnaire. That is when we decided to place new buttons and links (many of the links and buttons are deleted after a few days or placed at less prominent places on websites). This resulted in another big wave of response as Figure 6 shows.

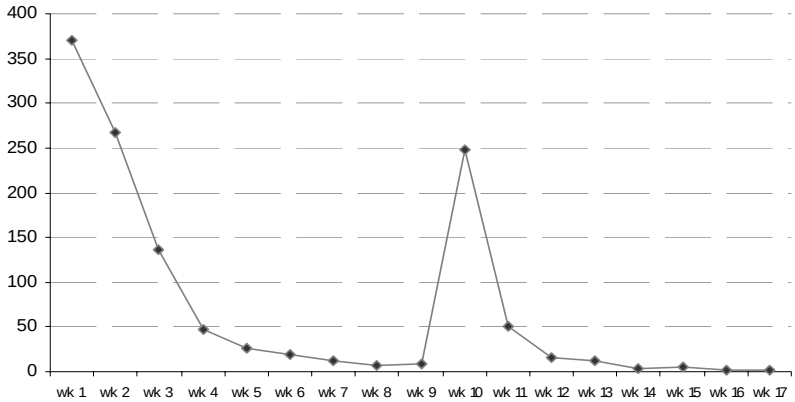


Figure 6 Response per week to the online questionnaire in 2005

External validity in this research

The external validity (generalizability) of data collected through online questionnaires is often considered questionable. In research such as this thesis, however, the population consists of *internet users*. All the people in the population are on the internet more or less frequently and therefore recruiting respondents via the internet seems adequate.

Since there was no sampling frame (there is no list of email addresses of all internet users, like people are listed in phonebooks with addresses and telephone numbers), we were not able to draw a random sample; nor could a non-response be calculated. We do know that 20 to 30 percent of the respondents who started filling out the questionnaires completed them. Respondents were approached in several ways to reduce coverage error (Arentze, Bos, Molin, Timmermans, 2005). Besides the buttons and links on websites, emails were sent to potential respondents with the URL of the online questionnaire. These potential respondents were people that had filled out an earlier questionnaire on a similar subject. In various newsletters (of or via the co-financing parties) people were invited to participate in the research. The websites were chosen in such a way that websites for the elderly, women and those not so skilled in internet use were also confronted with the online questionnaire. These groups of internet users are often considered to be underrepresented in online research.

In order to improve external validity, demographic weighting could be a solution (Taylor, 2000), but finding the accurate variables on the basis of which to weight is not always clear. Gender, age and household situation may not be the variables that make a difference in our results. A bigger issue here is that there is neither a sampling frame nor detailed data on the Dutch *internet population* and we do not have far reaching insight into the characteristics of internet users. For example on the basis of the information of

Statistics Netherlands, we do not know how many married women between the age of thirty and forty use the internet.

In conclusion, we argue that high costs and the time consuming aspects of both postal and telephone surveys make online questionnaires an attractive alternative to collect and process data. In addition to its operational benefits, it could reduce data entry error and increase flexibility in visual presentation and design. Judging the data collection method should be done within the context of the research conducted. This means that for some studies with particular goals and populations, online questionnaires are more suitable than others. The population of the research presented in this thesis is all Dutch internet users. The goal is to explore the reasons and impediments for switching to broadband and to gain insight into the usage of (broadband) internet. An online questionnaire would seem to be suitable for this population and goal. While there is still some concern about the generalizability of online survey results, existing research supports using the internet as an effective method for collecting survey data, particularly if the population to be studied is known and identifiable, or as in this research, consists of "all internet users".

1.6. Outline

This thesis is based on a collection of articles published in scientific journals, books and proceedings of scientific conferences. All published works are (double) blind refereed. The references to the original publications are given in each chapter and all publications of the author are listed in Appendix A. The structure of the thesis is depicted as follows: Chapter 2 aims to gain insight into the state of the Technology Acceptance Model and Diffusion of Innovations, using a systematic approach. This is done with a meta analysis using the OpenKI tool and network analysis. As this method for meta analysis is quite innovative, we will concentrate on the possibilities and limitations of this research method. Another focus in this chapter is identifying the key theoretical concepts on the adoption and use of new technologies as well as how these concepts are related to each other. Moreover, by using this research method we want to investigate to what extent the hypotheses posed in both approaches hold once they are put to the empirical test.
In Chapter 3 diary research as a means of data collection will be discussed. The central research question in this chapter is whether diaries are useful research instruments to study the behaviour of internet users. Theoretical issues as well as practical issues that need to be taken into account to perform these methods are addressed.

After that, chapter 4 revolves around the reasons for our impediments to adopting broadband. Now that internet has become widely available in the Netherlands, some people have taken the step to a broadband connection at home whereas others have not. The goal of this chapter is to gain insight into the reasons why people adopt or reject broadband in the residential context.

Main research question (MRQ): To what extent can developments of residential adoption and usage of broadband internet be recognized over the course of 2001 to 2005and how can these developments be understood from a user perspective?

Research Question	Research Method	Analyses	Chapter
RQ 1 What are the possibilities and limitations of (combinations of) various research methods to gain insight into the adoption and use of new technologies?	Diary research (2001, 2003), Literature review	Meta analysis/ network analysis	2, 3
RQ2 Which developments can be recognized with regard to reasons and thresholds for residential adoption of broadband internet between 2001 and 2005 and how can these developments be understood?	Online Questionnaires (2001, 2003, 2005)	Descriptive analyses	4
RQ3 Which developments in residential broadband usage patterns can be recognized between 2001 and 2005, with regard to Information, Communication, Entertainment and Transaction functions and how can these developments be understood?	Online Questionnaires (2001, 2003, 2005)	Descriptive analyses, Cluster analysis	5,6
RQ4 Which developments in residential broadband usage patterns can be recognized between 2001 and 2005, with regard to health, safety and telework services and how can these developments be understood?	Online Questionnaires (2001, 2003, 2005), additional questionnaire (2003)	Descriptive analyses, regression analysis	7,8
All	Review of the findings		9

Having gained more insight into the residential adoption of broadband, we take a closer look at the (changing) usage patterns of broadband users in chapters 5 and 6. First of all in chapter 5 the question is raised whether and how Dutch internet users with a broadband connection differ from people with a narrowband connection in terms of demographics (age, gender, education), internet experience (experience, frequency, intensity of use),

expectations (of narrowband users), experiences (of broadband users), annoyances and patterns of internet usage. Secondly, the question is addressed whether and how these differences change over time.

Chapter 6 goes into more detail with regards to evolving usage patterns of specific groups of internet users. Different groups of people may use different types of internet connections for different reasons. The first objective in chapter 5 is to identify a small number of relatively homogeneous groups of Internet users, based on their usage patterns (for example typical 'gamers' or 'serious information seekers'). Secondly, we aim to identify the characteristics of the internet users in the various clusters. We focus on demographics, experience and the connection used (broadband vs. narrowband). Thirdly, we aim to identify changes in clusters over the years (2001, 2003 and 2005). Its rapid broadband adoption process (OECD, 2005) makes the Netherlands an interesting case for other countries.

Chapter 7 and 8 concentrate on specific domains of the internet: health, telework and safety. Broadband potentially has a strong influence on social issues such as mobility (telework), health, and public or personal safety. In order to understand and to predict the adoption of broadband services in these domains, it is necessary to ask (potential) users of those services about their actual usage and expectations. These issues are explored in chapter 7.

In chapter 8 the primary objective is to obtain insight into information seeking behaviour on the internet with regard to health information. Theories from two research areas are used to explain the use of the internet for health information: health behaviour and the adoption and use of new technologies.

Finally, chapter 9 reflects on the studies performed as well as the results and presents overall conclusions by answering the research questions.

References

AMS-IX (2005). Press release "AMS-IX first Internet exchange worldwide to break 100 Gbps barrier" accessed via http://www.ams-ix.net /news/archive

Anderson, B., C. Gale, M. L. R. Jones & A. McWilliam (2004). Domesticating Broadband — What Consumers Really Do with Flat-Rate, Always-On and Fast Internet Access. *BT Technology Journal*, 20 (1), pp. 103-114

Anderson, S. E. & B. M. Gansneder (1995). Using electronic mail surveys and computer monitored data for studying computer mediated communication systems. *Social Science Computer Review*, 13(1), pp. 33-46.

Angerhn, A. (1997) "Designing Mature Internet Business Strategies: The ICDT Model", European Management Journal, vol 15 No. 4, pp. 361-369

Arentze, T., I. Bos, E. Molin & H. Timmermans (2005). Internet based travel surveys: selected evidence on response rates, sampling bias and reliability. Transportmetrica, 1 (3), pp. 193-207.

Aronsson, M., D. Tholén, P. Josephson, H. Li & S.Kong (2003).Broadband services for residential and commercial tenants: a categorisation of current and future services and a survey on tenants needs in Sweden. *Building and Environment* 38(2), pp. 347-358

Atkin, D., L. Jeffres & K.Neuendorf, (1998). Understanding Internet adoption as telecommunications behavior. *Journal of Broadcasting and Electronic Media*, 42, pp. 475-490.

Beekman, N. & M.Vermeulen(2004). *Succes en faalfactoren Breedbandtoepassingen: quickscan*. Platform Nederland Breed. The Hague

Broadband Expert Group (2002), Netherlands Broadband Land: Recommendations to the Cabinet from the national Broadband Expert Group for achieving a national lead in the field of broadband infrastructures and applications, The Hague.

Broadband paper: The importance of a swift implementation and better use. (2006). Ministry of Economic Affairs Directorate-GeneralTelecommunications and Post (DGTP), The Hague.

CBS (Statistics Netherlands) (2005). *De digitale economie 2005*. CBS, The Hague

Choudrie, J. & Y. Dwivedi (2004). Towards a conceptual model of broadband diffusion. Journal of Computing and Information Technology, 12 (4), pp. 323-338.

Couper, M.P. (2000). Web Surveys a Review of Issues and Approaches. *Public Opinion Quarterly*, 64 (4), pp. 464-481.

Coyle, J. & E. Thorson (2001). The Effects of Progressive Levels of Interactivity and Vividness in Web Marketing Sites. *Journal of Advertising*, 30(3), pp. 65 – 77.

Daft, R.L. & R.H. Lengel, (1986). Organizational Information Requirements. Media Richness and Structural Design. *Management Science*. 32 (5), pp. 554-571.

Daft, R.L., R.H. Lengel & L. K. Trevino. (1987). Message equivocality. media selection and manager performance: Implications for information systems. *MIS Quarterly*, 11(3), pp. 354-366.

Davis, F.D. (1989). Perceived Usefulness. Perceived Ease of Use. and User Acceptance of Information Technology. *MIS Quarterly*. 13(3), pp. 319-341.

Davis, A. W. (1998). Broadband in the local loop: What high-speed Internet pipelines mean for emerging video imaging apps. *Advanced Imaging*, 13 (11), pp. 29-31

Dewilde, P., Khoe, D., Koonen, T., van Sinderen, M., Burgmeier, J., van der Lugt, H., van den Eijkel, G. (2002). Towards Freeband Communication proposal for an impulse in the development of advanced public knowledge in telecommunications (technology and pplications). Accessed via https://doc.telin.nl/dscgi/ds.py/Get/File-22068/freeband_impulse.pdf

Dijk, M. van, B. Minne, M. Mulder, J. Poort & H.van der Wiel (2005). *Do market failures hamper the perspectives of broadband?* CPB Netherlands Bureau for Economic Policy Analysis, The Hague.

Dillman, D. A. (1991). The Design and Administration of Mail Surveys. *Annual Review of Sociology*, 17, pp. 225 – 249.

Dillman, D.A., R. Tortora, & D.Bowker, (1998). "Principles for Constructing Web Surveys," Pullman, Washington. SESRC Technical Report 98-50, accessed via: http://survey.sesrc.wsu.edu/dillman/papers/websurveyppr.pdf on 28 January 2002.

Dillman, D. A. (2000). *Mail and Internet surveys: The tailored design method*. New York: John Wiley & Sons.

Goldenberg, J., D. R. Lehmann & D. Mazursky (2001). The Idea Itself and the Circumstances of Its Emergence as Predictors of New Product Success. *Management Science*, 47, pp. 69-84.

Ilieva, J., S. Baron & N. Healey (2002). Online Surveys in Marketing Research: Pros and Cons. *International Journal of Market Research*, 44(3), pp. 361 – 376.

Katz, Blumler and Gurevitch (1974). Uses and gratifications research. *Public Opinion Quarterly*, 37(4)

Katz, Haas and Gurevitch (1973). On the Use of Mass Media for important things. *American Sociological Review*, 38(2), pp. 164

Kiesler, S., J. Siegel & T.McGuire, (1984). Social psychological aspects of computer-mediated communications. *American Psychologist*, 39, pp. 1123-1134.

Kiesler, S., & L. Sproull, (1986). Response effects in the electronic survey. *Public Opinion Quarterly*, 50, pp. 402-413.

Kittleson, M. J. (1995). An assessment of the response rate via the Postal Service and e-mail. *Health Values*, 19(2), pp. 27-39.

Komsky, S. H. (1991). A profile of users of electronic mail in a university. *Management Communication Quarterly*, 4, 310-340.

Chang, L. & J. A. Krosnick, (2002) A Comparison of the Random Digit Dialing Telephone Survey Methodology with Internet Survey Methodology as Implemented by Knowledge Networks and Harris Interactive. Paper presented at the annual meeting of the American Political Science Association, Boston Marriott Copley Place, Sheraton Boston & Hynes Convention Center, Boston, Massachusetts

Kwak, N. & B. Radler (2002). A Comparison Between Mail and Web Surveys: Response Pattern, Respondent Profile, and Data Quality. *Journal of Official Statistics*, Vol.18 (2), pp. 257-273

Maltha S., K. Schuurman, K. Vermaas, R. Vandeberg, F. Bongers, R. Bekkers en L. van de Wijngaert (2002). *Breedband en de Gebruiker*. Utrecht, Dialogic.

Maltha S., F. Bongers, K. Schuurman, R. Vandeberg, K. Vermaas & L. van de Wijngaert (2003). *Breedband en de Gebruiker 2003*. Utrecht, Dialogic.

Maltha, S.R., & W. Zegveld (eds.) (2004). *Towards a national strategy for broadband: Recommendations made by the Broadband Impulse Committee*. Broadband Impulse Committee, The Hague

McQuail, D. (1987). Mass Communication Theory: An Introduction (2nd ed.). London: Sage

Ministry of Economic Affairs (2004), *the Broadband Paper: the importance of a swift implementation and better use*. Ministry of Economic Affairs Directorate-GeneralTelecommunications and Post (DGTP), The Hague.

Monro, T.M., P.J. Bennett, N.G.R. Broderick & D.J. Richardson (2000). New possibilities with holey fibers. Proceedings of *Optical Fiber Communication Conference*, 3, pp. 106-108.

Nelson, R. R. (1959). The Economics of Invention: A Survey of the Literature, *Journal of Business*. 32 (2), pp. 101-27.

Neuendorf, K. A., D. J. Atkin, & L. W. Jeffres, (1998). Understanding adopters of audio information innovations. *Journal of Broadcasting & Electronic Media*, 42, pp. 80-93.

Nilsson, O. (2001). Fundamental limits and possibilities for future telecommunications. *Communications Magazine*, IEEE, 39 (5), pp. 167-167.

OECD (2006) Organization for Economic Cooperation and Development, The Development of Broadband Access in OECD Countries. http://www.oecd.org. Accessed at 10-04-07

OECD (2005) Organization for Economic Cooperation and Development, The Development of Broadband Access in OECD Countries. Accessed via http://www.oecd.org/document/16/0,2340,en_2649_34225_35526608_1_1_1_1,00.html on 05 May 2006

OECD (2003). *Working Party on Telecommunication and Information Services Policies: UNIVERSAL SERVICE OBLIGATIONS AND BROADBAND*. Accessed at http://www.oecd.org/dataoecd/4/23/2496799.pdf on 22 December 2006)

Papacharissi, Z. & A.M. Rubin (2000). Predictors of internet use, *Journal of broadcasting and electronic media*, 44 (2) , pp: 175, 22

Pinch, T.J. & W.E. Bijker (1984). The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other. Social Studies of Science, 14, pp. 399-441.

Ray, N., K. Griggs & S. Tabor (2001), Web Based Survey Research Workshop, WDSI, April. Accessed via http://telecomm.boisestate.edu/research).

Rice, C. (1997) *Understanding Customers*. Oxford: Butterworth-Heinemann.

Rogers, E.M. (1995). *Diffusion of innovations*. New York : Free Press

Rubin, A. M. (1994). *Media Uses and Effects A Uses-and-Gratifications Perspective*. In: Bryant, Jennings and Zillmann, Dolf Editors, 1994. Media Effects Advances in Theory and Research Lawrence Erlbaum Associates, Hillsdale, NJ

Savage, S.J. & Waldman, D.M. (2004). United States Demand for Internet Access. *Review of Network Economics*, 3 (3), pp. 228-247.

Silverstone, R., & L.Haddon, (1996). *Design and the Domestication of Information and Communication Technologies – Technical Change and Everyday Life*. In Mansell, R. & Silverstone, R. (Eds.) Communication by Design: The Politics of Information and Communication Technologies, Oxford: Oxford University Press, pp. 44-74.

Spruijt, H.J., W.A. Dijk, K.J Visscher, W.R.M.Dassen, N.V.Putten, M.H. Baljon & A.R. Bakker (2001). Teleconsulting, teleguiding and teleteaching: gigabit networkapplications in cardiology. Computers in Cardiology, pp. 581-584

Stoop, I. (2005). *The Hunt for the last respondent*. Social and Cultural Planning Office, The Hague

Taylor, H. (2000). Does Internet Research Work?. *International Journal of Market Research*, 42(1), pp. 51 – 63.

Urban, G.L., & E. von Hippel (1988). Lead User Analyses for the Development of New Industrial Products. *Management Science* 34, (5), pp. 569-82.

Vermaas, K., H. de Groot & S. Maltha (2005). *Breedbandmonitor onderwijs 2005*. Dialogic. Utrecht

Vermaas, K., L. Verhagen, C. Zijderveld & B. Kaashoek (2006). *Breedbandmonitor onderwijs 2006*. Dialogic. Utrecht

Vermaas, K. & L. Van de Wijngaert (2004). Measuring Internet behaviour: Total Time Diary and Activity Diary as research methods. *Journal of Information Technology Theory and Application* (JITTA), 7 (1), pp. 121-134.

Von Hippel, E. (2005). *Democratizing Innovation*. Cambridge, MA: MITPress

Chapter 2

Accumulating IS theories using a network approach towards meta-analysis

2.1 Abstract

The adoption and usage of new information and communication technologies (ICT) have been investigated from different theoretical points of view, such as Diffusion of Innovations (DOI; Rogers, 1995) and the Technology Acceptance Model (TAM; Davis, 1989). Numerous empirical studies are available, but systematic reviews that accumulate the results are not abundant.

Meta-analysis is a way to accumulate the results of scientific research. Usually, a meta-analysis study focuses on investigating collected empirical results with regard to a single hypothesis. In this research we take a broader perspective by adding principles of network analysis to the basics of meta-analysis. This encompasses that we consider the concepts (or variables) in the hypotheses of relevant scientific papers and use them as the nodes in a network. Moreover, the presupposed relations between the concepts (also depicted in the hypotheses) are the links between nodes. The concept network that emerges can subsequently be analyzed in terms of e.g. density and degree. In order to test the robustness of a theory we compare the network of theoretically posed relations to the network of relations that are empirically validated and found significant. The paper describes the use of this approach towards meta-analysis as well as a tool that supports the approach: the Open Knowledge Infrastructure (OpenKI). This publicly accessible online database allows storage and retrieval of hypotheses and meta-information of scientific papers.

The overall aim of this research is to gain insight into the state of art with regard to TAM and DOI. The focus lies on identifying the key theoretical concepts in these theoretical frameworks as well as how these concepts are related to each other. Moreover, we want to investigate to what degree the hypotheses that are posed in both frameworks hold once they are empirically validated. Ultimately, the results of this research provide us with a deeper understanding of the adoption and use of new technologies in general. Moreover, our findings with regard to the (future) possibilities of this new approach towards literature research and the Open KI tool are evaluated.

Keywords: Technology Acceptance Model, Diffusion of innovations, Meta-analysis, Network analysis, Hypotheses, Empirical validation

2.2 Introduction

De Groot (1969) describes the scientific process as a cycle in which theoretical notions are put to an empirical test. In this cycle the results can be used for further development of theoretical notions. In this paper we follow the empirical cycle twice: [1] by testing a method to perform meta-analysis and [2] by accumulating the empirical findings of two theoretical frameworks.

Information and communication technology (ICT) is developing rapidly. With these developments, empirical research meant to understand, explain and predict the processes of adoption and use of new ICT is also expanding. These processes are investigated in several research areas, such as organizational science, communication science and information systems, resulting in theories, approaches and models such as Diffusion of Innovations (DOI; Rogers, 1962; 1995), Theory of Reasoned Action (Ajzen and Fishbein, 1980), the Technology Acceptance Model (TAM; Davis, 1989), Domestication (Silverstone and Haddon, 1996), Social Exchange Theory (Homans, 1958) and Task Technology Fit (Goodhue, 1995). These theoretical insights, especially those of TAM and DOI, have often been tested in quantitative empirical research. As a result a substantial number of empirical studies with regard to the adoption and use of ICT is available.

In their article on literature reviews the Information Systems (IS) field, Webster and Watson (2002) state that there are only few published review articles. As a result of that the progress of the IS field is impeded. A well known way to study and accumulate empirical results is meta-analysis. According to Light and Pillemer (1984), traditional literature reviews are subjective, scientifically unsound and not efficient. They state that meta-analyses are more rigorous and systematic. Meta-analysis encompasses all of the methods and techniques of quantitative research synthesis (Lipsey and Wilson, 2001). Since empirical research on the adoption of new technology is growing fast and since many of these studies are based on explicit theories and hypothesis, we argue that it is possible to perform a rigorous meta-analysis on this matter.

Although not abundant, there have been several meta-analyses in IS (Tornatzky and Klein, 1982; Alavi and Joachimsthaler, 1992; Benbasat and Lim, 1993; Hwang, 1996; Mahmood, Hall and Swanberg, 2001; Ma and Liu, 2004; Sultan, Farley and Lehmann, 1990). Most of these papers, take one theory, a small amount of concepts or a single hypothesis into account. In contrast, Venkatesh, Morris, Davis, and Davis (2003) take as many as eight models into account. They use the core constructs from the models and empirically test them in four field studies. Although Venkatesh et al. provide a meaningful study, they lack a systematic method to

identify the constructs that form the basis of their Unified Model of Technology Acceptance (UTAUT). In this paper we do provide a systematic and controllable approach towards accumulating the results of (quantitative) empirical research papers using the hypotheses that are posed and tested in scientific papers. This brings us to the basic assumption of this research which is that the hypotheses that are posed and tested are central in scientific research. The reason for this assumption is that we define a theory as a coherent system of hypotheses. A hypothesis in turn suggests a possible correlation between two concepts.
By analyzing the hypotheses that are posed and empirically tested we will obtain an overview of all the concepts that are relevant to a theoretical framework. Next to that, we will accumulate the results from the different papers in terms of a (social) network (Wasserman and Faust, 1994; Hanneman and Riddle, 2005) in which concepts are the nodes and the hypotheses are the links that connect the nodes. In order to do that we will make use of a the Open Knowledge Infrastructure (OpenKI) tool that we developed and used in this study. Because the use of this tool and a network analysis approach towards meta-analysis is new, the first research question is:

RQ1 *What are the possibilities and limitations of performing meta-analysis with the aid of the OpenKI tool and network analysis?*

The second aim of this research is to gain insight into the concept network for two widely accepted theories in the IS field, being Diffusion of Innovations and the Technology Acceptance Model. Accordingly, the second research question is:

RQ2 *Which key theoretical concepts on the adoption and use of new technologies can be identified and how do these concepts relate to each other in a network of concepts?*

An important aspect of quantitative scientific research is the empirical validation of hypotheses that are posed. Researchers examine, by operationalization of concepts, gathering data and (statistical) data analysis, if and to what degree a theoretical proposition can be validated in the empirical world. In general terms, validation is described as the success with which the measure obtained in particular cases allows us to predict the measures that would be arrived at by other procedures in other contexts (Kaplan, 1973). By comparing the theoretically posed hypotheses to the empirical results (i.e. the hypotheses that were supported) of a number of papers we accumulate the value of a theoretical framework in different contexts. This brings us to the third research question:

RQ3 *How are the theoretically posed hypotheses related to the relations that are empirically supported?*

the two different theoretical frameworks can help us understand the diffusion of ICT. Although this way of performing literature research can be applied to any empirical research domain, this study emerged in a project on residential broadband adoption and usage in the Netherlands. Therefore, we will refer to this in the conclusions.
In the next section we will first provide a short description of the theories that are taken into account for our meta analysis. After that, we will describe our approach towards finding answers to the research questions posed above. First of all, we will describe how literature was collected and analysed. Secondly, we will describe the use of a tool that was built to support meta-analysis. After our description of the method we used, we will present the results of our data gathering and analysis. Finally, we will present our conclusions and suggestions for further research.

2.3 Two Theories Explaining the Adoption and Use of ICT

Although TAM and DOI were not constructed to explain the residential adoption of broadband in the residential area per se, the constructs and variables from the theories are very well applicable to this matter. Therefore we have taken these two frameworks as a starting point in our network approach towards meta-analysis. In this section we will briefly describe the background and central elements of the two theoretical frameworks that are central in this paper.

Technology Acceptance Model

The Technology Acceptance Model that was developed by Davis (1989) is typically an Information Systems approach. In this model, an extension of Ajzen and Fishbein's (1980) theory of reasoned action (TRA), perceived usefulness and ease of use are related to attitude towards technology and subsequently intention to use and actual use. In later versions of the model perceived usefulness was extended with variables like experience, subjective norm, image, job relevance, output quality and result demonstrability. The level of measurement can be any individual, but mostly individuals within organizations are subjected to empirical research. As depicted in Figure 7 the dependent variables are behavioral Intention to use, and Actual Use of Technology. Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are the independent variables.

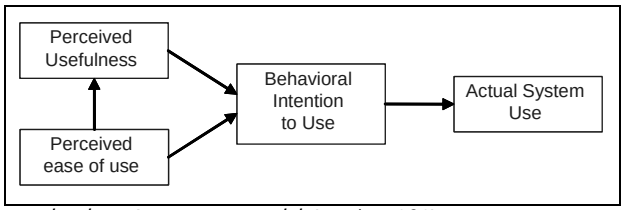


Figure 7 Technology Acceptance Model (Davis, 1989)

After this initial model of the TAM model many researchers have extended and refined the model in different directions. For example, studies that incorporate Task Technology Fit (TTF) constructs into TAM (Goodhue and Thompson, 1995) are included in our analysis.

Diffusion of Innovations (DOI)

Originating in Sociology, Communication, Marketing and Management and Economics, Diffusion of Innovations (DOI) explains technology adoption or diffusion primarily by the characteristics of the innovation and the characteristics of the individual.

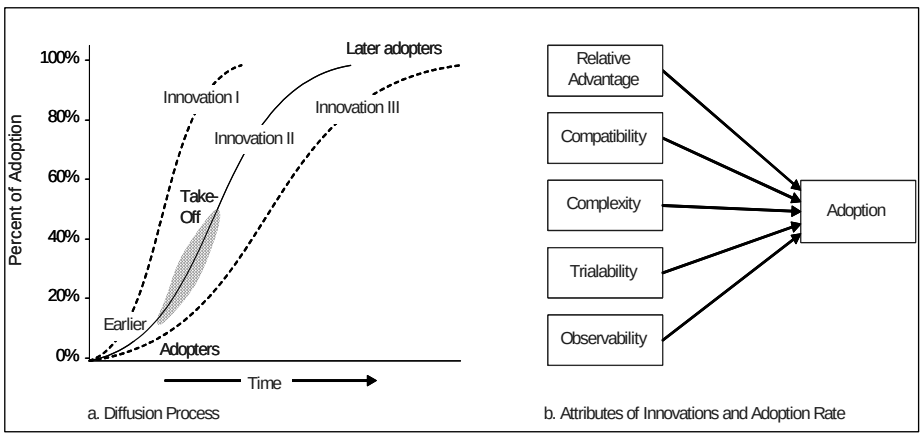


Figure 8 Diffusion of Innovations (Rogers, 1995)

Rogers (1995) defines the diffusion of innovations as: 'Diffusion is the process by which an innovation is communicated through certain channels among the members of a social system' (Figure 8a). In this definition Rogers summarizes a number of factors that can influence the (rapid) diffusion of an innovation. The first factor relates to the nature of the innovation. Innovations differ from each other in several ways: Relative advantage, Compatibility, Trialability, Observability and Complexity (Figure 8b). Secondly, Rogers mentions both personal and mass communication as a means to create shared meaning and changing attitude towards the innovation. Third, Rogers mentions the time that is needed for

potential users in order to take a decision on whether or not to adopt the innovation. The concept of time also relates to the individual's level of innovativeness (and accordingly, the amount of time needed to make a decision). Individuals are seen as possessing different degrees of willingness to adopt innovations and thus it is generally observed that the portion of the population adopting an innovation is approximately normally distributed over time (Rogers, 1995). Rogers identifies five types of users:

- Innovators - venturesome, educated, multiple info sources
- Early adopters - social leaders, popular, educated
- Early majority - deliberate, many informal social contacts
- Late majority - skeptical, traditional, lower socio-economic status
- Laggards - neighbors and friends are main info sources, fear of debt

The level of analysis mainly is society, groups, firms and individuals. Social influence is an important factor in the individual's decision to adopt an innovation.

2.4 Research Method

For this paper we have performed a meta-analysis that is innovative in two ways. First, it uses a database tool to collect the required data from literature, the OpenKI tool. Secondly, we have used network analysis to map the relations between hypothesized variables and between validated variables. In this section we will provide an overview of the way in which literature was gathered, the OpenKI tool and network analysis.

Selection of the Literature

In order to select literature for the meta-analysis we used the Association of Information Systems (AIS) community as a starting point. The corresponding website[2], provides an overview of theories and approaches relevant to the IS field. The overview also provides relevant literature. To add to these lists of literature we also looked for relevant literature on Google Scholar[3] and in Omega[4] at Utrecht University in The Netherlands. As key terms we have used the name of the theory combined with domain specific terms such as ICT, technology, internet and broadband. From the found literature a selection was made, based on the availability of the papers. Schwartz and Russo (2004) conclude their research with the remark that knowledge of which indexes (databases with

[2] www.isworld.org
[3] scholar.google.com
[4] Omega is a search engine developed at the library of Utrecht University which offers access to almost 15 million digital 'full-text' articles at omega.library.uu.nl

literature) are best to use is helpful to researchers, but that access to the indexes might be a problem. To some papers indeed, we were not able to get access, in spite of the various licenses Utrecht University has for scientific journals. After this step of retrieving literature the appropriateness of the papers were estimated by reading abstracts. The main condition was that it had to be empirical research, based on TAM or DOI and that the subject was new information and/or communication technology (which is not always the case with research based on DOI). Furthermore, many of the empirical studies found were performed in an organizational context. Because this research was provoked by the interest in finding variables that could be of influence on residential adoption of broadband, we excluded the literature that focused strongly on the role of management, technical staff and culture of the organization (for example Carter, Jambulingam, Gupta and Melone, 2001). As a result of this analysis 12 suitable empirical studies based on DOI and 18 appropriate papers on TAM were included in our meta-analysis. The references to these papers are included at the end of this paper.

The OpenKI Tool

Further analysis of the papers that were found was done based on the Open Knowledge Infrastructure (OpenKI) tool, described by Van de Wijngaert, Bouwman and Brinkkemper (2006). The OpenKI tool is an online database[5] that is accessible to any researcher who wants to add (although moderated) or to search content. In other words, anyone can enter their own data and use it for analysis or use the data of others for secondary analysis. With this approach, in which research efforts are shared we can accumulate knowledge with regard to IS as well as other research domains on a much larger scale than a single researcher would be able to.

Entering the Data: Meta Data and Hypotheses

The database supports the storage of meta-data about and content of the paper. The meta data concerns the type of publication (e.g. journal, conference), the abstract, key words, reference (e.g. journal, year, volume, issue, publisher). The content concerns the theory or theories taken as a starting point, research method(s) used, design (e.g. one shot), sampling (sample size and description) and data gathering (e.g. setting, structure, method), independent and dependent variables, level of analysis (e.g. interval, ratio), type of relation (causal, similarity), result description, support/reject and a measure of support (very strong to very weak). From the results section of the papers that were analyzed we extracted if and to what degree hypotheses were supported or rejected. Also a measure of strength of support that

[5] www.cs.uu.nl/people/lidwien/openki

was found was reported in the system. Significant correlations were entered when p levels drop below 0,05.
In most of the papers that were entered into the database for this project, the hypotheses were stated explicitly. Several papers were entered into the database by two researchers independently in order to check whether the two researchers notated the same concepts. In practice, the concepts notated by both researchers were the same. Some discussion however, emerged about mediating variables. This has been solved as follows. For mediating variables that have (hypothesized) influence on the relationship between two extra variables were added. Figure 9a shows a (fictitious) situation in which Perceived Usefulness (PU) influences Behavioral Intention to Use (BIU). The relationship is mediated by gender. Because the system only recognizes relations between variables and not the relation between a variable and a relationship the situation is described as depicted in Figure 9. Besides the direct relation between PU and BIU we see two extra sets of relations; one from PU via the mediating variable M-men to BUI and a similar relation for M-women. The two sets of relations show how the relation between PU is different for men and women. Note that the relations between the independent variable and mediating variable do not have a causal nature (obviously, PU does not lead to being man or woman).

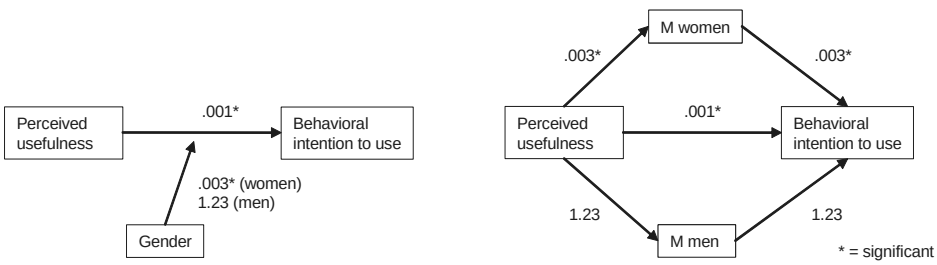


Figure 9. An Original Mediated Relation (left) and the OpenKI Notation (right)

In the OpenKI database the hypotheses from Figure 2 were notated as shown in Table 6. As said, the database can store much more information (e.g. research design, relation strength and type), for this research we only used a simple approach.

Table 6. Notation of Hypotheses and Mediating Variables in OpenKI

Reference	Independent variable	Dependent variable	Supported / Rejected
Author(s), title of the paper	PU	Behavioral intention to use	Supported
Author(s), title of the paper	PU	M women	Supported
Author(s), title of the paper	M women	Behavioral intention to use	Supported
Author(s), title of the paper	PU	M men	Rejected
Author(s), title of the paper	M men	Behavioral intention to use	Rejected

Aggregation of the Variables

An important step in the analysis was putting variable names into categories at a higher level. The reason for this is to reduce doubling of terms (for example 'usage' and 'use') and complexity. Figure 10 in the next section shows the complexity of a network looks that is not aggregated. In the aggregation process it is important that the researchers try to avoid aggregating too much, resulting in too abstract meaningless constructs. The researchers reviewed all variables and relationships carefully. With this qualitative clustering the number of variables for the hypothesized relationships was reduced. While interpreting and clustering the variables we tried to eliminate subjective interpretations as much as possible by debating about the aggregation steps among the researchers. We did retain all the original variables, so if in the analysis a relationship could not be interpreted or explained, we could fall back on an analysis of the original data for that part.

Network Analysis

Networks are defined by nodes and ties or links. Nodes can, for example, be actors (in case of actor networks). Ties are the relationships between these nodes (Wasserman and Faust, 1994; Hanneman and Riddle, 2005). Network analysis is increasingly popular in studies that aim to understand organizational communication and knowledge exchange. Using concepts and procedures from network analysis, we are able to analyze the collected data. The concepts can be considered the nodes in the network, and the links in the network represent the hypothesis or the relationship between the concepts. Using Netminer II from Cyram we are able to visualize 'conceptual networks' using for example the spring algorithm. Furthermore, we can use the basic measures in network analysis: size and density. Size is the number of nodes (concepts) in the network. Network Density measures the level of connectedness among the concepts in a network. It is computed as the number of present lines divided by the maximum

possible number of the lines among all of the nodes. Two other central measures in social network analysis are In-Degree (D_{in}) and Out-Degree (D_{out}). D_{in} relates to the number of lines that are incident to it. D_{out} refers to the number of lines that are incident from it. Based on the number of D_{in} and D_{out} relationships for each node, four different types can be distinguished: Isolates, transmitters, receivers and carriers.

- *Isolates*: These are nodes that are not connected to any of the other nodes (D_{in} =0, D_{out} =0),. In other words, a concept is not connected to the network. In the posed hypotheses network this does not emerge as a concept always connected to another one through the hypothesis. In the empirically validated networks isolates do occur when all hypotheses containing that concept are rejected.
- *Transmitters*: These are nodes that have lines going out, but no lines going in (D_{in} =0, D_{out} >0). These concepts are the independent variables, they influence other variables.
- *Receivers*: These are nodes that have lines coming in but do not have lines coming out (D_{in} >0, D_{out} =0), these concepts translate to being the dependent variables and are influenced by others.
- *Carrier*: These are nodes that have one line coming in as well as one going out (D_{in} =1, D_{out} =1). Although these concepts are rare, they are mediating concepts.
- *Ordinary*: Any other relationship which are, like carriers, mediating concepts.

There are many more analytical tools that can be borrowed from social network analysis. Examples are structural holes, communities and power distance. In this paper we will limit ourselves to some of the basic network characteristics.

2.5 Results

Analysis of TAM-Papers

In the 18 articles based on TAM that were included in our meta-analysis, we found a total of 247 hypothesized relationships. Of these hypothesized relationships 63 eventually were rejected after empirical research. Before aggregation of the data all these concepts and links mount to the image we see in Figure 10. As this image can not be interpreted like this, we aggregated the concepts as described before. For TAM, the aggregation was rather straight forward. For example, the concepts Usage behavior and Usage were aggregated to Use. The aggregated version of hypothesized relations consists of 30 nodes.

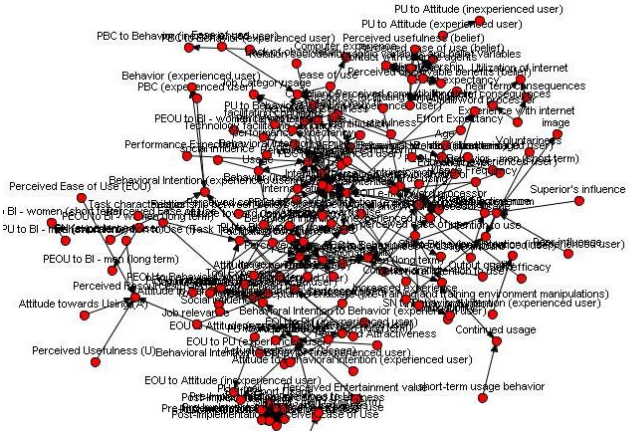


Figure 10. All Hypotheses in Not Aggregated Situation

Table 7 compares the results for the theoretically posed hypotheses and the hypotheses that were actually supported through empirical research. If we compare the two columns we see that 184 of 247 posed hypotheses are supported (a decrease of 74%), resulting in a decrease of 17 unique relationships (a decrease of 84%). Other findings are that the density of the network drops from 0,28 to 0,21.

Table 7. Theoretical and Empirically Supported Concepts and Relations for TAM

	Theory	**Empiric**
Number of variables in the network	30	30
Number of unique links in the network	106	89
Sum of all links in the network	247	184
Density of the network	0.284	0.211
Mean: average number a variable was mentioned	8.23	6.13
Number of isolates in the network	0	4
Number of transmitters in the network	14	10
Number of receivers in the network	0	0
Number of carriers in the network	1	1
Number of ordinaries in the network	15	15
Correlation Theory / Empiric	0.97	

Both in the theoretical as well as the supported network we see that the most variables are either transmitters (lines going out;

independent variables) or carriers (lines going in and out; mediating variables). When we look at the supported relations, we again see 30 variables, but four of them are isolates, which means that those variables do not have relationships with any other variable in the network.

When we draw a scatter plot for the sums of D_{in} and D_{out} for the theorized and empirically validated results we obtain insight into how well a theoretical framework performs in practice (see Figure 5). The first thing that stands out when looking at Figure 11, is that there is a strong linear relationship between the number of times a concept is mentioned in a theoretically posed hypothesis and the number of times it is supported in empirical research. In the situation that all theoretically posed relations are empirically validated the (linear) regression line is Y=X. In practice, of the line is less steep because not all relations are found to be significant. However, the steepness of the regression line we draw tells us something about the performance of a theoretical framework, especially in relation to another theoretical framework. Secondly, we see three clusters of variables: the ones that are tested only a few times (1), the ones tested in a small number of studies (2-11) and the ones that are tested in almost every TAM study. Moreover, we see that the concepts that are above the regression line are concepts that are relatively easy to prove empirically (e.g. Facilitating conditions, Perceived usefulness, Use) whereas the concepts that drop below the regression line perform relatively weak (e.g. Social influence, Experience, Perceived Ease of Use) The mediating variables experience and gender show mixed results.

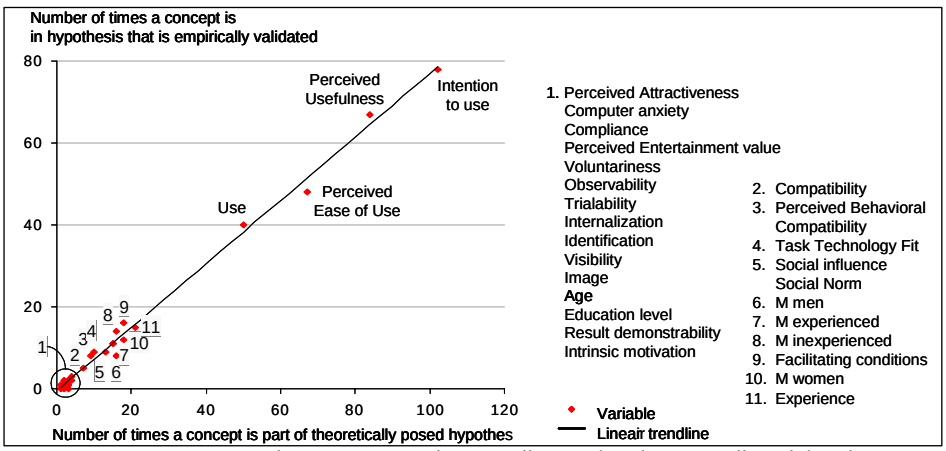


Figure 11. Relation Between Theoretically Posed and Empirically Validated Concepts for TAM

As a next step in our analysis we look at the main incoming and outgoing lines in the network of *supported* relations is presented in Figure 12. From the picture, the concepts that were used less than five times as well as mediating concepts were omitted. Figure 12 tells us something about which concepts are explained in a theory and which concepts explain those concepts. In other words, the picture shows us the main dependent and independent concepts. The main dependent variables are shown at the bottom of the figure: Intention to Use and actual Usage. A remarkable result is that many studies stop at Intention to Use, but do not explain actual Usage. Perceived Ease of Use and Perceived Usefulness, Experience, social Influence and Social norms are the main independent variables. However, we also see that Perceived Ease of Use and Perceived Usefulness are not *only* independent concepts, they are also the dependent concept in a substantial number of hypotheses. The other way around, the main dependent variables Intention to Use en Use also explain other variables. This shows that in TAM research the dependent and independent concepts are strongly interrelated.

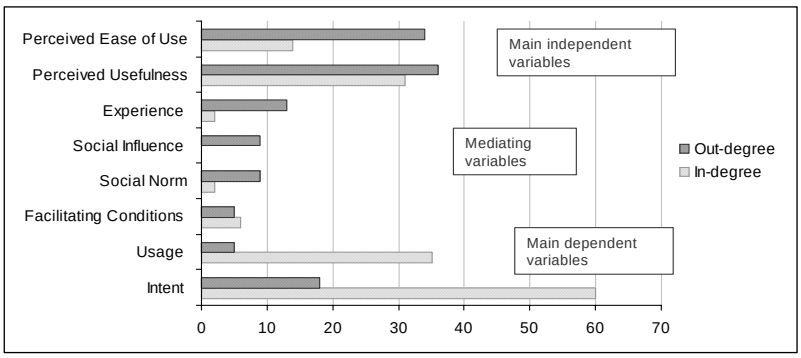


Figure 12. Main Ins And Outs in the Network of Supported Relations (TAM)

Putting it all together, we present the TAM model as a network in Figure 13. The size of the nodes is bigger for those mentioned more often and mediating variables are denoted with a triangle. Moreover, hypotheses that are mentioned more often are depicted with darker lines. From Figure 13 we can see that also here it becomes clear that the Intention to use is the most often mentioned dependent variable. Also perceived usefulness (PU) is dependent on many variables, but in itself PU also affects other variables. Perceived ease of use (PEOU) and actual usage (Usage) are slightly less frequently mentioned, but are also very central constructs in the supported model. In the new TAM model based on empirically tested and supported relations, we see the core constructs of TAM as main constructs: PU, PEOU, Intention and usage. Also social norms, experience (direct and as mediating variable) and facilitating conditions appear to be important (independent) variables in the network.

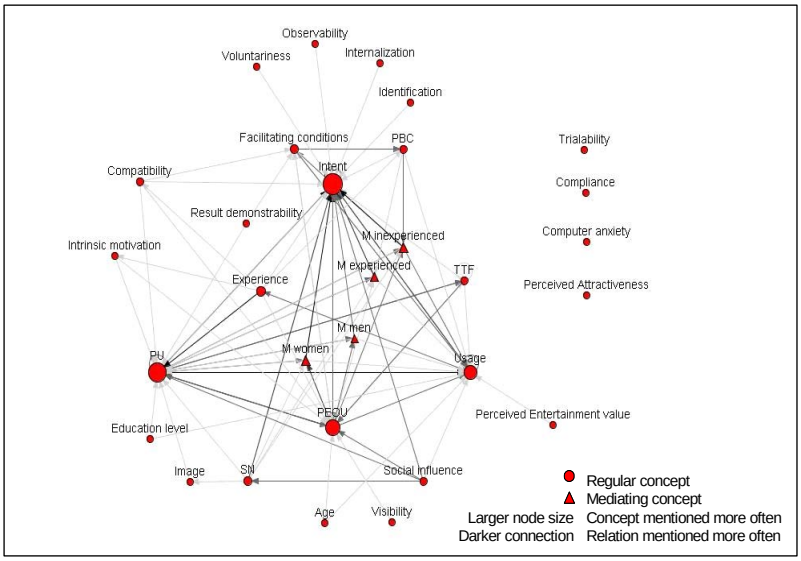


Figure 13. Accumulated Network of Supported Relations (TAM)

Analysis of DOI-Papers

In total, 12 papers were entered in the OpenKI database, yielding 120 hypotheses 99 different variables (Table 8). After aggregation, 34 variables were retained for further analysis. Due to aggregation 4 relations pointed at them selves (e.g. user characteristics influence user characteristics). These hypotheses were omitted in the analysis. From the 116 (85 different ones) hypotheses that were posed in the papers, 85 (69 different ones) were supported in empirical research. This is a decrease of 73% over all relations (and 81% for all unique relations).

Table 8. Theoretical and Empirically Supported Concepts and Relations for DOI

	Theory	**Empiric**
Number of variables in the network	34	34
Number of unique links in the network	85	69
Sum of all links in the network	116	85
Density of the network	0.103	0.076
Mean: average number a variable was mentioned	3.412	2.5
Number of isolates in the network	0	2
Number of transmitters in the network	23	22
Number of receivers in the network	2	2
Number of carriers in the network	0	0
Number of ordinaries in the network	9	8
Correlation Theory / Empiric	0.901	

In the DOI papers most variables are transmitters, both in the theoretical and empirical network. Second largest is the group of carriers. Two variables are receivers and there are no carriers in the network. We see the two isolates emerge in the empirical network. These variables (costs and gender) have no connection to the network anymore.

Similar to our analysis of the TAM papers we looked at how well the concepts stood up against empirical analysis. The scatter plot in Figure 14 tells us that the variables on the top-right side are in many different papers whereas concepts on the lower-left hand side are studied less often. Also here we see strong linear correlation, though slightly less than the TAM relations. Again the concepts below the trend line (e.g. Self Efficacy, Adoption Intention) being relatively harder to prove when put to the empirical test then the ones that are on top of the line (e.g. Usefulness, Adoption and Use).

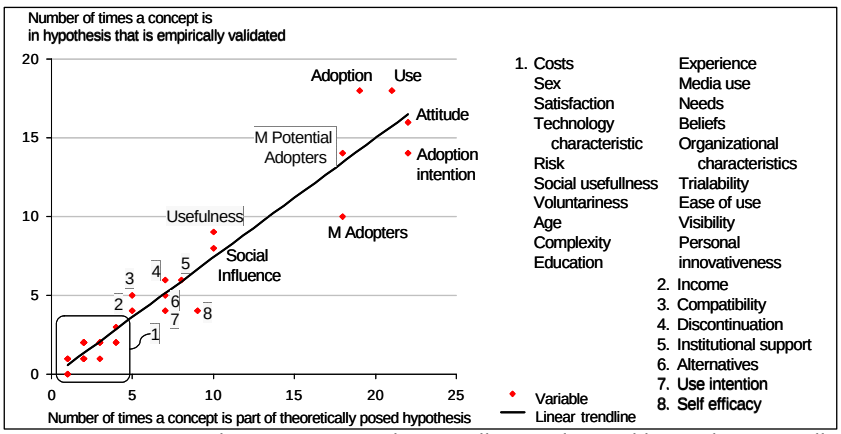
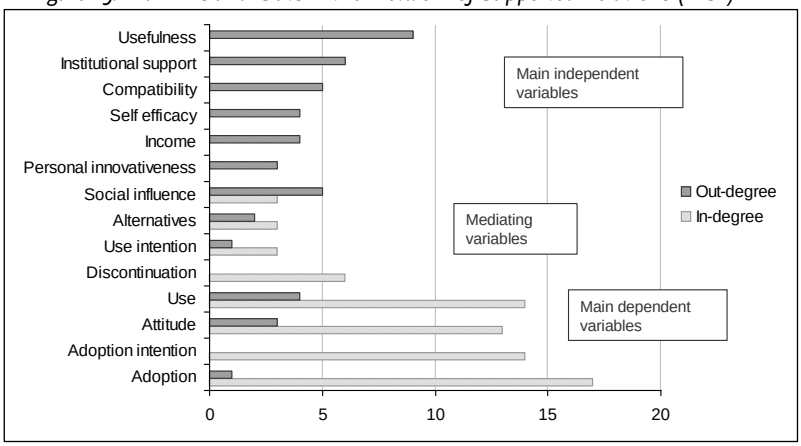


Figure 14. Relation Between Theoretically Posed Variables and Empirically Proven Variables (DOI)

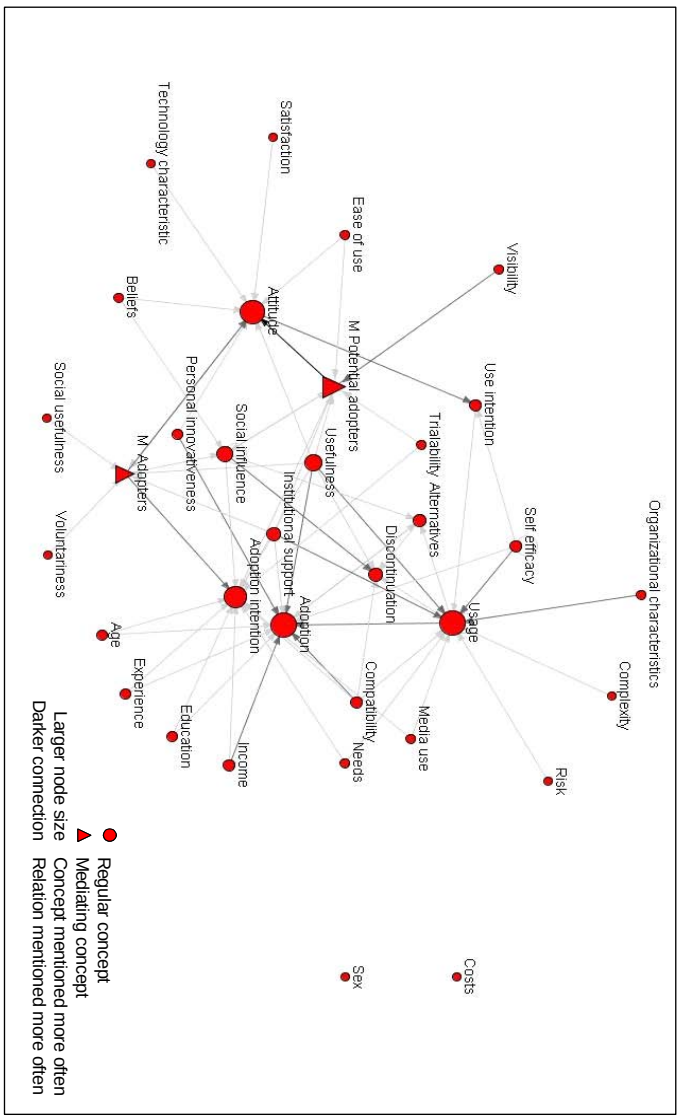
Figure 15 shows the in and out relations of the supported network. Much more than in the TAM papers, there is a strong division between independent and dependent variables. The most important predictors are usefulness, institutional support, and the mediating variable Adopter category. Attitude, Adoption Intention, Adoption, and Use are the most important dependent variables. Also based on the density index of the network we can conclude that DOI is a much 'looser' network than TAM.

Figure 15. Main Ins and Outs in the Network of Supported Relations (DOI)



In Figure 16 we again accumulate results in terms of a network. In the picture we see that adoption of a new technology is related to user characteristics such as Education, Experience, Age and Income. Actual use is related to variables such as Self Efficacy, Complexity and Risks. A remarkable result is that there is no direct relation between Attitude, Adoption intention and Adoption.

Figure 16. Accumulated Network of Supported Relations (DOI)



2.6 Conclusions and Directions for Future Research

The aim of this research was to gain insight into the state of theory for two frequently used theories in the IS field, being DOI and TAM, using a network approach towards meta-analysis and the OpenKI tool. This was done by comparing hypothesized relations with empirical results in a set of selected quantitative research papers. Moreover, the aim was to gain insight into the possibilities and limitations of performing meta-analysis with the aid of the OpenKI tool and network analysis. In this section we will provide some concluding remarks with regard to both subjects.

The Possibilities and Limitations of Network Analysis for Meta-Analysis and OpenKI (RQ1)

Based on the results of this research we believe that concept networks that accumulate different research papers can be made and help our understanding of the (empirical) strength of IS theories. The network approach towards meta-analysis provided an innovative way to accumulate research in the IS-field. A meta-analysis such as this one can help to determine which theory is best used as a conceptual model for further research, for instance in relation to the adoption of broadband internet. With the aid of network analysis of hypothesized and validated relations, a measure of overall empirical support for a theory can be given. The advantage of our approach towards meta-analysis is that a concept network can be visualized.

Moreover, concepts that are developed in (social) network analysis turn out to translate well to concept networks. Using quantitative network measures such as density and degree, networks from different theoretical frameworks can be compared to each other. There are some limitations to this research too. This study focused on empirical research in which hypotheses were clearly stated. For theoretical and qualitative studies it is more difficult to extract the central concepts. However, there are content-analysis techniques that can help to discover the central hypotheses in a paper (see for example de Wijngaert, Bouwman and Brinkkemper, 2006). A second issue with regard to the network approach in this paper is that now only basic network measures were used in the analysis. Future research can and should focus on more elaborate network measures. Examples are communities (discover clusters of concepts) and structural holes (discover new research area's). Moreover, the development of the network in the course of time can be used to understand theory development from a historical perspective.

With OpenKI we have developed a tool that supports the systematic accumulation of empirical research. This tool can be used in with regard to theories in the IS-field, as well as other research area's. Moreover, OpenKI provides a unique opportunity to share insights. Researchers from over the world can add papers to the central database. They can analyze their own entries and/or combine them

with the entries of others. Others can, in their turn also make use of the data in the central database. Of course a fast growth of the number of OpenKI users would imply a more elaborate monitoring system. Future research with regard to the OpenKI tool can focus on different areas. First of all, the user friendliness of the system can be improved. Secondly, many functionalities such as additional search possibilities and an aggregation function (now done manually) can be added. In an ideal situation researchers could for example have the opportunity to dynamically switch between high and low aggregation levels. Moreover, also a network function can be integrated. This would allow the possibility to directly generate network pictures as well as other pictures such as Figure 14 and 15.

Key concepts and empirical value of TAM and DOI (RQ2 and RQ3)

Before we say anything with regard to the two frameworks (TAM and DOI), we need to spend some words on the literature that was used in the meta-analysis. Despite the subscription to a substantial number of journals, we were not able to get a hold of all articles we wanted to include in our research. Also, the possibility exists that we have missed relevant papers, despite our extensive search efforts. However, using OpenKI as our tool, it is easy to go back, add papers and analyze the data again. However, we are convinced that the papers we did use provide a meaningful and representative sample of research papers on the adoption and use of ICT's.

With regard to the two frameworks, we have shown an extensive analysis of the core concepts as well as their empirical robustness. We can conclude that although the two frameworks may be different theories and although variable names may be different, the theories do also share many concepts. A substantial part the results for the two frameworks are overlapping. Usefulness, Use intention, Attitude towards using and actual Use are concepts that emerge in both frameworks.

However, there are also some differences between the two frameworks. The most striking difference between the two frameworks is that TAM concepts seem to point at each other as explanatory factors. DOI, in contrast makes a clear distinction between dependent and independent concepts. This result would imply that DOI is a more meaningful theoretical framework. However, when we look at the empirical strength of the two theories, DOI scores lower than TAM. This may also be explained by the fact that TAM concepts are closer to each other than the DOI concepts. In other words, we conclude that TAM primarily explains itself, because the relatively sparse concepts in the original TAM are so closely related to each other. This parsimony and its relatively strong predictive power make TAM applicable to different situations, but this strength is also an important limitation: TAM is predictive but its generality does not provide sufficient understanding of the adoption of new technologies by users

(Mathieson 1991; Venkatesh, 2000). DOI tends to provide a broader view on user adoption of new technologies.
In this research we chose not to combine the results of TAM and DOI in one 'big' network of concepts. The reason for this is that we feel that other frameworks such as Media Richness, Social Influence Model, Domestication, Social Exchange Theory and Task Technology Fit should then also be added. Future research, using a network approach towards meta-analysis and OpenKI may help to link these theories and models to each other.

Translated to broadband

Since the reason for performing this meta analysis was a research into the adoption and usage of broadband, we will now discuss the implementations for broadband adoption and use. Directly translated to the adoption of broadband, TAM and DOI implicate that people will consider the perceived usefulness of this infrastructure. In other words they will evaluate the difference that broadband will make in their lives. If people do not have a use for it in their daily lives, they will not decide to use it. Then they will also consider the ease (or complexity) with which it can be used, which in the case of broadband is not different from narrowband. Maybe because of its speed, it may seem easier to use for some people. Also, social influence is of importance in the decision whether to use new technologies or not, according to validated relations of both theories.
The insights brought to us by this meta analysis however, do not provide us insights into the developments and changes in adoption criteria over time, while it is possible and comprehensible that adoption criteria for one new technology may not stay the same in every phase of adoption. Therefore, there is a need for research that takes into account this time dimension and developments of adoption criteria and usage. Also, these insights do not provide us any clues on how the usage develops after the decision to start using the technology. As TAM does not provide satisfactory understanding of the adoption of new technologies from a user perspective, we suggest research that looks further into adoption and usage of new technologies than the key concepts of TAM. This means: not investigating the process until usage, but beyond (what do people actually do?) and not taking PU and PEOU as a starting point, but rather looking at what lies underneath.

References

Ajzen, I., and Fishbein, M. *Understanding attitudes and predicting social behavior*, Eaglewood Cliffs, NJ: Prentice-Hall, 1980

Alavi M. and Joachimsthaler E.A. "Revisiting DSS Implementation Research: A Meta-Analysis of the Literature and Suggestions for Researchers", *MIS Quarterly* 16(1), 1992, pp. 95-116

Benbasat I. and Lim, L.H. "The Effects of Group, Task, Context and Technology Variables on the Usefulness of Group Support Systems: A Meta-Analysis of Experimental Studies", *Small Group Research*, 1993, pp. 430-462

Carter, F. J., Jambulingam, T. and Gupta, V.K, and Melone, N. "Technological innovations: A framework for communicating diffusion effects", *Information & Management*, 38(5), 2001, pp. 277-287.

Cyram, *Netminer II (Version 2.5.0)*, Cyram, Seoul, 2004

Davis, F. D. "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly*, 13(3), 1989, pp.319-339.

Goodhue, D. and Thompson, R. "Task-technology fit and individual performance", *MIS Quarterly*, 19 (2), 1995, pp. 213-236.

Groot, A.D. de, *Methodology: Foundations of Inference and Research in the Behavioral Sciences* Mouton, Den Haag, 1969.

Hanneman, R.A. *Introduction to Social Network Methods*, University of California, Berkeley, CA, 2001

Hedges, L., and Olkin, I. .*Statistical Methods for Meta-Analysis*. Orlando, FL, Academic Press., 1985

Homans,G.C. "Social Behavior as Exchange", *American Journal of Sociology*, 63 (6), 1958, pp. 597-606.

Hooff, van den, B., Groot, J.and De Jonge, S. "Situational influences on the use of communication technologies", *Journal of Business Communication*, 42 (1), 2005, pp. 4-27.

Hwang, M. "The Use of Meta-Analysis in MIS Research: Promises and Problems", *The Data Base for Advances in Information Systems*, 27, 3, 1996, pp. 35-48

Kaplan, A. *The conduct of inquiry* Chandler, San Francisco, 1964.

Lewis, M. W. and Grimes, A. J. "Metatriangulation: Building Theory From Multiple Paradigms", *Academy of Management Review*, 24 (4), 1999, pp. 672-690

Light, R.J. and Pillemer, D.B. *Summing up: The Science of Reviewing Research*, Harvard University Press, Cambridge, MA, 1984

Lipsey, M.W., and Wilson, D.B. *Practical Meta-Analysis* London, Sage, 2001.

Ma, Q., and Liu, L. "The Technology Acceptance Model: A Meta-Analysis of Empirical Findings," *Journal of Organizational and End User Computing* (16:1) 2004, pp 59-72.

Mahmood, M.A., Hall, L., and Swanberg, D.L. "Factors Affecting Information Technology Usage: A Meta-Analysis of the Empirical Literature," *Journal of Organizational Computing and Electronic Commerce* (11:2) 2001, pp 107-130.

Mahmood, M.A., Hall, L. and Swanberg, D.L. "Factors Affecting Information Technology Usage: A Meta-Analysis of the Empirical Literature", *Journal of Organizational Computing and Electronic Commerce*, 11 (2), 2001, pp. 107-130

Mathieson, K. "Predicting User Intentions: Comparing the Technology Acceptance Model with the Theory of Planned Behavior", *Information Systems Research* 2 (3), 1991, pp. 173-191

Sultan, F., Farley, J.U., and Lehmann, D.R. "A Meta-Analysis of Applications of Diffusion Models," *Journal of Marketing Research* (27:1) 1990, pp 70-77.

Venkatesh, V. "Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model", *Information Systems Research*, 11(4), 2000, pp. 342-365.

Wasserman, S., and Faust, K. *Social Network Analysis: methods and applications*, Cambridge University Press, Cambridge, 1994

Rogers, Everett M. *Diffusion of Innovations*. New York: Free Press, 1962, 1995

Schwartz, R. B., and Russo, M. C. "How to Quickly Find Articles in the Top
IS Journals", *Communications of the ACM*, 47(2), 2004, pp. 98-101.

Silverstone, R. and Haddon, L. "Design and the Domestication of Information and Communication Technologies: Technical Change and Everyday Life", in *Communication by Design: The Politics of*

Information and Communication Technologies, Mansell, R. (ed.), Oxford, Oxford University Press, 1996, pp. 44-74

Tornatzky, L.G., and Klein, K.J. "Innovation Characteristics and Innovation Adoption Implementation: A Meta-analysis of findings", *IEEE Transactions on Engineering Management*, 1982, pp. 28-45

Venkatesh, V., Morris, M., Davis, G., Davis, F. "User acceptance of information technology: Toward a unified view", *MIS Quarterly*, 27 (3), 2003, pp 425-478

Wasserman, S., and Faust, K. *Social Network Analysis: Methods and Applications* Cambridge University Press, Cambridge, 1995.

Webster, J., and Watson, R. T. "Analyzing the Past to Prepare for the
Future: Writing a Literature Review", *MIS Quarterly*, 26(2), 2002.

Wijngaert, L. van de, S. Brinkkemper & H. Bouwman (2006), The development and validation of a Web-based Knowledge Infrastructure for multi-theory, multi-method literature research in the IS domain. In: V. P. Guerrero-Bote (ed). Proceedings International Conference on Multidisciplinary Information Sciences and Technologies InSciT2006, Current Research in Information Sciences and Technologies. Multidisciplinary approaches to global information systems, Mérida, Spain, October 25-28, PP. 630-634.

Yousafzai, S., Pallister, J., Foxall, G. A Meta-Analysis of Technology Acceptance Model, *Cardiff Marketing and Strategy Working Papers,* 2006.

Literature included in the analysis

DoI

Stern, S.E., Gregor, S., Martin, M.A., Goode, S., and Rolfe, J. "A classification tree analysis of broadband adoption in Australian households," in: *Proceedings of the 6th international conference on Electronic commerce*, ACM Press, Delft, The Netherlands, 2004, pp. 451-456.

Li, S.-C.S. "Electronic newspaper and its adopters: examining the factors influencing the adoption of electronic newspapers in Taiwan," *Telematics and Informatics* (20:1) 2003, pp 35-49.

Hung, S.-Y., Ku, C.-Y., and Chang, C.-M. "Critical factors of WAP services adoption: an empirical study," *Electronic Commerce Research and Applications* (2:1) 2003, pp 42-60.

Eastin, M.S. "Diffusion of e-commerce: an analysis of the adoption of four e-commerce activities," *Telematics and Informatics* (19:3) 2002, pp 251-267.

Flanagin, A., and Metzger, M. "Internet use in the contemporary media environment," *Human Communication Research* (27:1) 2001, pp 153-181.

Beatty, R.C., Shim, J.P., and Jones, M.C. "Factors influencing corporate web site adoption: a time-based assessment," *Information & Management* (38:6) 2001, pp 337-354.

Tan, M., and Teo, T.S.H. "Factors influencing the adoption of Internet banking " *J. AIS* (1 1es) 2000 p5

Liao, S., Shao, Y.P., Wang, H., and Chen, A. "The adoption of virtual banking: an empirical study," *International Journal of Information Management* (19:1) 1999, pp 63-74.

Karahanna, E., Straub, D.W., and Chervany, N.L. "Information Technology Adoption Across Time: A Cross-Sectional Comparison of Pre-Adoption and Post-Adoption Beliefs," *MIS Quarterly* (23:2) 1999, pp 183-213.

Parthasarathy, M., and Bhattacherjee, A. "Understanding Post-Adoption Behavior in the Context of Online Services," *Information Systems Research* (9:4) 1998, pp 362-379.

Lai, V.S. "Critical factors of ISDN implementation: An exploratory study," *Information & Management* (33:5) 1997, pp 87-97.

Dickerson, M.D., and Gentry, J.W. "Characteristics of Adopters and Non-Adopters of Home Computers," *The Journal of Consumer Research* (10:2) 1983, pp 225-235.

TAM

Adams, D. A., Nelson, R. R., and Todd, P. A. “Perceived usefulness, ease of use, and usage of information: A replication”, *MIS Quarterly*, 16(2), 1992, pp. 227-247.

Burton-Jones, A., Hubona, G. S. "Individual Differences and Usage Behavior: Revisiting a Technology Acceptance Model Assumption”, *ACM SIGMIS*, 36 (2), 2005, pp. 58-77

Dishaw, M. T., and Strong, D. M. “Extending the technology acceptance model with task-technology fit constructs”, *Information & Management*, 36(1), 1999, pp. 9-21.

Heijden, Van der, H. "Factors influencing the usage of websites: the case of a generic portal in The Netherlands.", *Information and Management*, 40 (6), 2003, pp. 541 - 549

Hubona, G.S. and Geitz, S. "External Variables, Beliefs, Attitudes and Information Technology Usage Behavior", In *Proceedings of the 30th Hawaii International Conference on System Sciences (HICSS)*, vol. 3: Information System Track-Organizational Systems and Technology, 1997, p. 21

Jiang, J.J., M.K. Hsu, Klein, G. "E-commerce user behavior model: an empirical study", *Human Systems Management*, 19, 2000, pp. 265-276

Klopping, I. M., and McKinney, E. "Extending the technology acceptance model and the task-technology fit model to consumer E-commerce", *Information Technology, Learning, and Performance Journal*, 22(1), 2004, pp. 35-48.

Malhotra,Y. and Galetta, D.F. "Extending the Technology Acceptance Model to Account for Social Influence: Theoretical Bases and Empirical Validation", in *Proceedings of the Thirty-Second Annual Hawaii International Conference on System Sciences*, 1(1), 1999

Mathieson, K., Peacock, E. and Chin, W.W. "Extending the Technology Acceptance Model: The influence of Perceived User Resources", *ACM SIGMIS Database*, 32 (3), 2001, pp. 86-113

Oh, S. and J. Ahn, B. "Adoption of broadband Internet in Korea: the role of experience in building attitudes", *Journal of Information Technology*, 18 (4), 2003, pp. 267-280(14)

Sun, H. and Zhang, P. "The role of moderating factors in user technology acceptance". *International Journal of Human-Computer Studies*, 64 (2) , 2006, pp. 53-78

Szajna, B. "Empirical evaluation of the revised technology acceptance model", *Management Science*, 42(1), 1996, pp. 85-92.

Taylor, S., and Todd, P. "Assessing IT usage: The role of prior experience", *MIS Quarterly*, 19(4), 1995, pp. 561-570.

Taylor, S., and Todd, P. A. "Understanding information technology usage: A test of competing models", *Information Systems Research*, 6(2), 1995, pp. 144-176.

Venkatesh, V., Davis, F.D. "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies", *Management Science*, 46 (2), 2000, pp. 186-205

Venkatesh, V., Morris, M. G. "Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior", *MIS Quarterly*, 24 (1), 2000, pp. 115-139

Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. "User acceptance of information technology: Toward a unified view", *MIS Quarterly*, 27(3), 2003, pp. 425-478.

Vishwanath, A., Goldhaber, G. M. "An examination of the factors contributing to adoption decisions among late-diffused technology products", *New Media Society*, 5, 2003, pp. 547-572

Chapter 3

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Measuring Internet behaviour: Total Time Diary and Activity Diary as research methods

Contribution

This paper contributes to IS research in several ways. Diary research is of interest for both the scientific area as well as in commercial contexts. Although it has been used in several research areas, such as medical and mobility studies, the use of diaries for in IS research is very new. This paper can be seen as a step in the validation of a method to study the adoption and usage of new technologies.
Furthermore, this paper provides guidelines for the practical implementation of diaries in order to monitor and understand the adoption and use of new technologies, especially more specifically, (broadband) Internet.

This research is particularly of interest for Internet Service Providers that have a need for a new and useful instrument to get to know their (potential) customers. But also managers in companies that are to implement a new technology within their company may find it interesting, as may providers of other technologies, such as WiFi and mobile telephony.

3.1. Introduction

Diary research as a method in which respondents keep track of their daily activities is all but new. In the late thirties by Sorokin and Berger (1939) already made an attempt to collect continuous 24-hour records of human behaviour. Since then the diary

approach has often been used in mobility studies (London Transport Executive, 1949; Timmermans, Waerden, Alves, Polak, Ellis, Harvey, Kurose and Zandee, 2003) time use studies (Broek, Knulst and Breedveld, 1995; Breedveld and Broek , 2001) and in medical research, where it is often used as an instrument to, for example, get more detailed information on patients' pain experience (Jamison et al., 2001; De Wit, 1999). In mass communication studies the diary approach of data collection is used to obtain a most accurate record of all communication activities (Wheeler and Nezlek, 1977; Gudykunst and Shapiro, 1996; Robinson and Godbey, 1997). For example, since 1930, the BBC has undertaken the Daily Life survey every decade to track changes in the way people spend their time and consume media. Since 1965 research is done on the media behaviour (radio and television) in the Netherlands. Participants keep a daily diary during one week, six times a year (Continued Listeners Research in The Netherlands). In this paper we focus on the use of diaries to study internet behaviour. The central questions that will be focussed upon are the following:

1. How does a diary compare to other methods to obtain information about Internet behaviour?
2. How do Total Time Diaries and Activity Diaries measure online behaviour
3. What is the practical value of both methods of data gathering?

This paper will reflect on the experiences and results of two Internet diary studies that have been conducted in the Netherlands in 2001 (Maltha, S., K. Schuurman, K. Vermaas, R. Vandeberg, F. Bongers, R. Bekkers & L. v/d Wijngaert, 2002) and in 2003 (Maltha S., F. Bongers, K. Schuurman, R. Vandeberg, K. Vermaas & L. v/d Wijngaert, 2003). As the vast amount of literature on diary research points out, many efforts have been made to help solve the theoretical issues involved in conducting diary research. Moreover the diary has shown to be a valid and reliable method in a variety of research areas, including the research area of communication. Surprisingly, diaries in which respondents are asked to write down daily Internet activities are virtually unknown. The two Dutch studies can be seen as a first exploration in developing understanding about how to implement diaries in Internet behaviour research.

3.2. Diaries versus other methods to study Internet behaviour

Over the years many methods have been used to study user behaviour regarding new media, such as the Internet. Online surveys are probably most often used to study what people do on the Internet in their daily lives. This method has proven to be a useful method, in which many users can be reached. A possible

concern with regard to (online) surveys however, is the fact that people have to rely on their (selective) memory. This may lead to an incomplete or incorrect view on daily Internet usage. Also, in many cases there is a need for more qualitative information about the way people use the Internet to complement results from online surveys.

Therefore focus groups and interviews have been used for the same purpose. Of course, these methods can be of importance in order to answer certain research questions. But focus groups are perhaps not the most satisfying way to gather information about the actual usage patterns of technology in the daily lives of people. Again people are not at home, behind their computer and connected to the Internet and again, there is a focus on their mnemonic abilities.

To avoid problems with remembrance of the conducted online activities web statistics or log files are often used to get an idea of what people do on the Internet. But web statistics, although an unobtrusive way to study user behaviour, do not always give an accurate view on that behaviour. For example, failing to log in and trying again may be perceived as visiting the same web page more than once, while in reality the page has not been visited at all. Also there is no information on the identity of the user and therefore it is not clear which person or people accessed the Internet during a session.

In most cases the aim of diary research is to obtain data that is close to how people perceive their behaviour. Higgins, McClean and Conrath (1985) claim that the frequency of recorded activities is to be regarded with care as it may not always be a reliable indicator of the actual frequency of those activities. Diary data could be biased in several ways: activities that are more important to the respondent could be reported as lengthier activities. Other issues that need to be kept in mind (Higgins et al., 1985) are duration (are longer activities more likely to be recorded? And are brief activities less likely to be recorded?) and direction (are initiated activities more or less likely to be reported?).

There is however no evidence that diary research is more prone to these problems than questionnaires. In fact more often diaries have been found to be a more valid and reliable method to gather information on activities than questionnaires (Ettema et al., 1996; Robinson, 1985; Arentze, Hofman, Kalfs and Timmermans, 1997). Greenberg, Eastin, Skalski, Cooper, Levy and Lachlan (2004) compare on-line survey, diary and questionnaire to measure Internet use. Their results show that point out that a weblogs are the most accurate way to collect data.

Because respondents do not have to rely so much on their retention, accurate data can be collected. The chance of overestimation, exaggeration or underestimation of the duration and/or frequency of activities tends to be smaller than with for example online surveys.

Table 9 summarised the characteristics of several methods to study online behaviour. These characteristics embed the advantages and disadvantages of the methods. Choosing a method depends on how these characteristics complies with the research goals. In the next section we focus on the choices that have to be made once a diary has ben chosen as a research method.

Table 9. Characteristics of methods to study online behaviour

	Need to rely on (selective) memory	Risk of over or underestimation	Obtrisiveness or intensity	Contextual Information
(Online) Survey	High	Medium	Medium	Medium
Focus Group	High	High	Medium	High
Monitoring	Low	Low	Low	Low
Diary	Low	Medium	High	High

3.3. Types of Diary studies

Sollicited versus unsolicited

As is the case with the aforementioned examples, this paper takes into account the solicited diary. Unlike unsolicited diaries that are spontaneous life documents (such as Anne Frank's diary) solicited diaries are kept at the request of a researcher. Usually the solicited diary is supplemented by interviews and/or questionnaires (National Research Council, 2000, Broek et al., 1995; Breedveld & Broek , 2001). Another distinction can be made between *full activity diaries* (Ettema et al. 1996) or *total time diary* (Robinson & Bostrom, 1994) on the one hand and *activity diaries* on the other hand. The first type of diary records facts about all activities that take place in a 24-hour period. The latter records facts about certain activities only, such as travel diaries (Ettema et al. 1996). In diary research concerning Internet activities this could be translated to "cybertravel diaries" that record about online activities only.

Time keeping the diary

The periods that respondents are asked to keep track of their activities is also an issue. The time spans of different diary studies have been diverse. Kay, Axhausen, Zimmermann, Schönfelder, Rindsfüser and Haupt (2002) for example report their finding from a six-week travel diary. In the various time-use studies the Dutch Social and Cultural Planning Office has conducted since 1975 (Broek et al., 1999) respondents are asked to report their time use for one week with 15-minute intervals. Hinds & Kiesler (1995) requested communication logs of employees for only two days. The period should ideally be long enough to capture the behaviour patterns of interest without putting at risk the completion by making it too much of a burden for the respondents. Carp and Carp (1981) conclude that a one-day diary is not an adequate substitute for a one-week diary. Respondent conditioning might be

influenced by the length of the diary-keeping period. The respondents may alter their behaviour by being aware of the studied behaviour for a longer period (Hilton 1989; Webb et al. 1990).

Leave behind or recall

The choice of the form affects the possible degree of overestimation, exaggeration or underestimation further. The form that this paper will focus upon are *leave behind diaries*, where subjects complete the diaries as the day progresses as opposed to *recall diaries*, where subjects are asked to recall their activities for the previous day. Leave behind diaries are found to be of greater quality than recall diaries (Juster, 1986).

3.4. Two Diary Studies

The goal of the two Dutch diary studies that have been conducted[6] is to gain insights into the information, communication, entertainment and transaction (further referred to as ICET) behaviour in the daily lives of Internet users from a user perspective.

In both cases a kick-off meeting was organised to make the respondents familiar with the procedures. At the end of the diary period the respondents were invited to a final meeting and to in-depth interviews to give more information about their activities and about their experiences with the diary itself.

The Total Time Diary study in 2001

In the case of the 2001 measurement there was a diary on paper (figure 17). The first pages contained a short survey on the demographical backgrounds and Internet experience of the respondents. The following pages of the diary consisted of 12 days (two working weeks and one weekend). Every day was divided into several parts. First the sixteen respondents were asked to give an overall time schedule of their day (did they work most of the day, did they do some shopping or were they actively sporting, and so on). In the second part the respondents gave an overview of their *online* and *offline* ICET- activities of that particular day, as well as the media and mode chosen. Activities ranged from talking to the neighbour at the door and going to the supermarket to e-mailing friends abroad and playing online games.

Codes were used to denote these activities. But because codes in itself do not give an extensive view on what people do, respondents wrote down what they did exactly, with whom and why. Also the

[6] By the Dutch independent research and consultancy firm Dialogic (www.dialogic.nl) in association with the Institute of Information and Computing Sciences, Utrecht University (www.cs.uu.nl)

time (beginning and end) was written down. Every page also contained some space for comments (wishes, frustrations, achievements, etc.) on the activities.

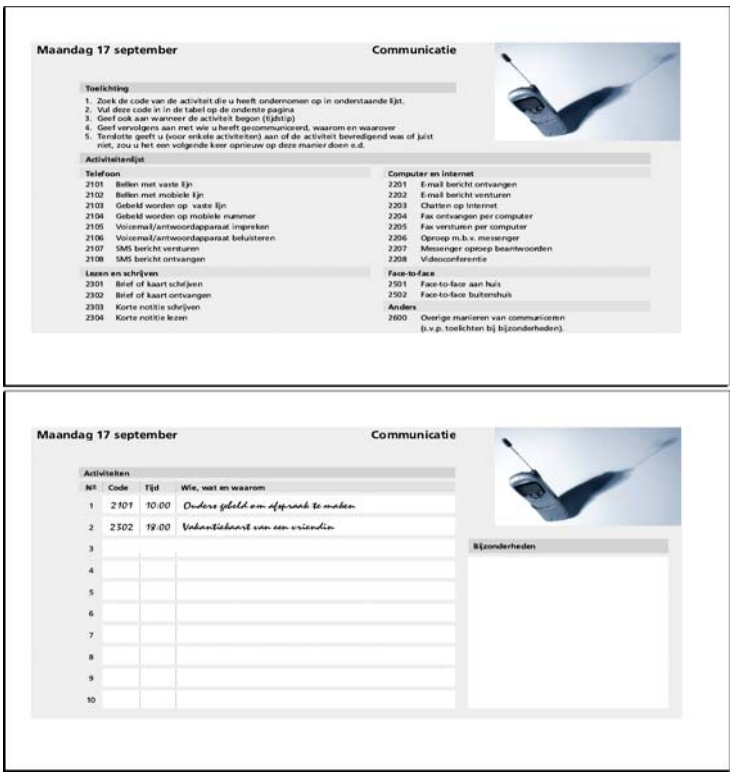


Figure 17. Paper Total Time Diary (2001 TTD study, Dialogic, 2001)

The Activity Study in 2003

During the month of February of 2003 36 people filled in a diary (figure 18). A difference with the diary in 2001 was that respondents were asked to denote only the *online* activities they had conducted. Respondents could use three different forms of the diary; one on paper, one on CD-ROM and an online version.

As a supplementation to the 2001 version there was more emphasis on the motivation for the activities that were conducted and the satisfaction they got out of it. Also every day there was an issue of the day. These were issues concerned with (broadband) Internet related matters, like online shopping, communities and e-health.

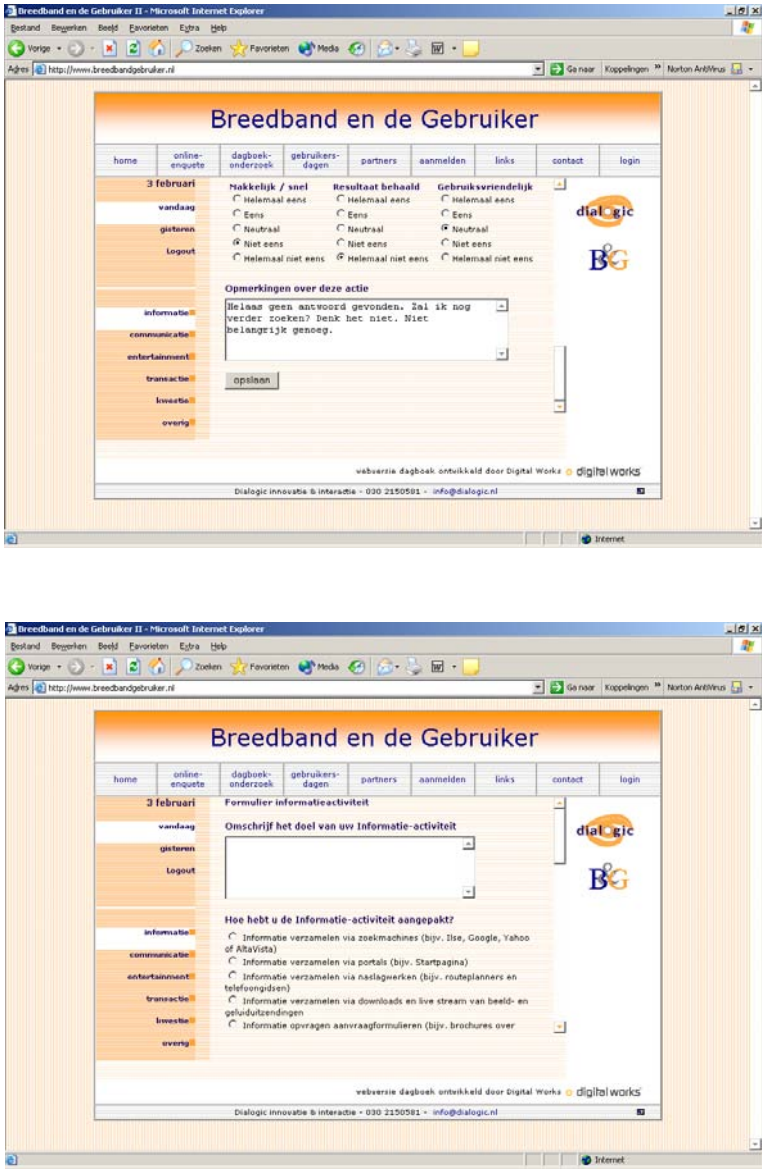


Figure 18. Examples of two pages of diary research of 2003. On the first page the respondents were asked to state the goal of their activity (in this case information activities). Then the approach or mode was specified. The last page starts with the satisfaction and ends with remarks on that activity

Comparing the two studies

Tabel 10 summarizes the different features in both diaries.

Table 10 Items of both diaries (Table continued at next page)

Item	Total Time Diary	Activity Diary
Diary Period	12 days: two working weeks and one weekend 2001	1 month (February) 2003
Form	Leave behind diary on paper	Leave behind diary online, digital (CD-ROM) and on paper at the choice of respondent
Recall period	Maximum of 12 days (no check possible when respondents filled in what day)	Only the present day or the previous day
Activities recorded	Full activity diaries or total time diary	"Cyber travel diary"
Help	Instruction in the diary, assistance through e-mail, telephone	Help files, assistance through e-mail, telephone
Meetings	Kick-off and final meeting + interviews	Kick-off and final meeting
Incentive	Gift-cheque and chance to win a digital camera + copy of final report	Gift-cheque and chance to win a digital camera + copy of final report
Demographics and experience	As a survey on first pages of the diary itself	Gathered at respondents' registration for the research (e-mail)
Global time schedules	To be able to compare to studies of the Dutch Social and Cultural Planning Office	-
Activities	Divided into 4 distinct parts information, communication, entertainment and transactions (as an apprehensive way to group the activities).	Divided into 4 distinct parts: information, communication, entertainment and transactions.
Code	Codes make the distinction between media and mode chosen	No codes, clicking radio button or checkbox/ ticking a checkbox
Time	Beginning and end time	Duration (scales)
Goal	No coding, but open: What, why with whom? (Global description)	No coding, but open: addressed separately (more precise description than 2001 measurement)
Media / approach	Media and approach	Only ONLINE activities, so only approach
Remarks	Per day, open,	Per activity (open) and per day (open)
Satisfaction	Remarks gave the opportunity to express frustrations, wishes and satisfaction regarding the conducted activities	Per activity, open (scale, more precise than 2001 measurement)

Motivation	No coding, but open: What, why with whom? (Global description)	Per activity (multiple choice, more precise description than 2001 measurement)
Visions on (future)Internet issues	-	Through 'the issue of the day'

3.5. Results

The research design for the 2001 TTD study provides us with information about the role that the Internet and online activities have among other media and offline activities, whereas the 2003 AD measurement provides more in depth information about the online activities. Basically, we can distinguish between three types of results: results that provide information with regard to the when, results that relate to the how and results that relate to what or why. The results that are presented here are not meant as a complete description of all the results of the two studies. We want to point out which kinds of results one can obtain from a diary research regarding Internet behaviour depending on the research design.

The time dimension: insight into daily time schedules

The global time schedules that could de deducted from the first diary show the differences between mornings, afternoons, evenings and the nights (figure 20). These global time schedules of the diary research could be compared with data from the Dutch Social and Cultural Planning Office (SCP). The overall image appeared to be comparable. Also a distinction could be made between typically weekday activities and weekend activities (figure 19). A next step that is possible is to determine at what time of the day activities took place and at what time of the day certain media was mostly used. This made clear there were some peaks and drops (figure 21a and 21b). Different needs are being met on different times of the day.

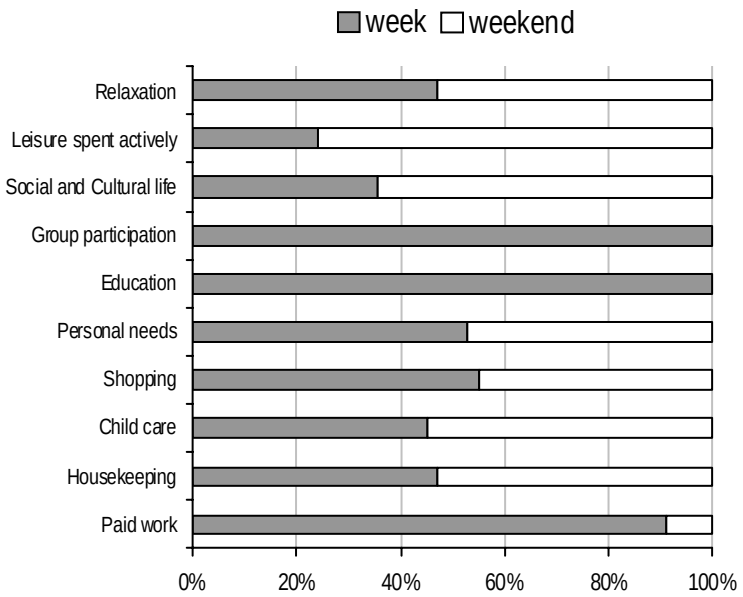


Figure 19. week and weekend activities

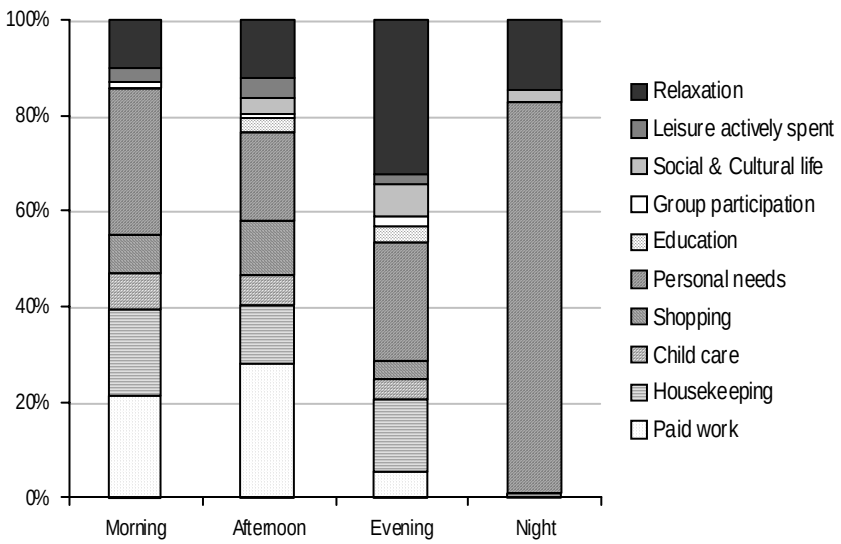


Figure 20. activities at different times of day

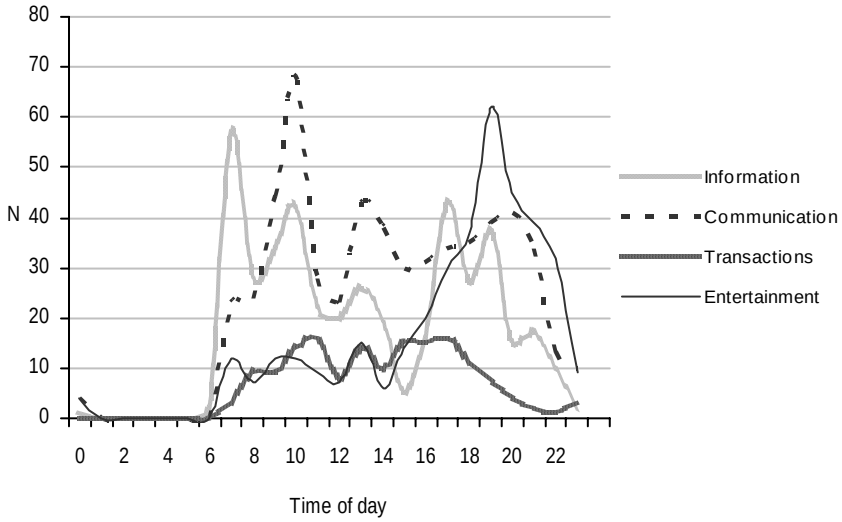


Figure 21.a Activities on different times of the day

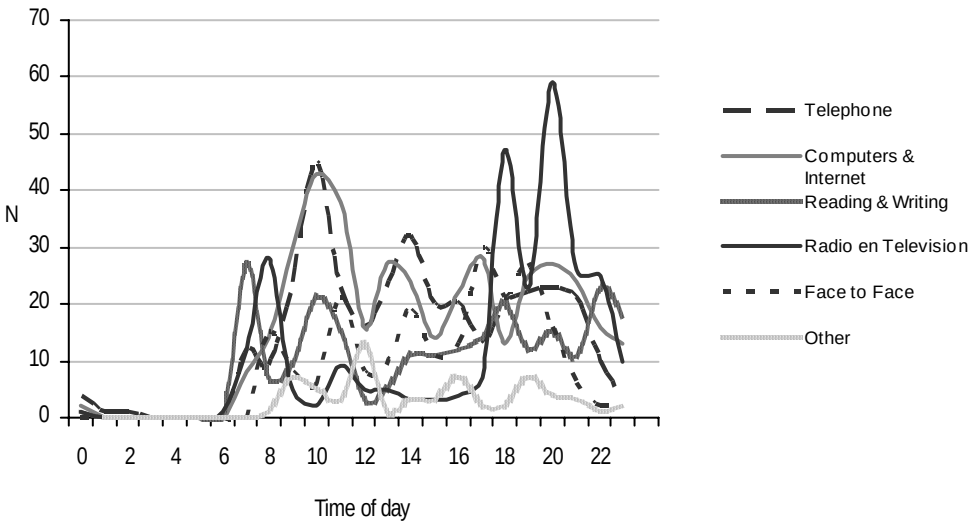


Figure 21.b Media used on different times of the day

Figure 21 . activities and media on different times of the day

The time dimensions not only relate to the time of the day that certain activities were performed. In both the 2001 TTD and the 2003 AD study the relation between ICET activities in frequency and duration was measured. In both diary studies it became evident that some activities were conducted more often than others. The example of the measurement in 2003 is given in table 11. But the relative importance of activities cannot only be measured by the frequency. Also the difference in duration has to be taken into account (figure 22).

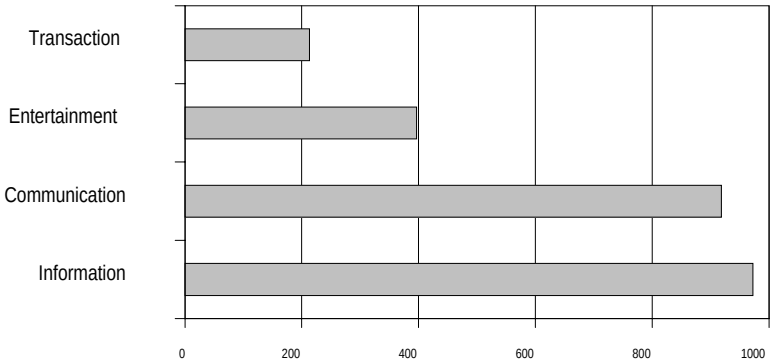


Figure 22.a Number of activities

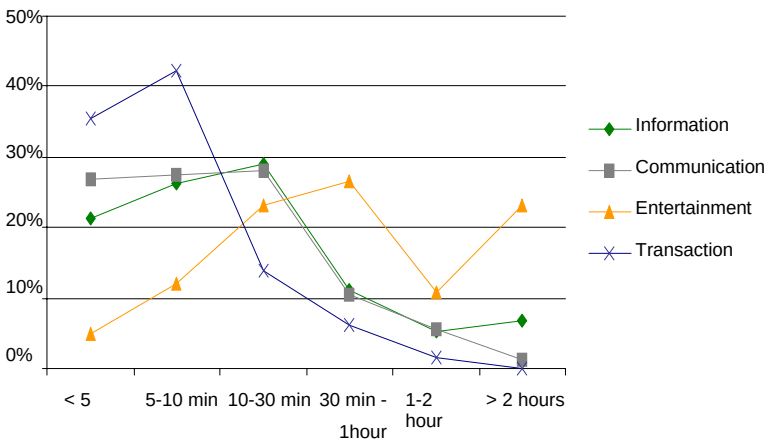


Figure 22.b Duration of activities

Figure 22: Time and activities (2003 AD study, N=2.499)

The How dimension: used media and modes

In the case of the 2001 diary results could be obtained about which media was used for which kinds of activities. Figure 23 shows an example of communication activities. The two most often used ways of communicating (via computer and telephone) are made explicit. Also there was a distinction between received e-mails or phone calls and sent e-mails or phone calls made by the respondent.

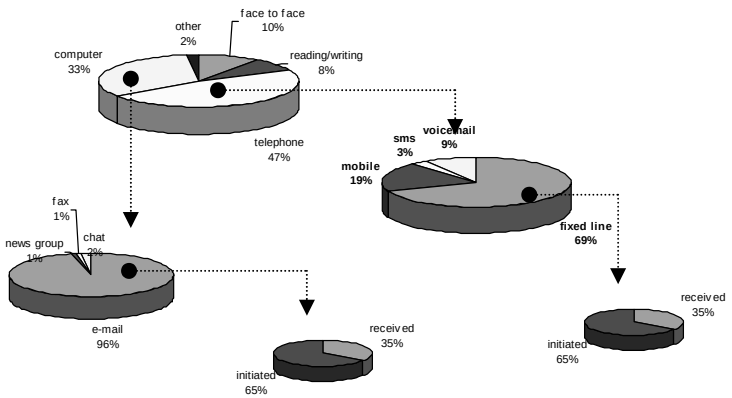


Figure 23: example of results (2001); media, approach and direction of communication activities

The What dimension: motivation and visions (2003)

In the 2003 measurement the focus was on online activities. As a consequence there was no opportunity to analyse the media used. In stead more in depth information was collected about the applications used and the chosen approach. Table 10 shows the example of online information activities (where search engines and favourite sites seem to be the most popular way to find information). This was done for all ICET-activities.

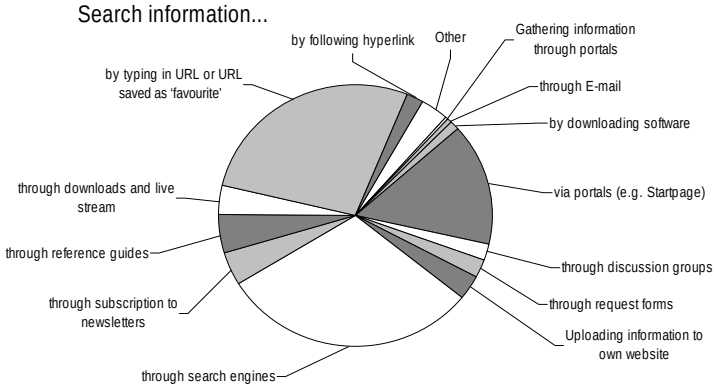
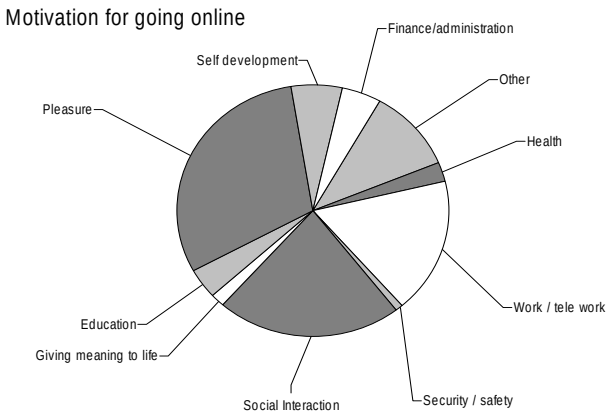


Figure 24. Example of results (2003); Approach of Information activities

Following theories such as uses and gratifications (Katz, Blumler and Gurevitch, 1974; Katz, Gurevitch and Haas, 1973) in the second diary there was emphasis on the motivation for people to do certain activities online. Besides the result shown in figure 25 there was also the possibility to analyse the motivations for each separate



ICET-activity.

Figure 25. Example of results (2003); Motivation for all activities carried out

The Issue of the day

In this section we have presented several results that can be expected from doing a Total Time Diary or an Activity Diary. Last but not least we would like to highlight one more way to gather information using a diary that does not belong to Total Time or Activity Diary. However, this method is closely connected with

diary research and provided us with a lot of information on internet usage. During the 2003 study we asked respondents to elaborate on 'The issue of the day'. The goal of the issue of the day was to gain insights into how people think about different (future) Internet applications and related matters. Every day there was a new issue that respondents were asked to comment on, on different subjects such as e-health, computer criminality, social contacts, e-learning etcetera. It was not the intention to analyse each issue separately. Instead it was aimed to give some overall descriptions of views that people have towards (broadband) Internet. What do people think are the possibilities, weaknesses, opportunities and dangers of this technology? The issues of the day provided a wealth of qualitative data that will be subjected to further exploration. Table 11 sums up the different ways the Internet is seen by the respondents.

Table 11. example of results (2003); visions on the Internet (short summary)

The Internet as:	
A	*Expensive medium* In many reactions on different issues respondents address high costs: electricity costs, telephone costs, subscription costs, delivery costs (when buying online) etc. Some see these high costs as a burden to use the Internet, whereas others think the advantages of having Internet are more important.
B	*Exotic dish* Many people are not familiar with all the possibilities of the Internet and especially broadband ('*that is out of my league*').
C	*Replacement of the real world* In most cases the respondents agree on that the internet can be a supplement to the real world but never a substitute. Virtual counters and buying online will not replace all actual visits to shops (smelling books, touching the tomatoes, talking to other people). *'A society in which everything is digital seems cold and impersonal to me'* *'Imagine entering the name of your new born daughter into an input field of the website of the city council. Then something is really missing!'*
D	*Danger* Poor social contacts, RSI, computer criminals and –terrorists, addiction, abuse of personal information are all possible dangers caused by the further spreading of the Internet.
E	*Hobby* Spreading information through own websites, web- and life logs, playing online games, online spirituality have more to do with hobbies and interests people have than with technology. Even though technology makes everything possible, a large group will not participate. *'Religion is not my cup of tea'', 'I never play games, I don't think that is interesting', 'Web logs are a completely uninteresting phenomenon for me''*
F	*World Reformer* For some (broadband) internet has great impact on their lives: *'Broadband has got enormous impact on my life. Without it I wouldn't have been the same person. That may sound drastic but it is undoubtedly so.' And 'Broadband gives meaning to my life'*. They also argue that (broadband) internet can help solve traffic jams, loneliness, medical problems etc.

Ultimately, with the data from the issues of the day we could provide insight in the different points of view people have towards broadband and if and how it will change the world of the personal environment of people. Figure 26 shows these points of views.

First, there are individuals that see that broadband technologies could change the world, but do not want to participate themselves. Secondly, there are individuals that have a very positive view on broadband technology in the future. According to them the world is going to change through this technology. This pleases them because they see the Internet and it's services as a hobby. Thirdly, we can distingish individuals that are very negative towards broadband technology. They do not have experience with broadband technology and primarily see dangers. And fourthly, there are individuals that are torn between two views. On the one hand they like to work with the Internet and it's services, but on the other hand they see dangers lying ahead.

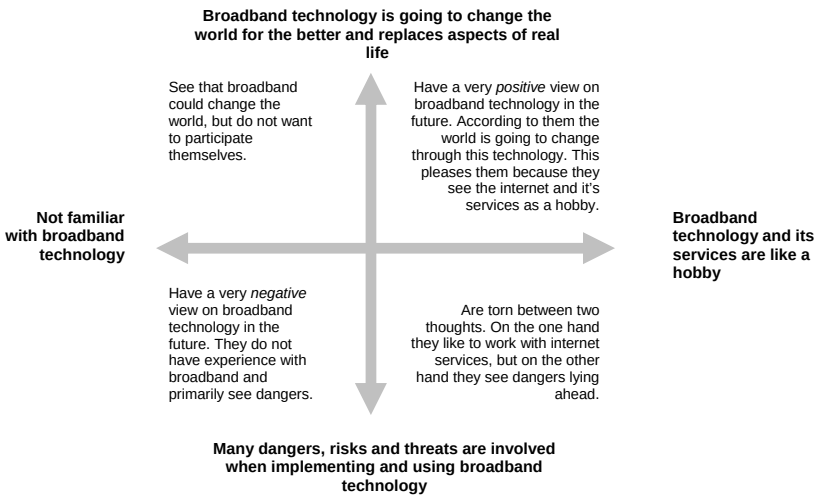


Figure 26. Point of views of internet users towards the future of broadband (2003).

Before we will draw our conclusions with regard to the applicability of diary research, we will first highlight some of the practical issues we encountered.

3.6 Practical issues encountered

Diary research, as any method of research is concerned with many practical issues. In this section we would like to highlight some of them: Response, period of measurement, meeting and help lines, Appearance and form of the diary, Respondent conditioning, cost of the diary, data and analysis.

Response

Diary research is known as a demanding research, for which it is hard to find respondents. In both diary studies this problem was encountered. Therefore an incentive for their effort was in given. This incentive was carefully chosen; it had to be more than a symbolic gesture, but smaller than a true payment as this may influence the respondents' attitude towards future research. Every respondent received a gift cheque (25-50 euro) and a copy of the final report. Furthermore, one digital camera was given away to one of the respondents. To reach the respondents advertisements were placed in free local papers and on websites. Also flyers were given to people on the streets and put into mailboxes. In 2003 of the 60 people found willing to participate, almost 22 dropped out before the research had started. Most people stated they did not have the time to participate. In 2001 this problem was not encountered. Of the people that actually started keeping the diary in 2003 only 2 respondents dropped out. Despite the fact that it was a demanding research in both cases, many respondents made explicit remarks that they liked participating.

Period of measurement

Holidays, sport events, elections etcetera all have influence on the willingness of people to participate in or to complete a diary research. Even in a small country like the Netherlands there are some holidays (like carnival and Ramadan) that are not celebrated by everybody, but can have an effect on activities performed. Both studies have been conducted in 'regular' weeks of September and February. In the case of 2001 the happenings of September the 11th were unpredictable. But because information was gathered on what people did exactly, it was possible to analyse what differences in activities were caused by these happenings. Respondents were told that they could miss out on one day a week, but many missed out more days. When there were days with special conditions (not going online, being ill, a day off etc.) respondents were asked to write that down.

The respondents of the second diary made remarks about the length of the research. Although the second measurement lasted 4 weeks compared to 2 weeks in the 2001 measurement) there is no evidence that the longer the respondents are looked at, the more detailed information is collected. These facts may plead for a maximum length of two weeks.

Meetings and help lines

The final meeting and especially the kick-off meeting have shown to be of importance. During these meetings people posed questions, got instructions and were encouraged to participate. The first day of the diary was filled in during the kick-off meeting. During the final meeting the first results were presented to the respondents.

Also important is the possibility for respondents to pose questions throughout the diary period. This was done by phone or e-mail. Few people have used these help lines, but some said that they would have given up on the research if they did not receive the needed help immediately.

Appearance and form of the diary

From interviews with the respondents it became clear that the appearance of the diary itself was important. Mistakes could become annoying and a reason to drop out. Also people stated that if it had been a boring and badly designed diary they would have lost the enthusiasm to continue. Regarding the 2003 diary, people were pleased with the fact that they could choose from different forms of the diary. The diary on paper as used in the first measurement was really referred to as 'dear diary' and respondents wrote down a lot of personal information.
Advantages of the online diary were that coding and retyping of the data into the statistical software was not necessary. The statistical software program easily read in the data that were collected in a database. By this, errors could be reduced and a fair amount of time was saved.

Respondent conditioning

Signs of limited respondent conditioning were found during both studies. Especially respondents with little Internet experience sometimes found themselves trying more online activities than they would have done otherwise. But this was not a problem because respondents wrote down when this occurred, so this could be regarded while analysing.

Cost of the diary

The overall costs of diary research may be higher than the costs of traditional or online surveys. There are different sorts of costs involved. First of all there were cost to gather the respondents (advertisements and flyers). Also the incentives took quite a lot of the budget (gift cheques and digital camera). Developing and printing or programming of the diary also takes a fair amount of time and money, mainly because the appearance and faultlessness of the diary is important. Also the costs of meetings (accommodation, drinks, snacks, refunding of travel expenses etc.) must not be overlooked.

Analysing

The data of the diaries was analysed through SPSS software[7]. The more qualitative data could be analysed through a special software

[7] www.spss.com

package Kwalitan[8]. In case of (suspected) errors and ambiguities respondents were contacted. The questions earlier addresses as theoretical issues (such as whether longer activities were more likely to be recorded direction whether received interactions were more likely to be recorded than self initiated ones) were questioned in interviews. There was no sign that people over- or under-estimated certain activities.
The examples of the quantitative results mainly take into account frequencies and cross tabulations, but more analyses could and will be performed. Also the qualitative data can be used to answer more specific questions.

Data

The data gathered by the two diary studies provide a wealth of qualitative data. More detailed information can be gathered on what people do exactly. For example, not only will we know that a person has looked for information, but also that that person looked for information on butterflies and that he did that because it is his hobby and that he found something else then he had expected, but what he found was even more beautiful than he expected etc. But also quantitative data can be obtained (especially with larger groups of respondents)

3.7. Practical applicability

In this final section we will focus on the practical applicability of diary research. We will outline the specific opportunities that Total Time Diaries and Activity Diaries have to offer. Also we will provide several examples of possible research contexts in which diary research can be applied.

Total Time Diary

A Total Time Diary provides a relatively general insight into human (internet) behaviour. It places certain activities into the broader context of daily (organizational) life. This provides us with a general, relatively slow changing view of how people use (or not use) old and new technologies. This approach towards diary research offers the opportunity to fundamentally understand human behaviour in a very broad sense. From this fundamental understanding it is possible to derive ideas for fundamental changes invoked by new technologies. Taking the people (rather than users of technologies) as a starting point we can think of radically new ways of applying new technologies. Total Time Diaries therefore offer the opportunity to reveal latent needs that can be served with innovative new services. By grasping what people consider frustrating, time-consuming and constraining in

[8] www.kwalitan.net

their daily lives, it becomes possible to deduct which new technologies and services can offer possibilties to overcome these frustrations. These technologies and services are likely to be adopted, because they fit the (latent) needs of people.

Activity Diary

In contrast to Total Time Diaries, Activity Diaries concentrate of specific behaviours. The diary study that was described in this paper concentrated on Internet behaviour. We believe that an Activity Diary is useful when there is a clear direction or domain with regard to which new technologies will be applied. An Activity Diary can provide useful information with regard to how a new technology will fit in the daily lives. An Activity diary can for example provide insight into specific behaviour, for example activities that are unusual task or tasks in a specific context.
If managers for example are to implement new technologies within their orgnization they are often confronted with problems. The acceptance of new technologies for professional activities is often far from uncomplicated. One of the explanations is that it is because the technology does not fit in the daily activities that the employees carry out. If a manager is aware of what activities employees carry out, in what way and by which media it is better possible to implement new technologies.

3.8. Conclusion

Diary research enables researchers to create an image of what people do with technology and perhaps more importantly *why* they do it. These insights into the role that a certain technology plays for people is of considerable importance for scientists that are concerned with understanding the adoption and the usage of new technologies and information systems. But is also of great interest for for example (Internet) Service Providers. By conducting diary research they are able to get to know their (potential) customers and develop and shape new technologies to better fit the needs and requirements of those (potential) customers. Although the diary as a scientific research instrument to study Internet behaviour needs further refinements, the two conducted diary studies appear to be a valuable step in the evolution of a valid instrument to measure Internet behaviour.
The insights gained through diary research provide an important (deepening) addition to results of online surveys and web statistics. The results tend to be more qualitative and detailed: telling the stories behind the figures. Compared to focus groups the diary approach tends to provide more quantitative results. Especially when the diary research is conducted with a larger group of respondents more quantitative results can be gained.

Moreover, the results of diary studies can be used to get to know the users of the media studied, whether they are customers, citizens or employees. With that information products and services can be adapted to better fit the needs of the users. Furthermore the results can be used to investigate the possible opportunities and constraints of new technology and services.

References

Arentze, T., Hofman, F., Kalfs, N., and Timmermans, H. (1997). Data needs, data collection and data quality requirements of activity-based transport models. Proceedings, International Conference on Transport Survey Quality and Innovation (Transport Surveys: Raising the Standard), 24-30 May 1997, Grainau, Germany.

Axhausen, K.W., Zimmermann, A., Schönfelder, S., Rindsfüser, G., Haupt, T. (2002). Observing the rhythms of daily life: A six-week travel diary. Transportation, 29 (2) , pp: 95-124, Kluwer

Broek, A. , van den, Knulst, W.P., Breedveld, K. (1999). Naar Andere Tijden. Den Haag, SCP (the Dutch Social and Cultural Planning Office)

Breedveld, K., Broek, A., van den (2001). Trends in de tijd. Den Haag, SCP (the Dutch Social and Cultural Planning Office)

Carp, F M; Carp, A (1981). The validity, reliability and generalizability of diary data.Experimental Aging Research, 7 (3), pp: 281-296

Conrath, D.W., Higgins, C.A., & McClean, R.J. (1983). A Comparison of the Reliability of Questionnaire versus Diary Data. Social Networks, 5, pp: 315-322, Elsevier

Ettema, D., Timmermans, H., Veghel, L.,van. (1996). Effects of data collection methods in travel and activity research. EIRASS (the European Institute for Retailing and Services Studies)

Godbey, G., Robinson, J. (1997). The increasing prospects for leisure. Parks and recreation, 32 (6), pp: 74-82

Goossens, M.E.J.B.; Molken, M.P.M.H.R.-v.; Vlaeyen, J.W.S.; van der Linden,
S.M.J.P. (2000). The cost diary - a method to measure direct and indirect costs in cost-effectiveness research. Journal of clinical epidemiology, 53(7), pp: 688-695

Greenberg, B.S., M.S. Eastin, P.D. Skalski, L. Cooper, M. Levy and K.A. Lachlan (2004). "E" for Accuracy! Comparing Survey, Diary, and E-tracking Methods of Measuring Internet Use. Paper presented at the 54th Annual ICA Conference on Communication and The Public Interest, New Orleans, May 27-31, 2004.

Gudykunst, W.B. & Shapiro, R.B. (1996). Communication in everyday interpersonal and intergroup encounters. International Journal of Intercultural Relations, 20 (1), pp: 19-45

Higgins, C.A., McClean, R.J., Conrath, D.W. (1985). The Accuracy and Biases of Diary Communication Data – Social Networks. International Journal of Structural Analysis, 7 (2). pp: 173-187, Elsevier

Hilton, M. E. (1989). A comparison of a prospective diary and two summary recall techniques for recording alcohol consumption. British Journal of Addiction, 84, pp:1085-92.

Hinds, P. & Kiesler, S. (1995). Communication across Boundaries: Work, Structure, and Use of Communication Technologies in a Large Organization. Organization science, 6 (4), pp: 373-393

Juster, F. Th. (1986). Response Errors in the Measurement of Time Use. Journal of the American Statistical Association, 81(394), pp: 390-402
Jamison, R.N., Raymond, S.A., Levine, J.G., Slawsby, E.A., Nedeljkovic, S.S., Katz, N.P. (2001). Electronic diaries for monitoring chronic pain: 1-year validation study 2001. Pain, 91 (3) pp: 277-285

Katz, Blumler and Gurevitch (1974). Uses and gratifications research. Public Opinion Quarterly, 37(4)

Katz, Haas and Gurevitch (1973). On the Use of Mass Media for important things. American Sociological Review, 38(2), pp. 164-181

London Transport Executive (1950). "London Travel Survey" Research Services, LTD, book review in American journal of sociology, 56(3), pp: 296-297 1949, (review author Breese, G.)

Maltha, S., K. Schuurman, K. Vermaas, R. Vandeberg, F. Bongers, R. Bekkers & L. v/d
Wijngaert, (2002). Breedband en de Gebruiker 2001. Utrecht, Dialogic innovatie & interactie

Maltha S., F. Bongers, K. Schuurman, R. Vandeberg, K. Vermaas & L. v/d Wijngaert (2003). Breedband en de Gebruiker 2003. Utrecht, Dialogic innovatie & interactie

National Research Council (2000) Time-use measurement and research: Report of a workshop, Committee on National Statistics. Ver Ploeg, M., Altonji, J., Bradburn, N., DaVanzo, J., Nordhaus, W., Samaniego, F. (eds). Commision on Behavioral and Social Sciences and Education. National Academy Press, Washington DC

Robinson, J. (1985). "The validity and reliability of diaries versus alternative time use measures". In: F. Juster en F. Stafford (eds). Time, goods, and well-being. Michigan: Institute for Social Research, 1985 (33-62).

Robinson, J.P. & Bostrom, A. (1994) "The overestimated workweek? What time diary measures suggest," Monthly Labor Review, 8, pp. 11–23.

Sorokin, P.A., & Berger, C.Q. (1939). "Time-budgets of Human Behavior." Book Review in American journal of sociology, 45 (2), pp: 274-276, (review author: Bowers, R.V.)
Timmermans, H., Waerden, P., van der, Alves, M., Polak, J., Ellis, S., Harvey, A.S., Kurose,

S. and Zandee, R. (2003) "Spatial context and the complexity of daily travel patterns: an international comparison". Journal of Transport Geography, 11(1), pp: 37-46

US department of labor (2003). Consumer expenditures in 2001. http://www.bls.gov/cex/(visited 10-06-03)

Webb, G. R., S. Redman, R. W. Sanson-Fisher, and R. W. Gibberd (1990). Comparison of a quantity-frequency method and a diary method of measuring alcohol consumption. Journal of Studies on Alcohol (51), pp: 271-277.

Wheeler, L & Nezlek, J. (1977) "Sex differences in social participation". Journal of Personality & Social Psychology, 35(10), pp: 742-754

Wit, R., de, Dam, F., van, Hanneman, M., Zandbelt, L., Buuren, A., van, Heijden, K., van der, Leenhouts, G., Loonstra, S., Huijer Abu-Saad, H. (1999). "Evaluation of the use of a pain diary in chronic cancer pain patients at home". Pain, 79(1), pp: 89-9

Chapter 4

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A longitudinal study into the reasons and thresholds for residential users to switch to broadband (2001 to 2005)

Abstract

Now that internet has become widely available in the Netherlands, some people have taken the step to a broadband connection at home whereas others have not. The goal of this research is to obtain insights into the reasons why people adopt or reject broadband in the residential context. This investigation is done from a user perspective. Using online questionnaires, a longitudinal (2001, 2003, 2005) study was performed. Results show that three features of broadband have been reasons to adopt it over the years: high speed, always on and flat rate. Furthermore, results show that for long the most important threshold was the financial one and paradoxically financial aspects are also a trigger for adoption. This financial bottleneck has largely disappeared, as well as the physical accessibility threshold. Cognitive and technical thresholds have shown less important over the years. What remains are the internet users who are quite satisfied with their current narrowband connection. It is probably hard to convince those people of the usefulness of broadband, unless for example alternatives are no longer available.

Keywords: broadband, users, adoption, reasons, triggers, thresholds

4.1 Introduction

Narrowband internet was already available to Dutch consumers in the nineties. Broadband internet is the next step after narrowband internet. A step some people have already taken, whereas others have not. Gaining insights into the reasons for people to make the step and insights into the thresholds for people who have not made

the step (yet) is important, because with these insights there is a chance to accelerate the adoption of broadband. This is important information for telecom providers and policy makers worldwide. But moreover, there is a need to broaden the scientific insights in adoption of new technologies. Of course, there has been research into the adoption of internet, but broadband adoption may be different to the adoption of (narrowband) internet in the nineties. In the nineties, internet was a completely new experience for the users, which involves particular reasons to adopt or reject. Broadband technology is new and innovative in technological terms, but the average user will hardly experiences any difference between broadband and narrowband (except for speed, the possibility to send and receive large amounts of data etc), especially now that real broadband services have not yet been developed.
The goal of this research is to get insights into the reasons why people adopt or reject broadband internet in the residential context. The research questions thus are:

1. What are the reasons people switch from a narrowband internet connection to a broadband connection?
2. What are the thresholds for people for switching to a broadband connection?
3. To what extent do these reasons and thresholds change over the course of time?

High price, lack of content and lack of awareness are said to be major factors influencing the adoption of broadband in the UK (Dwivedi, Choudrie & Gopal, 2003). In contrast to this study in the UK that examined the Internet Service Providers opinion upon the deployment of broadband, our investigation is done from a user perspective. In literature addressing the concept of diffusion, the adoption of technological innovations is seen as dependent on one's innovativeness, or willingness to try new products (Rogers, 1995; Atkin, et al., 1998; Neuendorf, et al., 1998). Although technology characteristics also play a role, according to Rogers (1995) 'an innovation is an idea, practice, or object that is perceived as new by an individual or another unit of adoption.' And 'innovativeness' is regarded as 'the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of a system'. These remarks make clear that the individuals that are to adopt (or reject) the innovation play a crucial role in the diffusion process. It is therefore important to study the adoption and diffusion process from a user perspective. Of course, we acknowledge that the determinants of broadband adoption are quite complex and include both demand and supply factors. But many parties involved in the promotion of broadband (for example governments and telecommunications companies) have shifted focus from the supply side to the demand side, because it becomes increasingly apparent to these parties that even where the availability of broadband is high and costs started to

reduce, the demand remains lower than expected (Firth et al., 2002). The reasons and thresholds may change over time, as costs tend to be reduced by competition in the market (OECD, 2001) and as the awareness and availability grows.

4.2 Broadband, benefits and thresholds

In order to get an understanding of what is meant by broadband Internet in this research, we will now discuss this. First of all we have only taken into account fixed internet access. Although we acknowledge that wireless broadband access is an important development, wireless connections, such as Wi-Fi and UMTS are out of the scope of this research.
The 'traditional Dial-up connections' such as PSTN (public switched telephone network) and also ISDN (Integrated Services Digital Network) connections are considered narrowband in this paper. Broadband is used to indicate telecommunication in which information can be transmitted over a wide band of frequencies. Because of the wide band of frequencies that is available, information can be sent on many different channels within the band simultaneously, allowing more information to be transmitted in a given amount of time. Two important characteristics of broadband Internet are 'flat fee' and 'always on'. 'Flat fee' means that the subscribers pay a fixed amount of money per month, regardless of the actual time spent online (as opposed to dial-up access, where people pay per time-unit that they are connected). 'Always on' means that there is direct connection at any time; there is no need to dial up. Based on these characteristics Asymmetric Digital Subscriber Line (ADSL), cable and fibre optics are considered broadband in this research.

Perceived benefits form an important factor in the adoption of technologies (Davis, 1989, Rogers, 1995). The particular aspects of broadband, such as always on and the ability to send and receive large amounts of data, may give the user more convenience compared to people who have used traditional telephone lines. Broadband users could save a considerable amount of time (Pociask, 2002) compared to narrowband users.
According to Anderson, Gale, Jones & McWilliam (2002) broadband users make more frequent use of a wider range of applications. In the research conducted by Wales, Sacks and Firth (2003) respondents universally said that they were not driven to broadband by an application. Rather, they found that broadband enabled them to use standard Internet applications (email, chat, browsing) more efficiently. Wales at al. speak of killer attributes instead of killer applications and these include reliability of service, downloading speed, networking of home computers, and the convenience of always on connectivity. They also mention cost reductions as a trigger to adopt broadband. Different from Wales et

al. there are researchers that do mention killer applications. While narrowband Internet is adequate for many current residential applications, some applications will be hard to use and cause annoyances by the users. In order to keep those annoyances to a minimum, many users that use peer to peer applications (including games, swapping of large files and pornography) will find they require a broadband connection. These applications are said to be the killer applications for broadband to the home (Firth & Kelly, 2001; Thierer, 2002; Waless et al., 2003, Anderson, 2002). Another possible reason for people to switch from a narrowband connection to broadband may be that with the flat fee, especially heavy users, may be able to reduce their internet costs (Wales et al., 2003). The study of Wales et al. (2003) also observed some discrepancies between the perceived benefits in households that had adopted broadband and those that hadn't. Then, there are researchers that suggest that internet and particularly broadband enhances the quality of life by increasing contact between parties. Internet users in fact have more face to face and phone contact with friends and family than do non-users. Those with good conventional friendship links extend those to the Internet (Katz et al., 2001). Also online relationships have been found to enhance conventional ones (Katz & Rice, 2002; Wellman et al. , 2001).
Table 12 shows the possible triggers with references to literature and the assumptions we have deducted from that. In the results section we will come back to these assumptions.

Table 12 Possible triggers for broadband adoption

		Reference	Assumption
Convenience / comfort	Always on	Choudrie & Dwivedi, 2005; Wales, Sacks and Firth, 2003	For broadband users the convenience that a broadband connection offers them was an important reason to adopt broadband.
	Send and receive large data files	Wales, Sacks and Firth, 2003; Choudrie & Dwivedi, 2005	
	Fast data transfer / Time saving	Wales, Sacks and Firth, 2003; Choudrie & Dwivedi, 2005; Pociask, 2002	
	Free telephone lines / no need for 2nd telephone line	Choudrie & Dwivedi, 2005; Hausman, Sidak & Singer, 2001	
	Ability to connect computers	Wales, Sacks and Firth (2003)	
Cost reduction	Flat fee	Wales, Sacks and Firth 2003; Choudrie & Dwivedi, 2005	For broadband users the cost reductions for internet use was an important reason to adopt broadband.
	Cost reduction, because of online content: films, video, music, games, software and because of less traveling		Broadband users and narrowband users have different views on the cost reductions that can be accomplished with broadband (Wales, et al., 2003).
Ability to use broadband (peer to peer) applications	gaming, swapping and using video/audio files	Firth & Kelly, 2001; Thierer, 2002; Wales et al., 2003; Anderson et al., 2002; Choudrie & Dwivedi, 2005	For broadband users the ability to use broadband (peer to peer) applications was an important reason to adopt broadband.
To better perform current tasks: social contacts, tele working and school activities		Katz et al., 2001, Katz & Rice, 2002; Wellman at al., 2001 Wales, et al. 2003Pratt, 2003, Choudrie & Dwivedi, 2005	For broadband users the ability to strengthen existing or begin new social contacts was an important reason to adopt broadband. For broadband users the possibility to (better) perform telework or school activities was an important reason to adopt broadband.

Annoyances as triggers

The perceived benefits of technologies will especially be visible to potential users when they compare it to their current situation. If internet users are not satisfied with their current situation, they will look for an infrastructure that will possibly take away their annoyances. If an internet user for example wants to use peer to peer applications, video on demand or other services that require a lot of bandwidth, but only has access to a narrowband connection, this will cause annoyances. With broadband there would be a better situation. The annoyances caused by the constraints of the connection will possibly trigger broadband adoption. Therefore annoyances and irritation are important to measure. But as far as we know, little or no research is done into this. In this research this is included.

4.3 Thresholds

What makes individual adopt and use certain media or technologies? A number of media choice theories have addressed this question. The central issue in many media choice theories is whether a technology is suitable to fulfil a specific need. The Social Presence concept (Short, Williams and Christie, 1976), Media Richness (Daft and Lengel, 1986; Trevino, Daft and Lengel, 1990), the Social Influence Model (Fulk, Schmitz and Steinfield, 1990), the Dual Capacity Model (Sitkin, Sutcliffe and Barrios-Choplin, 1992), and Media Appropriateness (Rice, 1993) offer comparable starting points for the analysis of media choice. The basic assumption is that a good task/medium fit is essential for effective communication. A lack of the fit between task and medium or technology can cause rejection. Apart form the Task Technology Fit (TTF) there are other conditions for adoption and use of a medium or technology. There are several barriers (Bouwman et al., 1996) or thresholds (Van Dijk, 1997) to be overcome before an individual will adopt a medium or technology. Van de Wijngaert (2001, 2004) in her 3- Thresholdsmodel discerns physical accessibility, affective accessibility and fit of the medium or technology. Bouwman et al. distinguish four thresholds. Apart from physical accessibility, they treat financial, technical and cognitive accessibility.

Accessibility

After determining the TTF, the question rises which technologies are accessible to someone in a certain situation? Accessibility can be defined as the subjective perception of the user of the degree in which he will encounter difficulties while using the technology (Auster en Choo, 1993). In order to use a medium or technology a user has to have physical access to it, by owning it or by accessing it in a different way, for example internet access in libraries or internet cafes. In some cases this could be related to financial accessibility; does a person have enough money to access the

technology? Even if someone has physical and financial access to a technology, technical accessibility can be an issue. This is concerned with the way the technology is offered and the consequences it has for the possibilities to use. Important aspects are ease of use and the user interface. Closely related to technical accessibility is cognitive accessibility. It involves the amount of experience that is needed to use a medium. This is related to what Davis (1989) refers to as perceived ease of use: the degree to which a person believes that using a particular system would be free from effort.

Negative outcomes as thresholds

While broadband-enabled activities may bring benefits, they may also have negative outcomes such as addiction, financial problems and displacement of conventional social contacts (Katz & Rice, 2002; Wales et al., 2003). Fears of or experience with these negative aspects may also be a threshold for some people to adopt broadband. The possible thresholds are depicted in Table 13. This table also makes clear that there are thresholds of *willingness* and thresholds of *ability*; if there is no need, if the technology doesn't fit the task or if people fear negative outcomes as a result of using the technology, they will be *unwilling* to use the technology. If, on the other hand, there is no broadband available, one has not enough money to buy or use the technology, has not enough skills to use it, or has no pc or other devices to use the technology, there is no *ability* to adopt.

Table 13 Possible Thresholds for adoption of broadband

	Threshold	References		Assumption
Willingness to adopt	**Lack of task technology fit or lack of need**	Short et al., 1976; Daft & Lengel, 1986; Trevino, et al., 1990; Fulk et al., 1990; Rice, 1993; Sitkin et al., 1992; Van de Wijngaert, 2001; Wales, Sacks and Firth, 2003; Davis, 1989	Not interested in broadband, broadband has no added value, satisfied with narrowband connection	The absence of a need in which broadband theoretically can be helpful is an important reason for people to reject broadband
	Negative outcomes	Katz & Rice, 2002, Wales et al., 2003	Addictive character of broadband, unwanted information (sex, advertisements etc.)	Possible negative outcomes are an important reason for people to reject broadband
Ability to adopt	**Lack of Physical accessibility**	Van de Wijngaert, 2001; Wales et al., 2003	Broadband is not available	The absence of broadband infrastructure is an important reason for people to reject broadband This threshold will get less important over time, as infrastructure grows
	Lack of financial accessibility	Bouwman et al., 1996; Wijngaert, 1996	Installation costs are too high, subscription costs are too high	The high costs for using broadband is an important reason for people to reject broadband This threshold will get less important over time, as prices go down because of market mechanisms
	Lack of Technical accessibility	Bouwman et al., 1996; Van de Wijngaert, 1996	Unsuitable PC	Having a unsuitable PC for using broadband is an important reason for people to reject broadband
	Lack of Cognitive accessibility	Bouwman et al., 1996; Van de Wijngaert, 1996; Davis, 1989	Lack of skills, too much hassle	The lack of skills is an important reason for people to reject broadband

When we combine the benefits of broadband as possible triggers for broadband adoption and the possible thresholds, which may change over the course of time, the following research model applies (Figure 27).

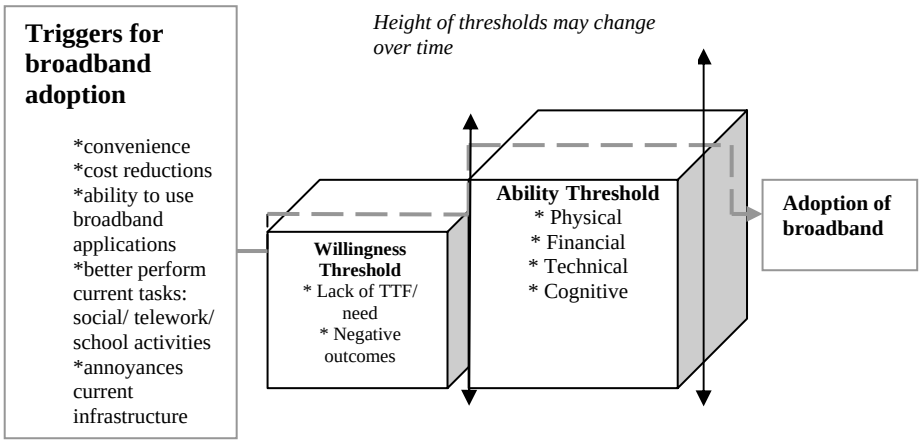

Figure 27 Research model for the longitudinal study into the reasons and thresholds for residential users to switch to broadband (2001 to 2005)

The method for investigating our research model and questions and the mode of data collection are presented in the next section. After this the results will be presented followed by conclusion and discussion section.

4.4 Method and data collection

The data for this paper is collected in a longitudinal study that allows us to see how technology use is developing over time. The first data gathering was in 2001 (September - November). The second wave of data gathering took place from January to March 2003 an the last measurement was from October 2004 to February 2005.

The objective of the online questionnaires used is to obtain insight into current internet behaviour. Questions regard type of internet access, activities on the internet, skills and experiences, wishes and expectations and the reasons for and impediments to switching to a broadband connection. In this study we deal with a convenience sample; buttons with links to the online questionnaire were placed on various public websites, such as websites of ISP's. As the

following table (Table 14) indicates all three data sets are quite comparable.

Table 14. Comparison of the response of 3 online questionnaires

	2001	2003	2005
N	1072	2325	1102
Male/female ratio	90/10	81/19	77/23
Age range (mean)	13-84 (37)	11-85(40)	10- 82 (43)
Together/single	71/29	71/29	75/25
Narrowband/ Broadband ratio	14/86	25/75	17/83

As table 14 also indicates is that there is some skewness for example in the male female ratio. We have not weighted the data, because it is not the aim and we do not compare demographics in this research. The data from the questionnaires were analysed by running frequencies and cross tabulations in SPSS.

4.5 Results 2001 - 2005

Annoyances

As we suggested earlier a good TTF can trigger adoption, whereas lack of TTF can cause rejection. The annoyances caused by the constraints of the connection (slow internet connection, technical failure etc.) will possibly trigger broadband adoption. Also in other ways annoyances could be an explaining factor if we look at the reasons why people adopt a faster connection with more bandwidth. This is why, before asking about explicit reasons and thresholds, we have asked the respondents to state their biggest annoyances they have with their current connection. We see (Table 15[9]) that narrowband users, through the years, are annoyed by a slow connection and high costs. However the discrepancy between the annoyances in cost of broadband and narrowband users is getting smaller over the years. This could hypothetically mean that narrowband connections are a bit faster than a couple of years ago, but more plausible is that it is due to the fact that people still working with a narrowband connection are satisfied with that. We will also see that in results hereafter.

If the group of narrowband users, annoyed by speed and high costs feels that broadband can change that, they will probably be willing to make the step to broadband. On the other hand broadband users suffer more from technical failures, lack of privacy and spam. This possibly could be reasons for narrowband users to not want to make the step to broadband.

[9] In the questionnaire the respondents stated whether they felt that none, one or more reasons and thresholds applied to their situation. Some respondents gave one answer, whereas the other gave three. This is why in the tables in the results figures may surpass 100%

Table 15 Difference in annoyances between narrowband and broadband over the years (2001, 2003, 2005)

Annoyances (%) 2001	**narrowband**	**broadband**	**chi2**	**sign. 2-tailed**
Spam	50.7	*64.1*	9.04	0.03
Slow internet connection	**85.4**	33.9	132.98	0.00
High costs	**49.9**	26.4	64.70	0.00
Technical failure	25.0	**33.2**	51.79	0.00
Lack of privacy	27.3	*30.4*	11.45	0.01
Information overload	28.5	26.1	0.56	0.91
Surfing of family members	7.0	10.8	3.00	0.39
None	13.25	17.2	1.83	0.61
Annoyances (%) 2003	**narrowband**	**broadband**	**chi2**	**sign. 2-tailed**
Spam	60.8	**78.0**	67.07	0.00
Slow internet connection	**78.0**	40.5	249.01	0.00
High costs	**43.3**	17.2	165.95	0.00
Technical failure	18.4	**36.2**	64.84	0.00
Lack of privacy	7.7	**16.1**	26.12	0.00
Information overload	10.6	9.3	0.83	0.37
Surfing of family members	4.8	4.2	0.35	0.56
None	3.7	6.0	4.49	0.02
Annoyances (%) 2005	**narrowband**	**broadband**	**chi2**	**sign. 2-tailed**
Spam	49.4	**62.8**	16.69	0.00
Slow internet connection	*31.1*	20.5	5.08	0.08
High costs	**27.4**	12.6	27.07	0.00
Technical failure	12.8	20.5	3.49	0.18
Lack of privacy	5.5	6.9	2.79	0.24
Information overload	4.9	3.0	8.61	0.65
Surfing of family members	1.2	6.5	7.24	0.27
Pop-ups	38.4	**69.1**	33.34	0.00
Viruses	39.6	**58.4**	14.19	0.00
None	6.7	2.1	4.16	0.13

Italic = significant at 5% level, ***Bold*** *= significant at 1% level*

In the measurement of 2005 two categories were added: viruses and pop-ups. In the first measurement there were no signs of this being a big problem, but during the measurement in 2003 we were confronted with this flaw in our questionnaire and so it was added in 2005. This proved to be an important improvement; it turned out that many internet users and especially broadband users suffered from both pop-ups and viruses. Although pop-ups and viruses are a hard problem to tackle, it is, from different point of views, important to get this under control. It could also help the adoption of broadband internet, as people could associate broadband with viruses, pop ups and spam.

Thresholds and benefits

Table 16 shows the thresholds for narrowband users to adopt a broadband connection. Until 2004 an important barrier to adoption was increased costs (both of installation and subscription). This typically is a financial threshold. Respondents that did have broadband in the same years mentioned the reduction of costs as a benefit of broadband. The paradoxical difference in these answers can be explained by the results from other parts of the research (Van de Wijngaert, Maltha and Vermaas, 2003): narrowband users are much lighter users of internet than broadband users. For narrowband users there is no reason to invest in 'Always on' and 'Flat fee'. For heavy users a broadband connection is relatively cheap. The willingness to adopt broadband depends on the degree to which the internet has an important place in their lives. After the measurement of 2003 we see a dramatic change in this picture, though: the costs are no longer important thresholds to adopt broadband. This is logical when we consider the tremendous offers that Internet Service Providers did to Dutch consumers. Several ADSL and cable light versions were introduced at only a fraction of the previous costs.

Table 16 Thresholds for making the step to broadband (2001, 2003, 2005)

Thresholds (%)	Narrowband 2001 (N=144)	Narrowband 2003 (N= 555)	Narrowband 2004/5 (N=164)
Unsuitable PC	4.9	4.6	5.0
Not interested	1.4	5.4	-
Installation costs	27.8	**28.2**	8.2
Subscription costs	41.7	**39.1**	7.2
No added value	2.1	4.5	4.3
Satisfied with narrowband	3.5	**13.9**	**41.3**
Lack of skills	0.7	**5.3**	6.1
Addictive character of broadband	**17.4**	2.0	0.0
Unwanted information (sex. adds)	4.9	2.6	1.3
Not available	-	**33.8**	4.3
Too much hassle	-	3.6	3.7
Other	**29.2**	6.7	5.3

Italic = significant at 5% level, ***Bold*** *= significant at 1% level*
(Chi² was calculated for differences between 2001 and 2003 and 2003 and 2005)

The fear of addictive character of broadband was in 2001 quite an issue and also reason to not adopt broadband. In later years this was of virtually no importance anymore.

A growing percentage of narrowband is satisfied with the connection they now own. In 2001 3,5% found their connection met their standards, in 2003 13,9% and in 2005 even 41%. This implies that the people still having narrowband are satisfied with that, because they are light internet users and see no immediate reason to change to broadband (in other words the task technology fit is low).

In 2003 an important reason that respondents do not have broadband is a lack of physical availability. In other words the

physical availability is low. More than ninety percent of the respondents that state that a lack of availability is the reason they don't have internet complain about the slowness of their internet connection and only five percent of this group find installation costs too high and almost 10% finds the subscription costs too high. This implies that these respondents in 2003 were willing to invest in a broadband connection. And they probably did in the following year: the availability of broadband had rapidly expanded in the Netherlands and in 2004 the availability was no longer an issue.

The cognitive accessibility threshold ("not enough knowledge") does not seem to play a very important role for broadband. Only a small amount of narrowband users claim that this is the hurdle that keeps them from switching to broadband. One could argue that it does not take more skills to operate the internet via broadband than it does via narrowband. Maybe even the opposite is true: in contrast to narrowband users, broadband users perceive themselves as very experienced users, even after short period of time they have internet (Van de Wijngaert et al., 2003).

Respondents appear to attach great value to face to face contact (e.g. while doing groceries, looking someone in the eye). Broadband technologies cannot replace this 'feeling' and consequently, many people fear the loss of social contact. Paradoxical, internet (both narrowband and broadband) can also provide additional contact when people with similar interests or problems can communicate with each other.

Table 17 Reasons for broadband users to adopt broadband (2001, 2003, 2005)

Reasons for adopting (%)	Broadband 2001 (N=928)	Broadband 2003 (N= 1770)	Broadband 2005 (N=938)
Controlling costs by flat rate	**77.1**	*53.9*	41.8
Always on	68.1	62.8	52.8
Tele working	12.5	4.8	6.6
Better sound and video quality	**31.9**	15.0	25.4
Social aspects: communication	**16.7**	3.5	3.5
Social considerations (mobility. environment)	2.8	0.8	0.2
High speed	**90.3**	63.5	69.6
School	5.6	4.9	4.9
Time saving	**38.9**	5.3	*12.4*
Connecting computers	-	10.9	14.2
Telephone lines free	-	33.6	27.4
Other	4.2	5.1	5.3
Online gaming	-	7.5	7.9
Sharing large files (film. music etc.)	-	9.7	*15.8*
Broadband content (film. audio etc.)	56.3		-

Italic = significant at 5% level, ***Bold*** *= significant at 1% level*
(Chi² was calculated for differences between 2001 and 2003 and 2003 and 2005)

The most important reasons to adopt broadband (Table 17) are high speed, controlling costs by the flat rate principle of broadband, and the always on aspect. These broadband features stay important reasons to adopt it over the years, as did the quality of sound of

video and audio. The fact that with broadband one can keep telephone lines free for incoming and outgoing calls has also been an important reason for people to connect to broadband (although this category was not included in the 2001 study). The possibility to connect computers was also important in the decision to adopt broadband. Saving time was in 2001 an important reason to make the step to broadband, while in the years after that, it was not that important anymore. Also in 2001 tele working and social aspects was a more important to internet users to make the switch to broadband.
Apart from the reasons above, the narrowband users is 2001 were also asked whether the know anyone with a broadband connection and whether this has effect on their decision to also adopt broadband. 75% of the narrowband users knew some one with a broadband connection and 52,8% confirmed that that had impact on their decision to (faster) adopt broadband.

Expected and realised cost reductions

Since costs play such an important role in switching from narrowband to broadband or not, we will elaborate on that a bit more. In the questionnaires we asked narrowband users in what area's they expect to reduce costs when they would install broadband. Also we asked users of broadband what cost reductions they have actually realised. Tables 18a, 18b and 18c shows the results of this question.
Both groups state the biggest cost reduction lies in a decrease of communication costs. For people that have broadband this even stronger than for narrowband users. This is constant over the years. In 2001 and 2003 narrowband users expect a cost reduction for buying and renting of video's whereas broadband users state less realized cost reductions from that. In 2005 however the realized costs by broadband users outweigh the expected costs of narrowband users. Surprisingly, narrowband users do not expect as many cost reductions as they did in 2001 and 2003 (45% says to expect no cost reductions, whereas in both 2001 and in 2003 this was approximately 27%). This could be due to the fact that the people that did expect cost reductions now have made the step to broadband. The light users that still have narrowband connections will indeed not realize so many cost reductions. Simply, because they do not have that big an interest in downloading films or music.

Table 18a Expected and realised cost reductions (2001)

Cost reduction (%) 2001	**Expected** (N=144 narrowband)	**Realised** (N=928 broadband)	**chi2**	**sign. 2-tailed**
Communication costs	69.4	70.0	0.02	0.88
Music	31.9	37.7	1.78	0.18
Video	16.0	10.7	3.48	0.06
Software	27.8	34.2	2.29	0.13
Travel cost	7.6	10.5	1.09	0.30
Other	27.1	26.6	0.01	0.91

Table 18b Expected and realised cost reductions (2003)

Cost reduction (%) 2003	**Expected** (N=555 narrowband)	**Realised** (N=1770 broadband)	**chi2**	**sign. 2-tailed**
Communication costs	47.6	**58.6**	18.03	0.00
Music	21.0	**31.0**	22.15	0.00
Video	16.7	10.4	4.81	0.08
Software	20.4	26.2	8.43	0.12
Travel cost	-	12.9	-	-
None	*27.0*	19.5	9.53	0.05
Don't know	**26.6**	12.0	23.07	0.00

Table 18c Expected and realised cost reductions (2005)

Cost reduction (%) 2004/5	**Expected** (N=164 narrowband)	**Realised** (N=933 broadband)	**chi2**	**sign. 2-tailed**
Communication costs	39.1	41.2	1.78	0.35
Music	7.2	**30.6**	135.81	0.00
Video/film	3.1	8.6	1.21	0.48
Software	4.7	**20.3**	11.54	0.00
Travel cost	15.6	10.6	2.93	0.09
None	**45.5**	25.0	43.78	0.00
Don't know	**-**	14.0	-	-

4.6 Conclusion and discussion

As with all research there are some limitations to this research. All the respondents for example are internet users. Those who do not have a internet connection at all, because the do not want it, cannot afford it, do not understand it etcetera, are not included in this research. But this research does provide us with some interesting insights into the adoption of new technologies, especially broadband.

Results show that the features of broadband are beneficial to such an extent that these features are reasons to adopt it. Especially high speed, always on and flat rate are features that, over the years, offer heavy users the comfort they are looking for.

Furthermore, results prove that for long the most important threshold was the financial threshold. Costs are the most important reason to reject new technologies, such as broadband. Paradoxically, costs were also one of the more important considerations for users to switch to broadband. But this bottleneck has largely disappeared as much cheaper offers are made by cable and ADLS suppliers.

Both groups state the biggest cost reduction lies in a decrease of communication costs. In 2001 and 2003 narrowband users expect a cost reduction for buying and renting of video's whereas broadband users state less realized cost reductions from that. Surprisingly, narrowband users do not expect as many cost reductions as they did in 2001 and 2003.This could be due to the fact that the people that did expect cost reductions now have made the step to broadband.

Also the physical accessibility threshold has changed and almost disappeared over time, due to the rapid roll-out of broadband in the Netherlands. In 2003 a lot of potential users were withheld from adopting broadband, because of the fact that it was simply not available where they lived. The physical accessibility threshold has changed and almost disappeared over time, due to the rapid roll-out of broadband in the Netherlands.

Whether real broadband applications, such as gaming and swapping of files are real "killer applications" for broadband we can not state unreserved. Broadband content showed very important in the first measurement. But, on this matter, we can not compare the results from different years without noting that in the first measurement different answering categories were used. Apart from that we can conclude that online gaming and sharing large files are not as important triggers as sometimes is claimed. In the first years, for the early adopters, it was most likely a more important trigger.

Cognitive and technical thresholds have shown less important over the years. This possibly has to do with the fact that to the average internet user there is, technologically seen, hardly any difference to narrowband internet: to use it does not require any extra skills and also the interface is in most of the cases of residential usage the same as that of narrowband internet. The need for broadband for school activities also never was an important trigger. Tele working at first was rather important, but since 2003 less important, as is the case with social aspects. The fear for addiction or unwanted information such as sex and advertisements has gotten less and less over the years, even to zero for the fear of addiction.

Many other thresholds have gotten less important. What remains are the internet users who are quite satisfied with their current connection. It is hard, if not impossible to convince those people of the usefulness of broadband, unless alternatives are taken away. The task technology fit threshold is probably an important factor here. As long as these people do not have reasons or interest to use it, as long as they see no added value, they will not adopt it.

Figure 28 shows this development. The overall relevance of the triggers of broadband remain constant over the years, whereas the relevance of thresholds are getting lower (B). For some people however, the perceived thresholds remain higher than the triggers that broadband has to offer (C). For others, innovators and early adopters (Rogers, 1995) the benefits of broadband outweigh the thresholds from the moment the technology is introduced (A).

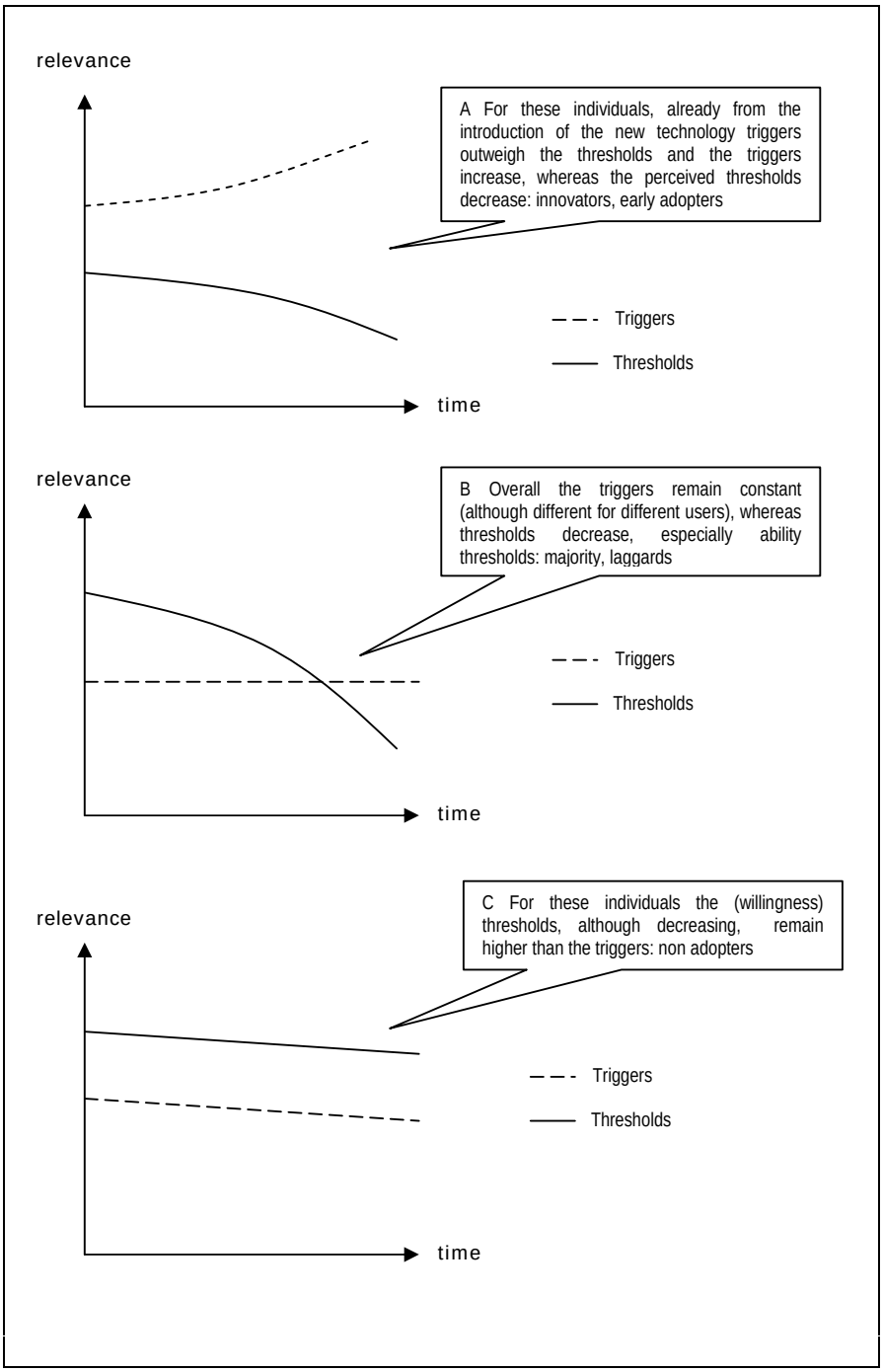

Figure 28. The development of adoption triggers and thresholds over time for different groups of people: three examples

Note that these developments in Figure 28 are not the only ones that can occur. For example, the perception of thresholds and triggers may vary over time, showing wavy lines (Figure 29).

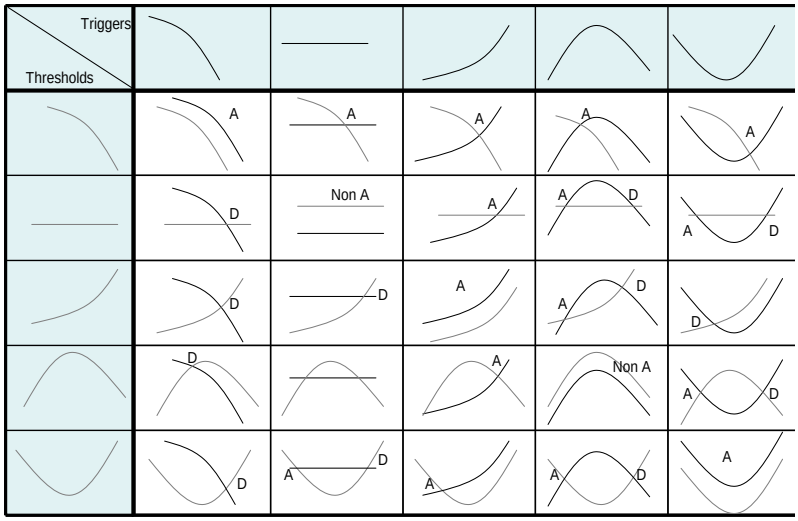

Figure 29. The possible developments of adoption triggers and thresholds over time for different groups of people (A=adoption, Non A = non adoption/rejection, D = discontinuation)

As it is now, the *ability* to adopt increases, whereas the *willingness* to adopt is much more complex, because the needs of people cannot be constructed as infrastructures can. Perhaps, when new 'real' broadband applications and services emerge, that fit or trigger their needs, they will find a link and want to adopt broadband too. Also when other options will no longer be available these people will finally make the step from narrowband to broadband internet. This is again comparable to the transition from black and white tv to colour tv.

Since the Netherlands have one of the highest penetration of broadband (OECD, 2005). This rapid adoption process possibly makes the Netherlands an interesting case for other countries. It would be interesting to compare results of this research to research done in other countries. The Netherlands are fore runners in the adoption of broadband and maybe there are different thresholds in other countries. Combining results will create a broader image, which is of both practical as well as scientific importance. Adding demographics might also broaden this understanding.

References

Anderson, B. Gale, C., Jones, M.L.R., and McWilliam, A. (2002). Domesticating broadband-what consumers really do with flat rate, always-on and fast Internet access. BT Technology Journal, 20 (1), 103-114.

Atkin, David J., Jeffres, Leo W., Neuendorf, Kimberly A (1998). Understanding Internet adoption as telecommunications behavior. Journal of Broadcasting and Electronic Media, 42, 475-490.

Auster, E., & Choo, C. W. (1993). Environmental Scanning by CEOs int wo Canadian Industries. Journal of the American Society for Information Science, 44(4), 194-203.

Bouwman, H., J. Nouwens, J. Baaijens en A. Slootman, Een Schat aan Informatie-
Toegankelijkheid van Overheidsinformatie (An Information Treasure: Accessibility of
Government Information). Den Haag/Amsterdam: Rathenau Instituut/Otto Cramwinckel, 1996.

Choudrie J. & Dwivedi Y.K. (2005), Investigating Broadband Diffusion in the Household: Towards Content Validity and Pre-Test of the Survey Instrument. In the proceedings of the 13th European Conference on Information Systems (ECIS 2005), Regensberg, Germany, 26th – 28th May 2005.

Daft, R.L., Lengel, R.H. (1986) Organizational Information Requirements, Media Richness and Structural Design, Management Science, 32, 5, pp. 554-571.

Davis, F.D. (1989). "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," MIS Quarterly, 13:3, pp. 319-341.

Dwivedi, Y.K., Choudrie, J. and U. Gopal (2003). Broadband stakeholders analysis: ISPs perspective. In Proceedings of the ITS Asia- Australasian Regional Conference (Cooper, R. et al. Ed.), Perth, Australia

Dijk, J.A.G.M. van, De netwerkmaatschappij: sociale aspecten van nieuwe media. Houten:Bohn Stafleu Van Loghum, 1996.

Firth & Kelly (2001) Firth, L., & Kelly, T. (2001). The economic and regulatory implications of broadband. Geneva, ITU. At http://www.itu.int/osg/spu/ni/broadband/workshop/briefingpaperfinal.doc (August 5, 2005).

Firth, L., Gillwald, A., Houghton, J., Morris, P., Prosperetti, L. and Merini, M. (2002).
Broadband: Four Nation's Experiences. Journal of Network Industries, v3 (2), pp. 183 – 222.

Fulk, J., Schmitz, J., & Steinfield, C. (1990). A Social Influence Model of Technology Use. In J. Fulk, & C. Steinfield (Eds.), Organisations and Communication Technology. pp. 117-140. Newbury Park: Sage.

Hausman, J.A., J.G. Sidak, H.J. (2001) Residential Demand for Broadband Telecommunications and Consumer Access to Unaffiliated Internet Content Providers Yale Journal on Regulation.

Katz, Rice, & Aspden (2001) The Internet, 1995–2000 access, civic involvement, and social interaction, *American Behavioral Scientist 45*, 3, pp. 405–419

Katz & Rice (2002) J. Katz and R. Rice, Social consequences of internet use access, involvement, and interaction, MIT Press, Cambridge (2002).

McClure, C. R. (1993). Network literacy in an electronic society; an educational disconnect? In Annual Review of the Institute for Information Studies, the knowledge economy. Queenstown, MD: Aspen Institute. (pp. 137-178).

Neuendorf, K. A., Atkin, D. J., & Jeffres, L. W. (1998). Understanding adopters of audio information innovations. Journal of Broadcasting & Electronic Media, 42, 80-93.
Organization for Economic Cooperation and Development, The Development of Broadband Access in OECD Countries, October 29, 2005.

Pociask, S. (2002), Building a Nationwide Broadband Network: Speeding Job Growth, white paper prepared for New Millennium Research Council by TeleNomic Research.
http://www.newmillenniumre-search.org

Pratt, J. (2003). Teleworking Comes of Age with Broadband: A Telework America Research Report of the International Telework Association & Council
Rice, R.E. (1993). Media appropriateness: Using social presence theory to compare traditional and new organizational media. Human Communication Research, 19(4), pp. 451-484.

Rogers, E.M. (1995). Diffusion of innovations. New York : Free Press

Silverstone, R en Haddon, L. (1996) . Design and the domestication of information and communication technologies: technical change and everyday life. In: Mansell, R. & Silverstone, R. (1996) (eds.). Communication by design. The politics of Information and Communication Technologies. Oxford: Oxford University Press.

Sitkin, S.B., Sutcliffe, K.M. and Barrios-Cholin, J.R. "A dual capacity model of communication media choice in organizations", Human Communication Research 18(4) pp.563-598.

Short, J., Williams; E., & Christie, B. (1976) The social psychology of telecommunications. London, Wiley

Thierer (2002) A. Thierer, Solving the broadband paradox, Issues in Science and Technology 18 (3), pp. 57–62.

Trevino, L.K., Webster, J. and Stein, E.W. (2000), Making Connections: Complementary Influences on Communication Media Choices, Attitudes, and Use, Organization Science 11(2), pp. 163-182.

Wales, C., Sacks, G., & Firth, L. (2003). Killer applications versus killer attributes in broadband demand. PTC Conference, Hawaii, 18–23 January.

Wellman, B., Quan-Haase, A., Witte, J., & Hampton, K.N. (2001). Does the Internet increase, decrease, or supplement social capital? Social networks, participation, and community commitment. American Behavioral Scientist, 45 (3), 437-456.

Wijngaert, L. van de (2001). Internet in Context: Fysieke en affectieve toegang, geschiktheid; vraag, aanbod en context. In H. Bouwman (Ed.), Communicatie in de Informatiesamenleving (pp. 51-70). Utrecht, The Netherlands: Lemma.

Wijngaert, L. van de (2004). Old and New Media; A Threshold Model of Technology Use. In H. van Oostendorp, L. Breure, & A. Dillon (Eds.), Creation, Use, and Deployment of Digital Information (pp. 247-261). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Chapter 5

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A longitudinal study to investigate consumer/user adoption and use of broadband technology in the Netherlands

Abstract

In the Netherlands a lot of people already use broadband internet. The question is whether people with a broadband connection differ from people with a narrowband connection.
The central research question in this paper therefore is: How do Dutch internet users with a broadband connection differ from people with a narrowband connection in terms of demographics (age, gender, education), internet experience (experience, frequency, intensity of use), expectations (of narrowband users), experiences (of broadband users), annoyances and patterns of internet usage? Secondly, this paper addresses the question whether and how these differences change over time. The paper uses a model of technology adoption and use that is built upon different theories such as Diffusion of Innovations, Uses and Gratifications, and Media choice theory. The results are based on two on-line questionnaires in 2003 and 2004/2005 (N=2404 and N=1102) with regard to current Internet behaviour in the Netherlands. Results show that broadband users are heavier Internet users and that broadband technology is mostly a matter of comfort, not of complete new ways of using the Internet.

5.1 Introduction

In December 2005, the Netherlands were indicated as one of the four leading countries with regard to broadband penetration, with more than 25 subscribers per 100 inhabitants (OECD Broadband Statistics, December 2005). That is why the Netherlands form a good starting point for investigating the usage of broadband and how it differs from the use of narrowband internet. Other (EU) countries can anticipate future developments based on these Dutch experiences.

Broadband possibly has many advantages for internet users. The particular aspects of broadband, such as always on and the ability to send and receive large amounts of data, may provide the user with more convenience compared to people who have used traditional telephone lines. Broadband users could save a considerable amount of time (Pociask, 2002) compared to narrowband users. According to Anderson, Gale, Jones & McWilliam (2002) broadband users make more frequent use of a wider range of applications. In research conducted by Wales, Sacks and Firth (2003) respondents universally said that they were not driven to broadband by a specific application. Rather, they found that broadband enabled them to use standard Internet applications (email, chat, browsing) more efficiently. Wales at al. (2003) speak of killer attributes instead of killer applications and these include reliability of service, speed of downloads, networking of home computers, and the convenience of always on connectivity. Different from Wales et al. (2003) there are researchers that do consider specific broadband applications, including games, swapping of large files and pornography to be the killer applications for broadband to the home (Firth & Kelly, 2001; Thierer, 2002; Wales et al., 2003, Anderson, 2002). Another possible reason for people to switch from a narrowband connection to broadband may be that with the flat fee. Especially heavy users, may be able to reduce their internet costs (Wales et al., 2003). The study of Wales et al. (2003) also observed some discrepancies between the perceived benefits in households that had adopted broadband and those that had not. Furthermore, there are researchers that suggest that internet and particularly broadband enhances the quality of life by increasing contact between parties. Internet users in fact have more face to face and phone contact with friends and family than do non-users. Those with good conventional friendship links extend those to the Internet (Katz et al., 2001). Also online relationships have been found to enhance conventional ones (Katz & Rice, 2002; Wellman, 2001).

Broadband defined by its characteristics

In this research the term narrowband is used for any connection that is established through dial-up access (traditional modems and an analogue telephone line). Therefore PSTN (public switched telephone network) and also ISDN (Integrated Services Digital Network) connections are considered narrowband. Two important characteristics of broadband Internet are 'flat fee' and 'always on'. 'Flat fee' means that the subscribers pay a fixed amount of money per month, regardless of the actual time spent online (as opposed to dial-up access, where people pay per time-unit that they are connected). 'Always on' means that there is direct connection at any time; there is no need to dial up. Based on these characteristics Asymmetric Digital Subscriber Line (ADSL), cable and fibre optics are considered broadband in this research.

The user perspective

Despite the fact that many service providers, network operators and researchers claim to maintain a user perspective, a lot of research and service development is still inherently technology driven. In many cases technology is developed using an iterative process in which technology is presented to users (in early and/or later stages) who can state what they like and dislike about the technology. This method of technology development does not address the question whether people actually need that technology. So instead of looking at what technology can do for people, we look at user behaviour, wishes, frustrations in a daily context in order to find out what technology people may need. Based on a broad set of theoretical insights we will try to explain the use of broadband technology.

The following section provides a brief discussion on the theoretical framework. After that the research methodology is discussed, followed by the findings. Finally, a concluding discussion of this chapter is provided.

5.2 A basic model of technology adoption and use

In our opinion, technology adoption and use is a process that results from experience and incentives from the past and present. In several research areas theories with a similar starting point can be found. In organizational literature innovation is described in terms of phases, starting with adoption (the strategic decision to invest in new technologies), implementation (putting everything in place) and incorporation (usage on a daily basis) (Andriessen, 1994). In the area of communication theory Trevino, Webster and Stein (2000) distinguish between general media (i.e. both old and new (information) technology) use and media choice. General use refers to an individual's broad pattern of technology usage over time. Choice refers to an individual's specific decision to use a technology in a particular communication incident. When we

combine these concepts the model as depicted in Figure 30 can be drawn.

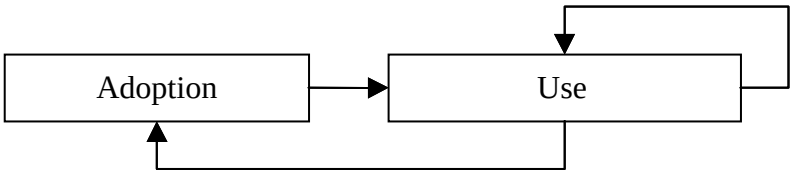
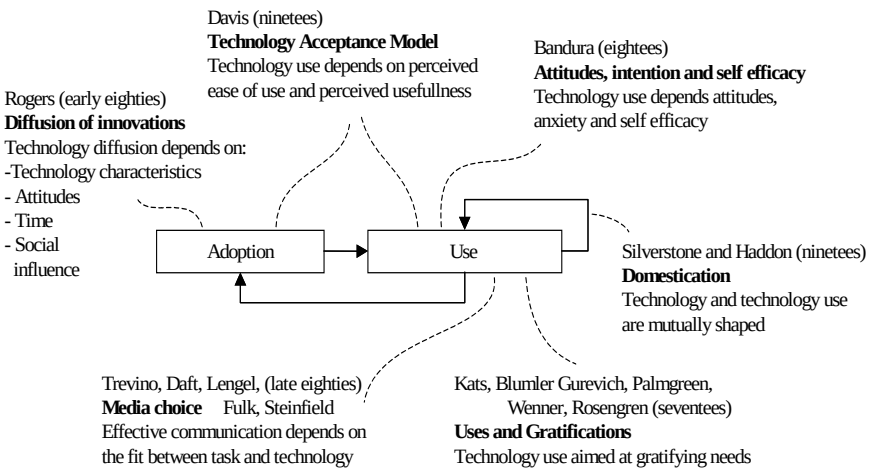


Figure 30 A basic model of technology adoption and use

The general outline of the model is as follows. Adoption is the process in which an individual comes to the decision to start using a new technology. Adoption is related to relatively slow, long term decision making process, learning to use and adopt that new technology. Major influences are demographic characteristics, attitudes and self-efficacy. As a result of adoption an individual starts using that technology. Use is the case by case decision whether or not to use the adopted technology or some alternative. Major influences here are task characteristics, contextual determinants and social influence. As a result of the use, future use can be influenced. Because a user gets more experienced, usage will develop and change. Use (and the experience that is the result) of technology will also influence the adoption of other (new) technologies in the long run.

The model that we use here is basically a synergy of many other theories (Figure 31, including main references). Diffusion of Innovations focuses strongly on the adoption phase. TAM also focuses relatively strong on the adoption phase. The difference between the two theories is that Diffusion of innovations describes this from a general perspective whereas TAM has the individual user as a starting point. Domestication describes how technology use changes over time and is placed on a middle position for both dimensions. Uses and gratifications provides a general framework to think about the relation between needs and technology use. Media Choice theory fills this in by relating (perceived) characteristics of the task to characteristics of the technology.

Figure 31 A two dimensional space of Adoption and Use theory



Based on this overview it is possible to identify several variables that explain the differences between the adoption and use of narrowband and broadband technology. In Table 19 the relation between the theories that were presented and the variables that are chosen is depicted.

Table 19 Relation between theories and research variables

Focus of theory on variables is
◎ Strong
⊙ Moderate
○ Light
- None

	Demographics (e.g. age, gender, education)	**Internet experience** (e.g. internet experience, frequency, intensity of use)	**Broadband experience** (e.g. expectations, experiences and irritations)	**Patterns of internet use** (e.g. task characteristics)
Diffusion of innovations	◎	⊙	⊙	-
Uses and Gratifications	⊙	⊙	⊙	◎
Media choice theory	⊙	⊙	⊙	◎
Technology Acceptance Model	○	◎	⊙	◎
Attitudes and self efficacy	○	⊙	◎	-
Domestication	○	⊙	◎	-

Based on these findings, the following research questions have been derived.

How do users with a broadband connection differ from users with a narrowband connection in terms of:

- *demographics (age, gender, education),*
- *internet experience (experience, frequency, intensity of use) and*
- *expectations (of narrowband users) and experiences (of broadband users) and irritations?*
- *patterns of internet usage?*

And (how) did these differences change over the period 2003 until 2005?

The goal of answering these questions in to obtain further insight into the theoretical framework that was presented as well as the future of adoption and use of broadband technologies.

5.3 Research Methods

Longitudinal

The data for this paper is collected in a longitudinal study that allows us to see how technology use is developing over time. The first wave of data gathering used for this paper took place from January to March 2003. The response consisted of 2404 completed and usable questionnaires. The last measurement was from October 2004 to February 2005 and resulted in 1102 completed questionnaires.

Multi-method

We used a multi-method approach, resulting in the following research lines. The first research line was an online questionnaire. The objective of this survey is to obtain insight into current internet behaviour. Questions regard type of internet access, activities on the internet (information seeking, communication, entertainment and transactions), skills and experiences, wishes and: expectations and the reasons for and impediments to switching to a broadband connection. In order to obtain a broader, more in depth view of how technology is used we also conducted two other research lines: a diary project and broadband focus groups. The focus of this paper lies with the results of the online questionnaire.

In 2003 25% of the respondents had a narrowband connection and 75% of the respondents a broadband connection. In 2004/5 16% had a narrowband connection and 84 a broadband connection.

5.4 Results

In this section we will focus on the differences between users with a narrowband connection and users with a broadband connection to the internet. We will describe the differences in demographics, experience (including irritations, expectations, and perceived barriers and benefits of broadband) and finally we will focus on usage patterns.

Demographic Differences

Both narrowband and broadband users are more often men than women in this sample. The most important difference between narrowband and broadband is that this image is even stronger for broadband users. There are no significant differences in age and income between narrowband and broadband users. In 2003 the education level of narrowband users was higher than that of broadband users. In 2004/5 this was the other way around. The overall image is that broadband users (in the Netherlands) do not match up to the image that is often depicted of broadband users: they are not per se better educated, younger and with higher incomes. Finally, among narrowband users there are more one person households and households without children. The highest penetration of broadband connections can be found within families with children.

Table 20 Differences in demographic characteristics between narrowband and broadband

Demographic characteristics		**narrowband**	**broadband**	**statistic**	**sign.** 2-tailed
2003					
age		μ = 40.8	μ = 40.3	t = 0.74	0.46
income		μ = 4.3	μ = 4.3	t = -0.09	0.93
education		μ = 3.2	μ = 3.1	t = 2.22	**0.03**
gender (%)	male	73.1	83.7	chi^2 = 33.18	**0.00**
	female	26.9	16.3		
household (%)	one person	28.5	24.9	chi^2 = 9.21	**0.03**
	single parent	4.0	3.6		
(un)married couple. no children		31.2	28.3		
(un)married couple. with children		36.3	43.3		
Demographic characteristics		**narrowband**	**broadband**	**statistic**	**sign.** 2-tailed
2004/5					
age		μ = 45.6	μ = 42.8	t = 0.84	0.18
income		μ = 6.3	μ = 5.6	t = - 1.98	0.88
education		μ = 3.0	μ = 3.1	t = 2.15	**0.03**
gender (%)	male	68.3	78.7	chi^2 = 28.12	**0.00**
	female	31.7	21.3		
household (%)	one person	28.7	19.8	chi^2 = 5.43	0.12
	single parent	1.2	3.7		
(un)married couple. no children		37.8	34.7		
(un)married couple. with children		32.3	41.6		

Differences in Experience

The image of broadband users in 2003 is quite similar to the image of broadband users in the following year. Broadband users are significant heavier users of the internet. They perceive themselves as more experienced users and use the internet more often and have longer online sessions than respondents with a narrowband connection.

The question here of course is whether these people already were online more often and longer and therefore had a need for broadband, or whether having broadband caused more intensive use of internet. In 2005 we addressed this question in the questionnaire. Mostly, broadband users state that they use their new connection as often as before (69%). A quarter of the broadband users state that they have started using their connection more, now they have broadband.

If we compare the two years, we find most changes among narrowband users. In 2004/5 narrowband users are more often online once a day (this was in 2003 20% whereas in 2004/5 almost 41%). Also in 2004 among narrowband users there are relatively

more new and less experienced users. A possible explanation is that many narrowband users that were already quite experienced internet users (both in years as in their description of their internet capabilities) in 2003 have adopted a broadband connection in the following year. In 2004 only the new and less experienced internet users stuck to their narrowband connection. In table 21 these results are summarised.

Table 21 Difference in internet use between narrowband and broadband

	2003		2005	
Frequency of usage	**narrowband**	**broadband**	**narrowband**	**broadband**
More than once a day	41.7	74.7	33.5%	71.7%
Once a day	20.0	15.3	40.9%	16.6%
More than once a week	31.0	9.4	17.7%	10.1%
Once a week	6.3	0.3	7.9%	0.9%
Less	1.0	0.3	0.0%	0.8%
Chi ²	317.67		116.13	
sign. 2-tailed	0.00		0.00	
Session length	**narrowband**	**broadband**	**narrowband**	**broadband**
< 15 min.	4.8	0.5	1.8	1.2
15 min. – 1 hour	36.8	12.9	22.6	17.4
1 – 2 hours	34.0	30.0	41.5	32.7
2-4 hours	18.6	33.7	32.3	31.8
4-8 hours	4.5	14.7	1.8	11.7
> 8 hours	1.3	8.2	0.0	5.3
Chi ²	298.71		36.74	
sign. 2-tailed	0.00		0.00	
Internet experience	**narrowband**	**broadband**	**narrowband**	**broadband**
1 – 3 years	13.1	11.6	45.8	17.2
4 - 6 years	50.0	53.2	38.5	43.1
7 – 9 years	23.3	23.9	12.7	28.1
More than 9 years	13.5	10.9	3.0	11.6
Chi ²	8.85		123.62	
sign. 2-tailed	0.840		0.00	
Internet experience	**narrowband**	**broadband**	**narrowband**	**broadband**
Laggard	0.2	0.2	0.6	0.1
Beginner	5.4	2.1	10.4	1.2
Average user	34.8	20.4	53.0	22.3
Experiences user	32.3	38.0	27.4	41.0
Very experienced user	15.3	25.5	5.5	23.6
Professional user	11.9	13.8	3.0	11.8
Chi ²	81.92		141.22	
sign. 2-tailed	0.00		0.00	

Annoyances

Annoyances could be an explaining factor if we look at the reasons why people adopt a faster connection with more bandwidth. This is

why, before asking about explicit reasons and thresholds, we have asked the respondents to state their biggest annoyances they have with their current connection. We see (Table 22) that narrowband users, especially in 2003, are annoyed by a slow connection and high costs. However the discrepancy between the annoyances in cost of broadband and narrowband users is getting smaller over the years. If the group of narrowband users, annoyed by speed and high costs feels that broadband can change that, they will probably be willing to make the step to broadband. On the other hand broadband users suffer more from technical failures, lack of privacy and spam. This possibly could be reasons for narrowband users to not want to make the step to broadband.

Table 22 Difference in annoyances between narrowband and broadband over the years (2003, 2005)

Annoyances (%)	**2003**				**2005**			
	nb	**bb**	**chi2**	**sign. 2-tailed**	**nb**	**bb**	**chi2**	**sign. 2-tailed**
Spam	60.8	**78.0**	67.07	0.00	49.4	**62.8**	16.69	0.00
Slow internet connection	**78.0**	40.5	249.01	0.00	31.1	20.5	5.08	0.08
High costs	**43.3**	17.2	165.95	0.00	**27.4**	12.6	27.07	0.00
Technical failure	18.4	**36.2**	64.84	0.00	12.8	20.5	3.49	0.18
Lack of privacy	7.7	**16.1**	26.12	0.00	5.5	6.9	2.79	0.24
Information overload	10.6	9.3	0.83	0.37	4.9	3.0	8.61	0.65
Surfing of family members	4.8	4.2	0.35	0.56	1.2	6.5	7.24	0.27
Pop-ups	-	-	-	-	38.4	**69.1**	33.34	0.00
Viruses	-	-	-	-	39.6	**58.4**	14.19	0.00
None	3.7	*6.0*	4.49	0.02	6.7	2.1	4.16	0.13

Italic = significant at 5% level. **Bold** = significant at 1% level

In the measurement of 2004/5 two categories were added: viruses and pop-ups. It turned out that many internet users and especially broadband users suffered from both pop-ups and viruses. Although pop-ups and viruses are a hard problem to tackle, it is, from different point of views, important to get this under control. It could also help the adoption of broadband internet, as people could associate broadband with viruses, pop ups and spam.

Thresholds and Benefits

Table 23 shows the thresholds for narrowband users to adopt a broadband connection. Until 2004 an important barrier to adoption were increased costs (both of installation and subscription). Respondents that did have broadband in the same years mentioned the reduction of costs as a reason to adopt broadband (Table 24). The paradoxical difference in these answers can be explained by the results from other parts of the research narrowband users are much lighter users of internet than broadband users (see Table 21). For light users there is no reason to invest in 'Always on' and 'Flat fee'. For heavy users a broadband connection is relatively cheap. In the diary project similar results

were found: the question is whether people are willing to pay rather than the absolute price. This willingness depends on the degree to which the internet has an important place in their lives.
After the measurement of 2003 we see a big change in this picture: the costs are no longer important thresholds to adopt broadband. This is logical when we consider the tremendous offers that Internet Service Providers did to Dutch consumers. Several ADSL and cable light versions were introduced at only a fraction of the costs that applied before.

Table 23 Thresholds for narrowband users to adopt broadband

Reasons for rejection	Narrowband 2003 (N= 555)	Narrowband 2005 (N=164)
Unsuitable PC	4.6	5.0
Not interested	5.4	-
Installation costs	28.2	8.2
Subscription costs	39.1	7.2
No added value	4.5	4.3
Satisfied with narrowband	13.9	41.3
Lack of skills	5.3	6.1
Addictive character of broadband	2.0	0.0
Unwanted information (sex. adds)	2.6	1.3
Not available	33.8	4.3
Too much hassle	3.6	3.7
Other	6.7	5.3

The fear of addictive character of broadband was in 2001 quite an issue and also reason to not adopt broadband. In later years this was of virtually no importance anymore.

A growing percentage of narrowband users is satisfied with the connection they now own. In 2003 13.9% found their connection met their standards. In 2004/5 this percentage has risen to 41%. This implies that the people that still have a narrowband connection are satisfied with that, because they are light Internet users and see no immediate reason to change to broadband.
In 2003 an important reason that respondents do not have broadband is a lack of availability of broadband. More than ninety percent of the respondents that state that a lack of availability is the reason they don't have internet complain about the slowness of their internet connection and only five percent of this group find installation costs too high and almost 10% finds the subscription costs too high. This implies that these respondents in 2003 were willing to invest in a broadband connection. And they probably did in the following year: the availability of broadband had rapidly expanded in the Netherlands and in 2004 the availability was no longer an issue.
Only a small amount of narrowband users claim that lack of knowledge is the hurdle that keeps them from switching to

broadband. One could argue that it does not take more skills to operate the internet via broadband than it does via narrowband. Maybe even the opposite is true: in contrast to narrowband users, broadband users perceive themselves as very experienced users, even if the have only had used internet for a short period of time.

Table 24 Reasons for broadband users to adopt broadband

Reasons for adopting	Broadband 2003 (N= 1770)	Broadband 2005 (N=938)
Controlling costs by flat rate	53.9	41.8
Always on	62.8	52.8
Tele working	4.8	6.6
Better sound and video quality	15.0	25.4
Social aspects: communication	3.5	3.5
Social considerations (mobility. environment)	0.8	0.2
High speed	63.5	69.6
School	4.9	4.9
Time saving	5.3	12.4
Connecting computers	10.9	14.2
Telephone lines free	33.6	27.4
Other	5.1	5.3
Online gaming	7.5	7.9
Sharing large files (film. music etc.)	9.7	15.8

The most important reasons to adopt broadband are high speed, controlling costs by the flat rate principle of broadband and the always on aspect. These broadband features stay important reasons to adopt it over the years, as did the quality of sound of video and audio. The fact that with broadband one can keep telephone lines free for incoming and outgoing calls has also been an important reason for people to connect to broadband. The possibility to connect computers was also important in the decision to adopt broadband.

Expected and Realised Cost Reductions

Since costs play such an important role in switching from narrowband to broadband or not, we will elaborate on that a bit more. In the questionnaires we asked narrowband users in what area's they expect to reduce costs when they would install broadband. Also we asked users of broadband what cost reductions they have actually realised. Table 25 shows the results of this question.

Table 25 Expected and realised cost reductions 2003 - 2004/5

Cost reduction (%)	2003		2005	
	Expected (N=555 narrowband)	Realised (N=1770 broadband)	Expected (N=164 narrowband)	Realised (N=933 broadband)
Communication cost	47.6	58.6	39.1	41.2
Music	21.0	31.0	7.2	30.6
Video	16.7	10.4	3.1	8.6
Software	20.4	26.2	4.7	20.3
Travel cost	-	12.9	15.6	10.6
None	27.0	19.5	45.5	25.0
Don't know	26.6	12.0	-	14.0

Both groups state the biggest cost reduction lies in a decrease of communication costs. For people that have broadband this even stronger than narrowband users. This is constant over the years. In 2003 narrowband users expect a cost reduction for buying and renting of video's whereas broadband users state less realized cost reductions from that. In 2004/5 however the realized costs by broadband users overweigh the expected costs of narrowband users. Surprisingly, narrowband users do not expect as many cost reductions as they did in 2003 (45% says to expect no cost reductions. whereas in 2003 this was approximately 27%). This could be due to the fact that the people that did expect cost reductions now have made the step to broadband. The light users that still have narrowband connections will indeed not realize so many cost reductions, simply because they do not have that big an interest in downloading films or music.

Differences in Patterns of Use

Table 26 shows an overview of the usage patterns of narrowband users in comparison to broadband users and the differences between figures from 2003 and 2004/5. The most striking result when looking at this table is that the differences are relatively small. Of all services that were presented only 10 services differed significantly at the 1% level (using chi^2 which is relatively sensitive to a large sample size). In 2004/5 more significant results (18) were found.

When we look at information activities we see that in 2004/5 broadband users more often use online reference works, such as telephone books and maps than narrowband users do (48.7% compared to 22.6% for narrowband users). Also information via sound and video is much more important to broadband users than to narrowband users and it is increasingly important to broadband users. Offering information through own websites is also getting more popular for broadband users.

In communication we see that chatting is becoming more popular for especially broadband users but also for narrowband users. Reading weblogs is significantly done more often by broadband

users, although not frequently done (8%). Discussions forms are more of a thing for broadband users, in 2003 as well as in 2004/5. Webcams for communication were not included in the 2003 measurement, but are significantly more used by broadband users than by narrowband users (12% compared to 5.9%).
In entertainment activities the image is steady over the years: broadband users more often play online games, downloads or watch films, tv, video recordings, download or listen more often to music via internet. Fun mail and fun surfing are important to narrowband users.
The most changes we see in transaction activities. In 2003 there were no significant differences between narrowband and broadband users, but in 2004/5 there are four: broadband users more often buy products and services online, buy or sell through online auctions, do telebanking and make reservations than narrowband users.

Table 26 Differences in usage patterns of narrowband and broadband 2003 and 2004/5

% respondents that uses an application								
	2003				2005			
Information	**nb**	**bb**	**chi**	**sign.**	**nb**	**bb**	**chi**	**sign.**
Info through search engine		80.4	2.58	0.06	87.8	89.1	0.23	0.64
Info through portals		32.1	7.07	0.01	31.1	35.4	1.12	0.29
Info through reference work		20.5	0.18	0.73	22.6	**48.7**	38.42	0.00
Info through sound and video		**13.9**	19.10	0.00	7.3	**40.8**	68.16	0.00
Info through application form		8.3	15.24	0.00	8.5	10.9	0.84	0.36
Info via subscription		11.0	0.35	0.50	2.4	**11.8**	13.1	0.00
Info through discussion group		*9.5*	5.19	0.02	10.4	11.6	0.20	0.65
Info through own website		11.3	2.51	0.13	3.0	**16.3**	19.94	0.00
Communication	**nb**	**bb**	**chi**	**sig.**	**nb**	**bb**	**chi**	**sig.**
Chat (ICQ)		**52.4**	70.13	0.00	14.9	**85.1**	80.39	0.00
Chat (anonymous/website)		11.4	2.37	0.07	0.6	*3.9*	4.51	0.03
Internet telephony		2.2	0.16	0.75	3.0	4.8	1.00	0.32
Videophone		1.9	3.38	0.07	0.6	1.0	6.19	0.66
Web log (read)		3.9	0.71	0.41	3.7	**8.0**	15.15	0.00
Web log (write)		1.8	1.83	0.18	1.2	2.7	1.23	0.26
Discussion forum		**16.9**	19.56	0.00	10.4	**15.6**	3.08	0.08
SMS/MMS		11.2	0.00	1.00	2.4	4.7	1.72	0.19
E-mail		95.0	1.33	0.29	90.2	94.0	3.21	0.07
Webcams		-	-	-	5.9	**12.0**	8.63	0.00
Entertainment	**nb**	**bb**	**chi**	**sig.**	**nb**	**bb**	**chi**	**sig.**
Online games		**30.8**	43.84	0.00	6.7	**28.0**	33.83	0.00
Download/watch movie		**26.0**	97.50	0.00	1.2	**17.0**	27.88	0.00
Upload movie		1.2	0.46	0.65	0.6	1.0	0.19	0.66
Set up or maintain community		6.4	0.34	0.63	1.2	*4.7*	4.25	0.04
Share in communities		8.6	2.02	0.16	12.8	*6.6*	7.56	0.01
Watch television		**10.1**	32.14	0.00	4.3	**13.0**	10.25	0.00
Watch video recordings		**23.3**	22.43	0.00	7.9	**18.6**	11.34	0.00
Upload video recordings		0.7	4.25	0.05	0.0	0.2	0.35	0.55
Download or listen to music		**66.5**	145.57	0.00	9.1	**47.3**	83.45	0.00
Upload music		*4.9*	62.17	0.01	1.2	2.0	0.49	0.48
Download or looking at pics		25.6	6.70	0.01	18.3	*25.6*	4.04	0.04
Upload pictures		5.5	17.95	0.00	6.7	7.0	0.01	0.90
Fun mail		31.5	9.31	0.00	**50.0**	23.2	50.82	0.00
Fun surfing		64.2	0.64	0.44	54.3	54.6	0.01	0.94
Transaction	**nb**	**bb**	**chi**	**sig.**	**nb**	**bb**	**chi**	**sig.**
Buy products/services (retail)		54.4	0.19	0.67	35.4	**55.7**	23.21	0.00
Buy or sell marketplace		18.0	0.13	0.75	15.9	*23.8*	5.62	0.02
Buy or sell auction		*14.7*	5.98	0.01	4.9	**14.7**	11.69	0.00
Swap products		3.5	0.11	0.89	1.2	*5.1*	4.94	0.02
Telebanking		*77.0*	6.33	0.01	61.0	**81.0**	32.72	0.00
Reservations		32.7	0.19	0.68	18.9	**30.5**	9.22	0.00

5.5 Conclusion and discussion

The most important results of the two surveys can be summarised as follows:

- The are no dramatic differences in user characteristics between broadband and narrowband users. The biggest difference lies in gender differences, but these characteristics remain steady over the years.
- The image of broadband users in 2003 is quite similar to that of broadband users in the following year. Broadband users are significant heavier users of the internet. The question here of course is whether these people already were online more often and longer and therefore had a need for broadband, or whether having broadband caused more intensive use of internet. From the results, the notion is supported that people choose broadband because they feel the need as they experienced the limitations narrowband connection.
- Spam, pop-ups and viruses are important annoyances for especially broadband users.
- Until 2004 important barriers to adoption were increased costs (both of installation and subscription). In the later measurement we see a big change in this picture: the costs are no longer important thresholds to adopt broadband, because of offers that ISP's make. Also high costs are getting a less important annoyance for both groups of users.
- In 2003 an important reason that respondents do not have broadband is a lack of availability of broadband, the availability of broadband had rapidly expanded in the Netherlands and in 2004 the availability was no longer an issue.
- Broadband characteristics, such as flat fee (controlling costs), always on and high speed are the most important reasons to adopt a broadband connection.
- Differences in patterns of use between narrowband and broadband users are getting more noticeable. In entertainment activities the differences already were evident in the 2003 measurement, but more differences are now also found in information, communication and transaction activities.

This research shows that is important to measure the adoption of new technologies such as broadband. Already in one year we see changes in the reasons and thresholds for people to adopt and in differences between broadband and narrowband users. This has to do with developments in the market (better availability, cheaper offers, more services). Currently we see a steady growth in the number of broadband subscriptions. Ubiquitous availability of broadband will further increase the number of subscriptions. However, this research also shows that not everybody is keen on taking the step from narrowband to broadband. Only when

broadband is standard (like colour TV's nowadays) and prices do not differentiate, also the lighter users will take the step to broadband. Especially for this group, that does not appreciate the benefits of the internet strongly, costs are an important factor. The use of technologies such as broadband actually are the subtraction of the technological possibilities and the needs people have.

When we look at our theoretical framework we can draw the following conclusions. A broad range of theories that describe the adoption and use of new technologies is available. Diffusion of Innovations shows us how a relatively small group of innovate users stimulate further development of internet and broadband technology, while other groups follow developments from a distance. Uses and Gratifications shows how there is a clear relation between people's motivations and the actual use of technology. With regard to media choice theory and the Technology Acceptance Model it is possible to state that people seek themselves a route with little resistance: they simultaneously try to maximize results and minimize costs.
All this illustrates how the adoption and use of new technologies is a complex process. In our opinion there is not so much a need for new theories but rather a need for a framework that grasps the complexity of the adoption and use process. This paper has provided an initiative towards integrating several theories that look at technology from a user perspective. Users can tell us what they do with new technologies, why they do it and how technology changes our lives.

As with all research there are some limitations with regard to this research. One of the limitations of this research offers opportunities though. While these results are solely based on Dutch internet users, the chance of comparing results from similar survey conducted in other countries, would give further insights into the adoption of technologies such as broadband. A second limitations involves the sample. Because of the convenience sample used, the segmentation of demographical characteristics may not be fully representative. In future in depth research on the relationship between demographical characteristics and technology adoption this should be addressed.

References

Anderson, B. Gale, C., Jones, M.L.R., and McWilliam, A. (2002). Domesticating broadband-what consumers really do with flat rate, always-on and fast Internet access. BT Technology Journal, 20 (1), 103-114.

Andriessen, J.H.T.H. (1994). Conditions for successful adoption and implementation of telematics in user organizations. In J.H. Erik Andriessen and Robert A. Roe (Eds.). *Telematics and Work*. Hove. Sussex: Lawrence Erlbaum.

Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englecliffs. NJ: Prentice Hall

Bunz, U. K. (2001). *Usability and gratifications – Towards a website analysis model*. Presented at the National Communication Association Convention. Atlanta. GA.
Chua. S.L.. Chen. D.T. and Wong. A.F.L. (1999). Computer anxiety and its correlates: a meta-analysis. *Computers in Human Behavior*,15, 609-623.

Durndella, A. and Haag. Z. (2002). Computer self efficacy. computer anxiety. attitudes towards the Internet and reported experience with the Internet. by gender. in an East European sample. In: *Computers in Human Behavior 18* (2002) 521–535.

Davis, F.D. (1989). "Perceived Usefulness. Perceived Ease of Use. and User Acceptance of Information Technology." *MIS Quarterly*. 13(3), 319-341.

Daft, R.L.. Lengel, R.H. (1986). *Organizational Information Requirements*. Media Richness and Structural Design. Management Science. 32 (5), 554-571.

Daft, R.L. Lengel, R.H. and Trevino. L. K. (1987). Message equivocality. media selection and manager performance: Implications for information systems. *MIS Quarterly*, 11(3), 354-366.

Firth, L., & Kelly, T. (2001). The economic and regulatory implications of broadband. Geneva, ITU. At http://www.itu.int/osg/spu/ni/broadband/workshop/briefingpaperfinal.doc (August 5, 2005).

Fulk, J.. Schmitz, J.. & Steinfield, C. (1990). A Social Influence Model of Technology Use. In J. Fulk. & C. Steinfield (Eds.). *Organisations and Communication Technology* (pp. 117-140), Newbury Park: Sage.

Galbraith, J.J. (1973). *Designing Complex Organizations*. Reading MA: Addison-Wesley.

Haan, J. de and Steyaert, J. (2003). *Jaarboek ICT en samenleving 2003. De sociale dimensie van technologie.* Amsterdam: Boom.

Hill, T.. Smith, N.D. and Mann, M.F. (1987). Role of Efficacy Expectations in Predicting the Decision to Use Advanced Technologies: The Case of Computers. *Journal of Applied Psychology, 72,* 307-313.

Igbaria, M. Iivar, J. (1995). The Effects of Self-efficacy on Computer Usage Pergamon *International Journal of Managemet Science,* 23(6), 587-605. Elsevier Science Ltd

Katz, E.. Blumler, J. G.. & Gurevitch, M. (1974). Utilization of mass communication by the individual. In J. G. Blumler and E. Katz. (Eds.). *The uses of mass communications. Current perspectives on gratifications research.* Beverly Hills. CA: Sage.

Katz, E.. Gurevitch, M.. & Haas. H. (1973). On the use of the mass media for important things. *American Sociological Review,* 38, 164-181.

Lin, C.A. (2002). Perceived gratifications of online media service use among potential users. In: *Telematics and Informatics. Volume 19* (1), 13-19.

Papacharissi, Z. and Rubin, A.M. (2000). Predictors of Internet Use. *Journal of broadcasting and electronic media. 44 (2), 175-197.*

Pociask, S. (2002), Building a Nationwide Broadband Network: Speeding Job Growth, white paper prepared for New Millennium Research Council by TeleNomic Research. At http://www.newmillenniumresearch.org

Rice, R.E. (1993). Media appropriateness: Using social presence theory to compare traditional and new organizational media. *Human Communication Research.* 19(4), 451-484.

Rogers, E.M. (1995). *Diffusion of innovations.* New York : Free Press

Rosengren, K. E.. Wenner, L. A. and Palmgreen, P. (1985). Media gratifications research : current perspectives. Beverly Hills: Sage.

Savolainen, R. (1999). The role of the Internet in information seeking. Putting the networked services in context. *Information Processing & Management,* 35 (6), 765-782.

Short, J.. Williams, E.. & Christie, B. (1976). *The social psychology of telecommunications.* London: Wiley

Silverstone, R en Haddon, L. (1996). Design and the domestication of information and communication technologies: technical change and everyday life. In: Mansell. R. &
Silverstone, R. (eds.). *Communication by design. The politics of Information and Communication Technologies.* Oxford: Oxford University Press.

Sitkin, S.B.. Sutcliffe, K.M. & Barrios-Cholin, J.R. A dual capacity model of communication media choice in organizations. *Human Communication Research 18*(4), 563-598.

Steinfield, C. (1986). Computer-mediated communication in an organizational setting: explaining task-related and socio-emotional uses. In M. McLaughlin (ed.) *Communication Yearbook 9.* Beverly Hills. CA: Sage.

Tan, A. (1985). *Mass communication theories and research.* New York: John Wiley & Sons.

Thierer, A. (2002). Solving the broadband paradox, *Issues in Science and Technology*,18(3), 57–62.

Trevino, L. K.. Daft, R. L. & Lengel, R. H. (1990). Understanding Managers' Media Choices: A Symbolic Interactionist Perspective. In J. Fulk. & C. Steinfield (Eds.). *Organisations and Communication Technology* (pp. 71-94). Newbury Park. California: Sage.

Trevino, L.K.. Webster, J. and Stein, E.W. (2000). Making Connections: Complementary Influences on Communication Media Choices, Attitudes and Use. *Organization Science 11*(2), 163-182.

Venkatesh, V. and Davis, F.D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science. 46,* 186-204.
Wales, C., Sacks, G., & Firth, L. (2003). Killer applications versus killer attributes in broadband demand. PTC Conference, Hawaii, 18–23 January

Webster, J.. & Trevino, L. K. (1995). Rational and social theories as complementary explanations of communication media choices: Two policy capturing studies. *Academy of Management Journal. 38,* 1544-1572.

Chapter 6

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Cluster analysis of internet users: a longitudinal examination

Abstract

Different groups of people may use different types of internet connections for different goals. The first objective of this exploratory study is to identify a small number of relatively homogeneous groups of Internet users, based on their usage patterns (for example typical 'gamers' or 'serious information seekers'). Secondly, we aim to identify the characteristics of the internet users that are in the different clusters. We focus on demographics, experience and the connection used (broadband vs. narrowband). Thirdly, we aim to identify changes of clusters over the years (2001, 2003 and 2005). The data were collected by an online questionnaire in the Netherlands, where the first wave of data gathering was in 2001 (N=1072). The second took place in 2003 (N=2325) and the last measurement was in 2005 (N=1102). Questions regard type of internet access, activities on the internet, skills and experiences, wishes and expectations and the reasons for and impediments to switching to a broadband connection.
To identify the groups of internet users cluster analysis was performed. For each of the three years we have identified five clusters of internet users. Based on our analysis form the clusters and developments over the years, we conclude that there are two dimensions in the diffusion process: intensity of use and spreading over (internet) society. This results in certain groups of activities that go through distinct diffusion processes.

6.1 Introduction

Someone might use the Internet to look up information like train departure times, telephone numbers etc. Someone else may not see that as the main function of the Internet at all. He might like to listen to online music and rather look at pictures of his grand children. Yet another person may go online to send e-mails and find information, others use the Internet more professionally.
Many different kinds of people use the Internet, for a variety of things. The question however is which kinds of people use which kinds of Internet applications? Can groups of Internet users be recognized that are for example typical 'gamers' or 'serious information seekers'? And what kind of people are they. The objective of this study is to identify a small number of relatively homogeneous groups of Internet users, based on their usage patterns and secondly, to observe whether these clusters are stable over the course of time. Adding demographics to the patterns make this information even more valuable. Insights in these patterns make it possible to better understand and predict internet usage. With this information internet service and content providers can offer their target groups applications that better fit the needs of each of those groups, more specifically with regard to broadband service development.
The Netherlands has the second-highest penetration of broadband at 22.5 subscribers per 100 inhabitants (OECD, 2005). This rapid adoption process makes the Netherlands an interesting case for other countries. Here, we can look at what people actually do online and the changes these usage patterns go through.

6.2 Theoretical background and research questions

Although we consider this research an explorative research, there clearly is a theoretical background for this research. The main assumption is that the use of an innovation is not static, but rather evolves over time. According to Rogers' Diffusion of innovations (1995) it takes time before new technologies spread through society. Innovation does not stop when an innovation is adopted, but continues throughout its use (Johnson & Rice, 1987; Kline & Pinch, 1996; Leonard-Barton, 1988; Rosenberg, 1982). People with different lifestyles are likely to show different internet usage patterns. But also per individual the usage patterns can change over time. Constantly people evaluate how an innovation or technology fits within their daily routines. The usage of a technology can change because of changes in daily routines and activities, but also the usage of the technology can cause changes in daily routines (mutual shaping).
During the implementation phase functions of a technology can change by usage patterns and experiences. This process can be divided into several phases (Rogers, 1995, Silverstone & Haddon,

1996, Agarwal & Prasad, 1997). Silverstone and Haddon (1996) describe how new technologies are incorporated within the daily life of users by means of a process of domestication. The central issue is the interaction between technology and the user. This process of mutual adaptation is called domestication of technology. Other researchers (Johnson & Rice, 1987; Rice & Rogers, 1980) speak of *reinvention* of the technology when the adopted technology is used for functions that it wasn't intended to. For broadband this is very well imaginable, maybe even more so than for other technologies, because there are so many different application and services that are and will be offered through broadband. Every service or application offered via broadband is a change in software, hardware or devices, and therefore an innovation in itself, with its own adoption process.
In order to understand the meaning of technology for an individual or household is not sufficient to look at characteristics like income, educations and age. More important is to obtain insight into how people use technologies and how the usage patterns change. In 2001 broadband was quite new and it probably was not incorporated in the daily lives of people as it is now. Therefore, it is interesting to see whether clusters of internet users can be recognized, based on usage patterns, and whether the clusters have changed from the introduction of broadband to the point that broadband became a fully fledged technology with many users. Can we recognize the same clusters over the years or do we see new kinds of clusters emerge and others disappear?

The research questions for this exploratory study are:

1. To what extent can individuals be clustered based on their Internet usage patterns?
2. How can the clusters be characterized (demographics and internet experience)?
3. To what extent can these clusters be recognized over the course of time?

6.3 ICET-model

For this research we have identified four needs that can be gratified by the internet. These needs are mainly deduced from Uses and Gratifications research (Katz, Blumler and Gurevitch, 1974, Katz, Gurevitch and Haas, 1973). These needs are translated to activities that can be carried out online. Our ICET-model takes into account Information (gathering), Communication, Entertainment and Transactions. This model is used as an apprehensive way to group 4 distinct, but not mutually exclusive activities.

* *The need for information*
In research into the needs and uses of internet researchers have mentioned in one way or the other the need for Information. In terms of Katz et al. (1974) this need is a cognitive need. But also McQuail (1987), Rubin (1994) and Papacharissi & Rubin (2000) mention this need. It is often proved that information gathering is an important reason to go online (Maltha, Schuurman, Vermaas, Vandeberg, Bongers, Bekkers & V/d Wijngaert, 2002;Maltha, Bongers, Schuurman, Vandeberg, Vermaas & V/d Wijngaert, 2003). Information is made more accessible by the internet and an abundant amount of information can be found online.

* *The need for communication*
Social interactive needs (Katz, 1974), social Interaction (McQuail, 1987), social Companionship (Rubin, 1994), Interpersonal utility (Papacharissi & Rubin 2000), it all comes down to the need people feel to be in contact with other people. Also for this need, the internet has brought tremendous changes. It is now possible to be in contact with almost everybody, independent of time and place.

* *The need for entertainment*
Besides the need for information and communication also the need for entertainment is an important need for many people to be gratified. Other U&G researchers also pay attention to this need: entertainment (McQuail, 1987), escape (Rubin, 1994), affective and tension release needs (Katz, 1974) and pass time and entertainment (Papacharissi & Rubin, 2000).

* *The need for transactions*
Completing online transactions is an increasing important driver to go online, because of the decrease of economic transaction costs (e.g. finding a physical seller, transportation costs and duration). However no specific attention is given to the need people have to complete transactions. This need might be more like an obligation, but apparently people feel the need to complete transactions online (and not through traditional media). The need to complete transactions is not easily comparable with needs stated by U&G research, but it is an activity that can very well be carried out online.
As stated before, all these needs can be gratified through the internet and can be translated into internet activities. For each of these services (table 27) respondents were asked whether or not they have used it.

Table 27. The functions of the internet

Information	Communication	Entertainment	Transactions
search engines	Messenger	Gaming	Buying service or product from provider
portals	Chat website	Watching Online films	Online marketplaces for individuals
Websites (url or favorites)	IP-telephony	Downloading films	Auction website
Reference works	Webcams	Uploading films	Tele banking
Streaming audio/video	Reading of a weblog	Owning/maintaining a community	Reservations
News letter	Writing/publishing a weblog	Participating in communities	
News group	E-mail	Downloading/ watching tv	
Discussion groups (information sharing)	SMS (from computer to mobile)	Downloading/ watching videoclips	
Own website (information sharing)	News group	Sharing videoclips	
Information forms		Listening to music	
		Downloading music	
		Entertainment via sharing music	
		Downloading photos	
		Sharing photos	
		E-mail	
		Surfing (fun surfing)	

6.4 Research method and data collection

Longitudinal data

The data for this paper is collected in a longitudinal study that allows us to see how technology use is developing over time. The first data collection was in 2001 (September - November). This resulted in 1072 respondents. The second wave of data gathering took place from January to March 2003. The response consisted of 2325 completed and usable questionnaires. The last measurement was from October 2004 to February 2005 and resulted in 1102 completed questionnaires.

The method used is an online questionnaire. The objective of this survey is to obtain insight into current internet behavior. Questions regard type of internet access, activities on the internet, skills and experiences, wishes and: expectations and the reasons for and impediments to switching to a broadband connection.

Cluster analysis

We used cluster analysis to organize the data into meaningful structures. Cluster analysis suggests a classification scheme of grouping cases into a certain amount of classes (Everitt, 1977). Here cluster analysis is used as a pattern recognition technique to summarize relatively homogeneous Internet usage patterns.

The collected data from 2001 is slightly different from the data collected in 2003 and 2005. In 2001 respondents were asked to state for every online activity how often they carried it out (5 point Likert scale ranging from "never" to "more than once a day"). Whereas in 2003 and 2005 respondents were asked which three activities they used most. These data are binary: the three activities most carried out, were given the value 1 and those not (regularly) carried out the value 0. Specific items in each scale (ICET) are more or less similar over the years. Therefore, we had to recode the data collected in 2001 to the same detail level of 2003 and 2005. In order to do so, we constructed a top 3 activities from the 5 point scale by taking the highest scores per respondent per ICET element.

As a similarity measure Dice was chosen (also known as the Czekanowski or Sorensen measure). With this index joint absences (0-0 matches) are excluded from consideration. This is important, because only top 3 activities were given and the rest of the activities had the value 0 and so there are a lot of 0-0 matches. Considering 0-0 matches would give a wrong image.

The cluster method used is average linkage. Average linkage within groups is the mean distance between all possible inter- or intra-cluster pairs. The average distance between all pairs in the resulting cluster is made to be as small as possible. This method is therefore appropriate when the research purpose is homogeneity within clusters.

After examination we concluded that for the data of 2003 the data could be best divided into five clusters. The procedure followed is an examination of incremental changes in the agglomeration coefficient. Fewer clusters would leave out information, while more clusters did not add more information. For the sake of comparison and readability we decided to aim at five clusters for each measurement.

6.5 Results

Although in each year five clusters were found, there are some differences in size (table 28, 30 and 32). None of the clusters however, is so small that we considered one of them not to be taken into account for further analysis.

In this section we will first per year describe what the main differences are in usage patterns and characteristics of the internet users in the clusters. In table 28, 30 and 32 the internet usage patterns are shown and in tables 29, 31 and 33 the characteristics of

the internet users in the clusters. After that we will discuss a broader view of the developments of different internet functions over the years.
While interpreting the clusters and the developments in usage patterns over the years, it is important to bear in mind that in the different datasets different respondents are reached. No conclusions can be made about the development of one particular cluster over the years. Due to the large quantity of data we focus on the main differences and peculiarities.

2001
Table 28 shows the internet functions the people in the different clusters of 2001 use.

Table 28 Summarizing table 2001: activities and characteristics

	I	C	E	T
Cluster 1 (N=261)	★Search engines ⅄Reference works ⅄Audio & video	✶E-mail ⅄Messenger	★Downloading photos ✦ Fun surfing	★Telebanking
Cluster 2 (N=89)	★Search engines ⅄Portals	✶ E-mail ⅄ Messenger	★Downloading photos ✦Fun surfing	★Buying from official supplier ⅄Online marketplaces ⅄ Auction websites ⅄ Online reservations
Cluster 3 (N=342)	★ Portals ✦Search engines ⅄Audio & video	✶E-mail ⅄Messenger	✦Downloading photos ✦Fun surfing ⅄Email	★Telebanking
Cluster 4 (N=92)	✶Newsgroups ★Newsletter ✦Search engines	✶E-mail ✦Newsgroups	★Downloading photos ⅄ Fun surfing	★Telebanking
Cluster 5 (N=288)	✦Search engines ✦Audio & video ⅄Portals	✶E-mail ★Messenger ✦chat websites ⅄SMS	★Funsurfing ★Downloading music ✦Listening to music ⅄Gaming ⅄Downloading / watching films ⅄ Sharing photos ⅄ E-mail	★ Telebanking

⅄ 20-40%
✦ 40-60%
★ 60-80%
✶ 80-100%

The largest cluster in 2001 is cluster 3 (N=342). Like in (most) other clusters in 2001 the people in this cluster use search engines

for information, communicate via email and messenger, like surfing the web for fun, download photos and they do telebanking. More than others they enjoy email as a way of entertainment. Also different from other clusters is that this cluster frequently uses portals in order to get the needed information. Furthermore, they use audio and video to get information. Summarizing, we can say that these people show mo*derate, functional usage patterns*. This cluster predominantly consists of men (91%) (table 29). 51% Of the people in this cluster are under 40 years old, 6% older than 60. Half of the respondents have children. Furthermore, they have a middle to high education (respectively 41% and 36%), but this is lower than the other clusters, except cluster 5. Also, there are relatively many broadband users (90%), who go online frequently (92% once a day or more) for up to two hours (57%). With a mean of 7.4 they rate themselves as experienced internet users, but this mean is lower than in other clusters.

The second largest cluster in that year is cluster 5 (N=288). The use of audio and video for information is highest in this cluster, as is communication via messenger, chat websites and SMS (from PC to mobile). With regard to entertainment they show the highest scores of all clusters: gaming, watching and downloading films, listening to and downloading music, sharing photos and fun surfing. This cluster is made up of young, lower educated (probably because they have not finished their education), broadband users, that go online more frequently and stay online longer than those in the other clusters. Maybe these internet users are best classified as *young fun users*.

Cluster 2 is the smallest cluster (N=89) and the internet users in this cluster show differences in the way they use complete *transactions*. They have highest scores on: buying products or services from official providers, transaction via online marketplaces for individuals and auction websites and they also make online reservations more than all of the other clusters, but they are not used to telebanking. The people in this cluster are relatively young (64% is under 40 years old), are high educated and are mostly men (90%). In this cluster there are relatively many narrowband users (25%) and they go online less frequently than people in the other clusters and for a relatively short amount of time.

Cluster 4 (N=92) is different from the other because of the use of newsletters and newsgroups for information as well as for communication. These internet users can be characterized as *serious debaters*. The people in this cluster are higher educated than others and this cluster contains the largest proportion of male internet users, who rate their own internet experience slightly higher than people in the other clusters. 60% has no children.

Cluster 1 (N=261) is quite similar to cluster 3, again using their internet connection for *moderate, functional uses*. Although this cluster does not use portals (most other clusters do), but does use reference works (online telephone guides etc.) to get information. Like cluster 3 and 5 they use audio and video for information.

People in the cluster are mainly aged between 20 and 40 (55%), have mid to high education (41%). This cluster contains more women than the other clusters (12%) and there are relatively many narrowband users (21%).

Table 29 characteristics of internet users in clusters in 2001

2001

Cluster		**1** (N=261)	**2** (N=89)	**3** (N=342)	**4** (N=92)	**5** (N=288)
Characteristics						
age	-20	8%	9%	6%	6%	21%
	-40	51%	55%	45%	44%	53%
	-60	36%	33%	43%	43%	25%
	60+	5%	3%	6%	7%	1%
education	high	41%	43%	36%	54%	28%
	mid	41%	38%	41%	32%	47%
	low	18%	19%	24%	14%	28%
gender	male	88%	90%	91%	95%	89%
	female	12%	10%	9%	5%	11%
household	children	44%	44%	50%	40%	48%
	no children	56%	56%	50%	60%	52%
connection	broadband	79%	75%	90%	85%	93%
	narrowband	21%	25%	10%	15%	7%
experience	Mean score (1-10)	7.7	7.6	7.4	8.0	7.9
frequency online	> once a day	75%	57%	76%	82%	91%
	once a day	15%	33%	16%	11%	6%
	> once a week	9%	10%	9%	8%	3%
	once a week	2%	0%	0%	0%	0%
	less	0%	0%	0%	0%	0%
duration online	<2 Hours	62%	61%	57%	56%	33%
	2-4 hours	25%	25%	30%	20%	32%
	4-8 hours	10%	8%	8%	19%	20%
	> 8 hours	3%	6%	5%	5%	15%

2003

In 2003 the largest cluster is cluster 1 (N=744) (table 30). The rather *moderate usage* pattern is made up of using search engines (as is the case with all the other clusters), portals an more than in other clusters directly accessing a website by typing in the URL or clicking on the website in a list of saved favourites. Communication is done via email, which is used by all of the clusters. Gaming and downloading music are done moderately, whereas fun surfing is done frequently. Online transaction are only telebanking for this cluster.

The second largest cluster is cluster 3 (N=707). They frequently use discussion groups for information, whereas none of the other cluster does that. This is also the case with sharing information via an own website and communicating via newsgroups. They are the

only cluster that does not use portals. Rather they go directly to a relevant website by typing in the URL or via saved favourites. For communication they use messenger and, as do all the other clusters, email. Fun surfing, gaming and downloading music is done by almost all clusters in this year, also by cluster 3. Apart from cluster 3 however, none of the other clusters own, maintain or use communities. Transactions for cluster 3 are buying from a website of an official supplier, telebanking and making reservations. People in this cluster seem quite lively, with lots of *entertainment and discussion/newsgroups*.

Cluster 2 (N=562) is different from the other clusters because of the extensive use of audio and video for information. Also messenger is used quite frequently. This cluster is the only one in 2003 that watches films online. Downloading video clips is only shared with cluster 4 and more than in the other clusters music is downloaded. Entertainment is important to the people in this cluster.

The usage pattern of cluster 4 (N=228) is quite similar to that of cluster 2. It involves quite a deal of information via portals and also reference works are used as a source of information. Messenger for communication is used moderately, as are online gaming opportunities. Fun surfing is done a lot and by this cluster the most online reservations are made.

The remaining cluster 5 shows *moderate usage* and uses reference works more than the other clusters and also portals are used more than three other clusters. Downloading photos and fun surfing are done to a certain extent.

Table 30 Summarizing 2003: activities and characteristics

	I	C	E	T
Cluster 1 (N=744)	✶Directly to URL ★ Search engines ⮝Portals	✶E-mail	★Fun surfing ⮝Gaming ⮝Downloading music	★Telebanking
Cluster 2 (N= 562)	★Search engines ★Audio & video ⮝Directly to URL ⮝Portals	✶E-mail ✦Messenger	★Downloading Music ✦Fun surfing ⮝Gaming ⮝Watching films ⮝Video clips ⮝Downloading photos ⮝E-mail	★Telebanking ★Buying from official supplier ⮝Reservations
Cluster 3 (N=707)	★Search engines ★Discussion groups ✦Directly to URL ⮝Own website	✶E-mail ✶Newsgroups ✦Messenger	★Fun surfing ⮝Gaming ⮝Owning, maintaining community ⮝Participating in communities ⮝Downloading music ⮝E-mail	★Telebanking ✦Buying from official supplier ⮝Reservations
Cluster 4 (N=228)	★Search engines ✦Portals ⮝Directly to URL ⮝Reference works	✶E-mail ⮝Messenger	★Fun surfing ✦E-mail ⮝Gaming ⮝Video clips ⮝Downloading music ⮝Downloading photos	★Telebanking ✦Reservations ✦Buying from official supplier
Cluster 5 (N=186)	★Search engines ✦Portals ✦Reference works	✶E-mail	✦Fun surfing ⮝Downloading photos	★Telebanking

⮝ 20-40%
✦ 40-60%
★ 60-80%
✶ 80-100%

Table 31. characteristics of internet users in clusters in 2003

Characteristics	*Cluster*	**1** (N=744)	**2** (N=562)	**3** (N=707)	**4** (N=228)	**5** (N=186)
age	-20	9%	27%	5%	3%	3%
	-40	38%	43%	38%	34%	25%
	-60	46%	27%	47%	50%	53%
	60+	7%	3%	10%	13%	19%
education	high	40%	32%	43%	49%	37%
	mid	41%	40%	35%	31%	39%
	low	19%	27%	22%	20%	24%
gender	male	84%	87%	73%	79%	87%
	female	16%	13%	27%	21%	13%
household	children	46%	43%	48%	42%	42%
	no children	54%	57%	52%	58%	58%
connection	broadband	79%	87%	72%	56%	60%
	narrowband	21%	13%	28%	44%	40%
experience (yrs)	Mean score	6.2	5.7	5.6	6.0	6.2
frequency online	> once a day	72%	77%	59%	58%	56%
	once a day	16%	14%	19%	15%	18%
	> once a week	11%	8%	20%	22%	21%
	once a week	1%	1%	2%	3%	4%
	less	0%	0%	0%	2%	1%
duration online	<2 Hours	49%	37%	60%	79%	72%
	2-4 hours	33%	34%	29%	18%	25%
	4-8 hours	13%	18%	10%	6%	5%
	> 8 hours	6%	13%	4%	1%	3%

Concerning the age of respondents, cluster 1, 3 and 4 do not differ significant. Furthermore, cluster 2 consists of a lot of young Internet users whereas older people (40-60yrs and 60+) are predominantly clustered in 4 and 5. Difference in education is weak as well as the spread of households (with or without children) and gender; all groups show at least 73% male respondents. Interesting findings are about frequency of being online and duration of Internet use: cluster 1 and 2 are concerned with a high level of frequency (more than once a day) and duration, whereas cluster 4 and 5 show less frequency and duration. Additionally, cluster 4 and 5 are less connected to broadband in contrast to the other groups.

2005

In 2005 the largest cluster is cluster 3 (N=425). This cluster, like all the other clusters uses search engines, email, telebanking and to a lesser extent fun surfing. The people in this cluster use audio and video for information a lot and they are the only ones to share information via their own websites. Also messenger for communication is used frequently. Watching films online is done by no other cluster than this cluster and also gaming is done to some extent. Downloading music is very popular with this cluster. Furthermore, they use a range of online transaction means: aside from telebanking they buy products and services from official suppliers, use online market places and make reservations.

Table 32. Summarizing 2005: activities and characteristics

	I	C	E	T
Cluster 1 (N=87)	✶Search engines ✦Portals ✦Reference works	✶E-mail	✦Downloading photos ⮝Gaming ⮝Video clips ⮝Fun surfing	✶Telebanking ⮝Online marketplaces
Cluster 2 (N= 129)	✶Search engines ✦Portals	✶E-mail ⮝Messenger	✶E-mail ✦Fun surfing	★Telebanking ⮝Buying from official supplier
Cluster 3 (N=425)	✶Search engines ★Audio & video ⮝Portals ⮝Reference works ⮝Own website	★Messenger * E-mail	★Downloading music ✦Fun surfing ⮝Gaming ⮝Watching films ⮝Downloading photos	★Telebanking ✦Buying from official supplier ⮝Online marketplaces ⮝Reservations
Cluster 4 (N=185)	✶Search engines ✦Reference works ⮝Portals ⮝Audio & video ⮝Discussion groups	★Messenger ✶E-mail ✦News groups	★Fun surfing ✦Downloading music ✦Gaming ⮝E-mail	★Buying from official supplier ⮝Online marketplaces ★Telebanking ⮝Reservations
Cluster 5 (N=276)	✶Search engines ✦Portals ✦Reference works ⮝Information forms	✶E-mail	★Fun surfing ⮝Video clips ⮝Downloading photos	★Buying from official supplier ★Telebanking ⮝Reservations

⮝ 20-40%
✦ 40-60%
★ 60-80%
✶ 80-100%

Cluster 5 is also a big cluster in 2005 (N=276). They are the only ones to use information forms for information. Like the other clusters they also use search engines, portals and reference works for information. For communication they only use e-mail. Watching video clips and downloading photos are means to be entertained for this cluster, although they are not very frequently turned to. Funsurfing is a more important way to get entertained. With regard to transactions, they use telebanking and buy directly from official suppliers of services and products.

Special in Cluster 4 (N=185) is the use of discussion groups, which no other cluster does. Also newsgroups for communication are popular with this cluster. Furthermore, there is a varied usage pattern with some use of audio and video, which is only also done by one other cluster (3). Messenger is used a lot in cluster 3, as are the possibilities to download music. Telebanking and buying from an official suppliers site are the most used transaction functions, but also marketplaces are visited and reservation are made.

In cluster 2 (N=129) e-mail for entertainment is popular. Also, fun surfing is done. For information, communication and transactions the functions used are quite conservative (*moderate, functional usage*): search engines, portals, email, messenger and telebanking. The smallest cluster, Cluster 1 (N=87) downloads more photos than any of the other clusters. Also there is some gaming, watching video clips and fun surfing. Telebanking is done more by this cluster than by the other. Marketplaces are also a way to complete transactions for this cluster. For communication only email is used and search engines, portals and reference works are used for information.

Table 33 characteristics of internet users in clusters in 2005

Cluster		**1** (N=87)	**2** (N=129)	**3** (N=425)	**4** (N=185)	**5** (N=276)
Characteristics						
age	-20	0%	5%	8%	2%	2%
	-40	30%	34%	41%	53%	27%
	-60	54%	44%	42%	42%	53%
	60+	16%	17%	9%	3%	18%
education	high	32%	27%	39%	43%	46%
	mid	40%	39%	35%	33%	34%
	low	28%	34%	26%	24%	20%
gender	male	75%	66%	85%	69%	77%
	female	25%	34%	15%	31%	23%
household	children	43%	38%	46%	46%	41%
	no children	57%	62%	54%	54%	59%
connection	broadband	78%	53%	97%	97%	75%
	narrowband	22%	47%	3%	3%	25%
experience (yrs)	Mean score	4.6	4.6	5.5	5.8	5.3
frequency online	> once a day	53%	47%	77%	73%	58%
	once a day	23%	36%	14%	16%	25%
	> once a week	17%	14%	7%	10%	14%
	once a week	5%	3%	1%	1%	3%
	less	2%	0%	1%	0%	0%
duration online	<2 Hours	66%	65%	42%	45%	66%
	2-4 hours	25%	29%	34%	37%	30%
	4-8 hours	8%	5%	15%	14%	3%
	> 8 hours	1%	1%	9%	4%	1%

In 2005, older respondents are more clustered in 1 and 5 (to a certain extent cluster 2). So, cluster 3 contains more young respondents (< 20 yrs). Concerning education cluster 4 and 5 are highly educated, whereas cluster 2 shows a significant lower level of education, in specific. Cluster 3 and 4 are dominantly connected to broadband: 97 per cent. These respondents (3 and 4) in general started to use the Internet 1 year before other respondents (cluster 1 and 2). The other clusters, certainly the second one (47%), make use of narrowband as well. Interestingly, the frequency and duration of Internet use is consistent with that.

Developments of internet functions

In this section some of the most noticeable developments of the usage of internet functions are described. The first thing that becomes apparent in table 34 is that over all years in all clusters search engines are frequently used for information, email for communication, fun surfing for entertainment and tele banking for transactions. There are however some fluctuations that will be elaborated on underneath.

Information

Search engines are used by each cluster, each year. We do however see that the frequency with which they are used increased. The usage gets more intensified. In contrast, portals do not get used more frequently over the years, but do get used by more clusters; it is spreading over (the internet) society. This is also the case with gathering information via reference works.

Information gathering via audio and video downloads shows some ups and downs. In 2001 it is used by three clusters, in 2003 by one and in 2005 by two. The usage has not become more or less frequent over the years. What is eye-catching, is that it only gets used very intensively by one cluster. This is an internet function that is some sort of specialty, very convenient for only a small group of internet users. This is also the case for information via discussion groups, but here, even for the only cluster that uses them, they get less used. Sharing information via an own website is not something for many internet users between 2001 and 2005 and it also does not get used very frequently.

Communication

Messenger has been popular from 2001 through 2005.The main changes we see, is that less clusters use it (in 2001 four clusters and in 2005 three), but the usage is more intense. Special websites for chatting (chat rooms) were quite intensively used in 2001 by one cluster, but in 2003 and 2005 it is not in the top three of any of the clusters. Webcams and web logs are lagging behind and did not get into the top 3 of internet functions of any cluster in any year. Email on the other hand is used frequently by each cluster in each year.

Entertainment

With regard to gaming we see that the number of clusters that practice online gaming first increases and then decreases, but that the intensity, especially in one cluster increases. A similar pattern is observed with downloading music. This seems something many internet users have tried, but will only get a true leisure pursuit for a few internet users. Downloading photos was done by all clusters and quite frequently, but over the years the usage became less frequent and by less clusters. Funsurfing is constantly used by many internet users and quite frequent.

Transactions

In 2001 transactions, apart from telebanking, were only completed by one cluster, whereas in later years the usage is much more spread over the (internet) society. Buying products and services from a website of an official supplier has gotten more widely and intensively used.

Table 34 usage of internet functions by clusters in 2001, 2003 and 2005

	2001					2003					2004/5				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Information via search engines	★	★	✦	✦	✦	★	★	★	✶	★	✶	✶	✶	✶	✶
Information via portals		⅄	★		⅄	⅄	⅄		✦	✦	✦	✦	⅄	⅄	✦
Information via websites (url or favorites)	.	.	.	.	.	✶	⅄	✦	⅄		.	.	.	.	.
Information via reference works	⅄								⅄	✦	✦		⅄	✦	✦
Information via audio/video	⅄		⅄		✦		★						★	⅄	
Information via newsletter				★											
Information via newsgroup				★		.	.	.	.	.	.	.	.	.	.
Information sharing via discussion groups	.	.	.	.	.			★						⅄	
Information sharing via own website								⅄					⅄		
Information via information forms															⅄
Communication via messenger	⅄	⅄	⅄		★		✦	✦	⅄			⅄	★	★	
Communication via chat website					✦										
Communication via IP-telephony															
Communication via Webcams	.	.	.	.	.	.	.	.	.	.					
Communication via Reading of a weblog	.	.	.	.	.										
Communication via Writing/publishing a weblog	.	.	.	.	.										
Communication via e-mail	✶	✶	✶	✶	✶	✶	✶	✶	✶	✶	✶	✶	✶	✶	✶
Communication via SMS (from computer to mobile)					⅄										
Communication via newsgroup				✦				★						✦	
Entertainment via gaming					⅄	⅄	⅄	⅄	⅄		⅄		⅄	✦	
Entertainment via watching films					⅄		⅄						⅄		
Entertainment via downloading films					⅄	.	.	.	.	.	.	.	.	.	.
Entertainment via uploading films															
Entertainment via owning/maintaining a community	.	.	.	.	.			⅄							
Entertainment via participating in	.	.	.	.	.			⅄							

	2001					2003					2004/5				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
communities															
Entertainment via downloading/watching tv	.	.	.	.	.										
Entertainment via downloading/watching videoclips	.	.	.	.	.										
Entertainment via sharing videoclips	.	.	.	.	.						.	.	.	.	.
Entertainment via listening to music						.	.	.	.	.	.	.	.	.	.
Entertainment via downloading music															
Entertainment via sharing music	.	.	.	.	.										
Entertainment via downloading photos															
Entertainment via sharing photos											.	.	.	.	.
Entertainment via e-mail															
Entertainment via surfing (fun surfing)															
Transaction via buying service or product from provider															
Transaction via online marketplaces for individuals															
Transaction via auction website															
Transaction via tele banking															
Transaction via making reservations															

[10]

20-40%
40-60%
60-80%
80-100%
. no measurement for this activity in the relevant year

6.6 Discussion and conclusion

Different groups of people may use different types of internet connections for different goals. The first objective of this exploratory study was to identify a small number of relatively homogeneous groups of Internet users, based on their usage patterns (for example typical 'gamers' or 'serious information seekers').

[10] The exact proportions of each ICET function we do not know, because the respondents were asked to give a top 3 for information, one for communication and also a top 3 for entertainment and transactions. Respondents could not for example state eight entertainment functions and one communication activity.

It appears difficult to attach such labels on people in different clusters. We do however see cluster characteristics recur over the years, such as internet users with interest in discussion groups and newsgroups (cluster 4 in 2001, 3 in 2003 en 4 in 2005) and people who have a great liking for entertainment. In the first year a group of people distinguishes itself from other groups by performing online transactions more than other. We don't see such a clear difference in later years, as online transactions are more spread over the clusters.
Secondly, we aimed to identify the characteristics of the internet users that are in the different clusters. We focus on demographics, experience and the connection used (broadband vs. narrowband). Here we do not see really clear distinctions. Thirdly, we aimed to identify changes of clusters over the years (2001, 2003 and 2005). The rapid adoption process of broadband in the Netherlands (OECD, 2005) makes this country an interesting case for other countries.
Results for example show that that over all years in all clusters search engines are frequently used for information, email for communication, fun surfing for entertainment and tele banking for transactions.
Based on our analysis from the clusters and developments over the years, we conclude that there are two dimensions in the diffusion process: intensity and spreading over (internet) society (Figure 32).

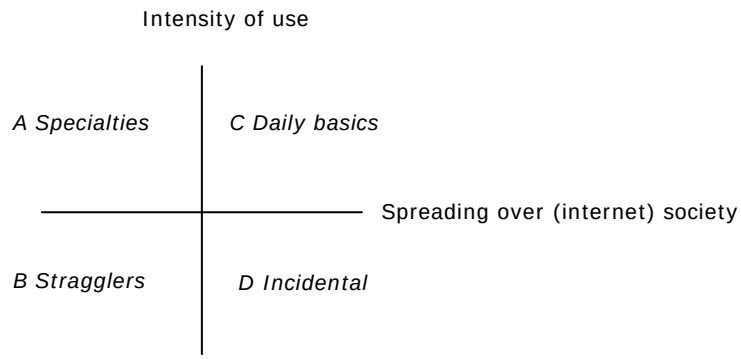

Figure 32 Dimensions of changes of internet functions over time: intensity and spreading over (internet)society

A) *Specialties*: Usage of a function gets more intensive (higher frequency), but this function is only used by one or a few specific clusters (e.g. messenger);
B) *Stragglers*: Usage is not frequent and also not spread over the different groups of internet users (e.g. communities);
C) *Daily basics*: Usage is intensive and also spread over different groups of internet users (e.g. search engines);

D) *Incidental basics*: This function is used by many different internet users but the usage is not intense (e.g. downloading photos).

We can conclude that some functions of the internet become more intensively used whereas others get less frequently used over the years. Also some functions are more and more used by specific groups, whereas other functions become general functions for almost all internet users.

References

Agarwal, R. & J. Prasad (1997). The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies, *Decision Sciences*, 28(3), p. 557-582, 1997

Angleman, S. (2000). Uses and Gratifications and Internet Profiles: A Factor Analysis. Is Internet Use and Travel to Cyberspace Reinforced by Unrealized Gratifications? Paper presented at the Western Science Social Association 2001 Conference held in Reno, NV.

Bunz, U.K. (2001). Usability and gratifications: towards a website analysis model. Presented at the National Communication Association Convention, Atlanta, GA.

Eighmey, J., McCord, L. (1998). Adding Value in the Information Age: Uses and Gratifications of Sites on the World Wide Web, Journal of Business Research, 41(3), pp: 187-194.

Everitt, B.(1977). Cluster Analysis, Heinemann Educational Books ltd., London

Johnson, B. M., & Rice, R. E. (1987). Managing Organisational Innovation: The Evolution from Word Processing to Office Information Systems. . Columbia University Press.

Katz, Blumler and Gurevitch (1974). Uses and gratifications research, Public Opinion Quarterly, 37(4).

Katz, Haas and Gurevitch (1973). On the Use of Mass Media for important things, American Sociological Review, 38(2,) pp. 164-181.

Kline, R., & Pinch, T. J. (1996). Users as agents of technological change: The social construction of the automobile in the rural United States. Technology and Culture, 37(4), 763–795.

Leonard-Barton, D. (1988) Implementation Characteristics of Organizational Innovations, *Communication Research*, 15, 5, 603-631.
Leung, L. (2003). Impacts of Net-generation attributes, seductive properties of the Internet, and gratifications-obtained on Internet-use, Telematics and Informatics, 20, pp. 107-129.

Leung, L. & Wei, R. (1998). The gratifications of pager use: sociability, information-seeking, entertainment, utility and fashion and status. In: Telematics and Informatics, 15, pp. 152-264.

Lin, C.A. (2002). Perceived gratifications of online media service use among potential users, Telematics and Informatics, 19 (1), pp. 3-19.

Maltha S., F. Bongers, K. Schuurman, R. Vandeberg, K. Vermaas & L. v/d Wijngaert (2003). Breedband en de Gebruiker 2003. Utrecht, Dialogic.

Maltha S., K. Schuurman, K. Vermaas, R. Vandeberg, F. Bongers, R. Bekkers en L. v/d Wijngaert (2002). Breedband en de Gebruiker. Utrecht, Dialogic.

McQuail, Denis (1987): Mass Communication Theory: An Introduction (2nd ed.). London: Sage

OECD (2005) Organization for Economic Cooperation and Development, The Development of Broadband Access in OECD Countries.

Papacharissi, Z., Rubin, A. M. , 2000, Predictors of internet use, *Journal of broadcasting and electronic media*, 44 (2) , pp: 175, 22

Rice, R. & M. Rogers (1980). "Reinvention in the Innovation Process" Knowledge: Creation, Diffusion, Utilization, 1 (4) 499-514

Rogers, E.M. (1995). *Diffusion of innovations*. New York : Free Press

Rosenberg, N. (1982) "Learning by Using," in N. Rosenberg, Inside the Black Box. Cambridge, Cambridge University Press, 120-140.

Rubin, A. M., 1994. Media Uses and Effects A Uses-and-Gratifications Perspective. In: Bryant, Jennings and Zillmann, Dolf Editors, 1994. Media Effects Advances in Theory and Research Lawrence Erlbaum Associates, Hillsdale, NJ

Silverstone, R en Haddon, L. (1996) . Design and the domestication of information and communication technologies: technical change and everyday life. In: Mansell, R. & Silverstone, R. (1996) (eds.). Communication by design. The politics of Information and Communication Technologies. Oxford: Oxford University Press.

Chapter 7

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Broadband in Telework, Health and Safety: the user perspective*

Abstract

Broadband potentially has strong influence on social issues such as mobility (telework), health and public and personal safety. In order to understand and to predict the adoption of broadband services in these domains, it is necessary to ask (potential) users of those services about their actual usage and expectations. Our research is an exploration of these issues. Results show that broadband connections, applications and services do not yet play an important role in the social issues covered in this research. This is understandable, since many real broadband services are not yet offered on a large scale. When looking at the perceived positive aspects of broadband services and applications, especially in telework and health care, it seems socially desirable for example government and employers to stimulate telework and the development of broadband health care services. In the public and personal safety domain the role of broadband is not so self-evident for the potential users of broadband services.

Keywords: Broadband, social domain, health, safety, telework

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7.1 Introduction

In recent years, broadband has gained ground in the very heart of the Dutch society and economy. An increasing number of households, businesses and (semi-)public institutions frequently use broadband connections for a wide variety of information, communication and entertainment purposes. Despite positive expectations in terms of social and economic benefits, private investments in broadband networks and applications have proved limited to date. As key technologies, broadband and ICT can play a crucial role in innovation processes and social inclusion. Internationally, broadband has been described as the solution for a range of social and economic problems (Firth, Gilwall, Houghton, Morris, Marini & Prosperetti, 2002). Broadband could function as the enabler for the innovation and improvement of various business processes, products and services. Broadband innovations are not limited to the corporate sector; innovation can also help to overcome problems in social areas (Maltha & Zegveld, 2004). According to Warschauer (2003, p. 9) "the ability to access, adapt and create new knowledge using ICT is critical to social inclusion in today's era".
Among users as well as suppliers of broadband infrastructure and services there are expectations about broadband playing a substantial role (in solving bottlenecks) in different social domains, such as mobility (more specific telework), safety and health. On one hand existing processes, products and services can be brought to end users faster and better and on the other hand, new services and products can be developed, that would never have been developed without broadband. Since end users of broadband are important in the uptake of broadband infrastructure and the development of new services, in this research the use of broadband for end users in three domains is investigated: safety, health and mobility (telework).

7.2 Literature Review

In this section we will elaborate on the background for this research and we will discuss related literature.

Telework

Traffic jams in the Netherlands in particular result into poor accessibility of cities and create substantial economic losses. In recent years, the economic heart of the Netherlands (Randstad) has been losing its leading position in Europe as an attractive economic metropolis. The indirect effects of congestion, such as irritation, lack of time, environmental damage and falling productivity, are also having a considerable impact on the Dutch society. Given the problems described above, applications such as teleworking should be given more consideration (Impuls Commissie Breedband,

2004). With broadband Internet telework can be done in an easier way and more efficiently, because it is possible to exchange large files (in company networks) and communicate real time with colleagues supported by video and audio.
Teleworking has been given a fair amount of attention in recent years and internationally. The idea of distance working, away from the office or working space, is made possible by new technologies such as Internet, was originally referred to as telecommuting. Haddon (1989) and others (e.g. Bailey & Kurland, 1998) reviewed a considerable amount of literature on teleworking since its origin. Many different definitions of teleworking have been proposed (Huws, 1988) and it appears difficult to define the concept. The focus in this paper will be on telework in the sense that someone works at home using Information Technology, in particular the Internet.
Earlier studies on this topic examined attitudes toward telecommuting (DeSanctis, 1984; Duxbury et al., 1987), preference for telecommuting (Bagley & Mokhtarian, 1997; Mokhtarian & Salomon, 1997; Stanek & Mokhtarian, 1998). Not many studies have attempted empirically to explore temporal patterns of telecommuting behavior. As Haddon and Silverstone (1992) point out that for long most research the figures on usage of telework are predictions of how much telework is possible. Also in many cases it is not clear why people do or do not use Internet to telework, what teleworkers do exactly, how often and how long, and which applications they use. In this research these issues are addressed. Investigating the issues in this research is important for our understanding of the adoption of teleworking and the possible impact of teleworking.

Health

Besides safety health also is an issue in which broadband is possibly of great importance. The potential for broadband and on-line health applications (telemedicine) is often predicted to be immense (Field & Grigsby, 2002; Hailey, Roine, & Ohinmaa, 2002). According to Bauer et al. (2002), narrowband is adequate for some telemedicine specialties including tele-diagnosis and tele-dermatology, but other e-specialties require broadband with tele-radiology requiring the most bandwidth. Therefore, clinics, hospitals and surgeries require broadband if they are to participate in much of telemedicine. At the residential user level, searching for information on health topics is one of the most important activities people carry out on the Internet (Teo & Lim, 2000; Maltha, Bongers, Schuurman, Vandeberg, Vermaas & Van de Wijngaert , 2003; UCLA, 2003; Nammacher & Schmit, 1998). This possibly involves significant risks, because of false, incomplete or otherwise unreliable information. But of course, a whole other range of health services and telemedicine services could be accessed or developed because of the benefits of broadband. Wanless (2002) sees the provision of information to health consumers or patients

as only one of the ways in which broadband can enhance health services. In this research we focus on the role of broadband for health from a user perspective, the health relates activities already carried out with the help of Internet and the future activities they wish to carry out, all in relation to the state of health of the respondents.

Internet connections

Before presenting any results it is important to define broadband Internet. Broadband has been defined differently by different people and tends to change rapidly.

The Dutch Broadband Expert Group, in their advice to the Dutch cabinet (2002) interprets the term 'broadband' as follows: "a connection that is 'always-on' and suitable for good quality video and audio applications and for exchanging extensive data files. Others define broadband by the exact speeds (Kennedy & Van Olst, 2004). Also the Dutch Broadband Expert Group distinguishes an initial category of connections with speeds from 1 Mbps to 10 Mbps. This implies an important role for the upgrading or further upgrading of existing DSL and cable infrastructures. A second category involves speeds of 10 Mbps and higher, where the emphasis is on constructing fibre optic connections from the home.

In this research the focus is not on the technology itself, therefore, like in research by for example Savage and Waldman (2004) and the OECD (2003) certain properties are given to distinguish broadband from the 'traditional Dial-up connection'. In this research the term narrowband is used for any connection that is established through dial-up access (traditional modems and an analogue telephone line). Therefore PSTN (public switched telephone network) and also ISDN (Integrated Services Digital Network) connections are considered narrowband. Broadband in general, is used to indicate telecommunication in which information can be transmitted over a wide band of frequencies. Because of the wide band of frequencies that is available, information can be sent on many different channels within the band simultaneously, allowing more information to be transmitted in a given amount of time. Two important characteristics of broadband Internet are 'flat fee' and 'always on'. 'Flat fee' means that the subscribers pay a fixed amount of money per month, regardless of the actual time spent online (as opposed to dial-up access, where people pay per time-unit that they are connected). 'Always on' means that there is direct connection at any time; there is no need to dial up. Based on these characteristics Asymmetric Digital Subscriber Line (ADSL), cable is considered broadband in this research. Respondents with fibre optics are not included in the response.

User perspective

In literature addressing the concept of diffusion, the adoption of technological innovations is seen as dependent on one's innovativeness, or willingness to try new products (Rogers, 1995; Atkin et al., 1998; Neuendorf et al., 1998). According to Rogers (1995, p. 5) 'an innovation is an idea, practice, or object that is perceived as new by an individual or another unit of adoption.' And 'innovativeness' is regarded as 'the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of a system'. Of course, we acknowledge that the determinants of broadband adoption are quite complex and include both demand and supply factors, but the remarks above make clear that the individuals that are to adopt (or reject) the innovation play a crucial role in the diffusion process. It is therefore important to study the adoption and diffusion process from a user perspective.

Hardly any scientific research focuses on a user's perspective on broadband in social domains. Especially with regard to safety there is a lack of literature. Although policy makers and suppliers of broadband services for safety feel there is a substantial role for broadband in the safety domain there is, to our knowledge, little or no research into the user perception of the current and future role of broadband in public and personal safety. Also, there have been no studies which ask Internet users whether Internet ever played a role in increasing their feeling of (personal or public) safety, nor have users been asked what kinds of broadband services they wish to use in the future.

Because of this deficiency in literature addressing the subject of broadband in social domains from a user's perspective, we need to rely on literature that covers only parts of our problem statement. With regard to the added value of broadband in social domains there seems to be a bias towards government white papers and policy reports. Policy makers consider broadband an important innovation to improve life quality in social domains, but empirical evidence is limited. This is caused by the fact that many "social" broadband applications and services only exist shortly, whereas the number of broadband households is limited (with some exceptions such as the Netherlands and Korea). However, the number of publications on society and Internet is growing rapidly. Popular issues dealt with are the digital divide (e.g., Warschauer, 2003) and the contribution of ICT to productivity, innovation and economic performance (e.g., OECD reports). Unfortunately, Internet research has yet not made a proper distinction between narrowband and broadband Internet. In our perspective, broadband Internet can provide substantional added value in the field of innovations in social domains compared to narrowband Internet. If we consider broadband Internet an innovation, the work of Rogers (1995) becomes very relevant. Rogers integrates technical and non-technical innovation in a social context. In our view, broadband Internet is not only a technical innovation. For

users, it opens a new world of applications and services that go beyond the technology itself. Consequently, broadband Internet becomes a subject in sociological research, for example does (broadband) Internet improve social cohesion and human capital (Putnam, 2000).

7.3 Research goals and questions

This paper investigates the role of broadband in three social domains: health care, personal and public safety and telework, from a user perspective. As stated in the literature review it is in many cases not clear why people do or do not use Internet to telework, what teleworkers do exactly, how often and how long, and which applications they use. This is also the case with the other two domains. This is why in this research we ask these questions. Also, in order to understand what difference it makes to have a broadband connection with regard to the use of Internet for safety, health and telework, it is important to look at the differences between broadband and narrowband users. Furthermore, in order to get an understanding of the possible future adoption of broadband services with regard to safety, health and telework, it is crucial to ask about the intentions to use these services.

The questions in this research are:

- To what extent do end users use the Internet for health care, personal and public safety and telework purposes?
- What are the differences between broadband users and narrowband users with regard to the use of the Internet for health care, personal and public safety and tele work purposes?
- Will end users use broadband services and applications in the future in the three domains? What are drivers and thresholds?

7.4 Research Methodology

Since there has not been a lot of research on the impact and use of broadband in the domains of this research we consider this research to be exploratory in nature. This is why we did not construct a model that is tested by this research. We intend to use the results of this research in future research. Especially the focus groups and diary research are exploratory; whereas the online questionnaire gives us information on for example how often broadband is used for heath, safety and telework. Also we may use the experiences in this research to determine the usefulness of the three research methods in order to study this matter in the future.

The data for this paper is collected from a study on broadband use in the Netherlands. We used a multi-method approach, resulting in three research methods. In a previous research we identified the strengths and weaknesses for three often used methods for obtaining data on Internet use and expectations (Vermaas & Van de Wijngaert, 2003). Table 35 gives an overview.

Table 35. Characteristics of different methods for gathering information on Internet

	Need to rely on (selective) memory	**Risk of over or underestimation**	**Obtrusiveness or intensity**	**Contextual Information**
(Online) Survey	High	Medium	Medium	Medium
Focus Group	High	High	Medium	High
Diary	Low	Medium	High	High

Because of the strengths and weaknesses of the methods we suggested that a combination of research methods will provide the most complete information on this subject. The first research method was an online questionnaire. The objective of this questionnaire was to obtain insight into current Internet behaviour. Questions focus on the type of Internet access, activities on the Internet, skills and experiences, wishes and: expectations and the reasons for and impediments to switch from a narrow band to a broadband connection. Data gathering took place from October 2004 to February 2005. The response consisted of 1,102 questionnaires. This research is based on a convenience sample. In this case this means that we have asked people that had already responded to one of our studies and left their email addresses. We provided links to our online questionnaires on several websites in order to get a diverse group of respondents. The following websites were involved in our research: websites of ISP's (such as the Dutch telecom company KPN and cable companies), official websites of Dutch cities (Amsterdam, Almere), focussed on the elderly, women and immigrants. In Table 36 some of the characteristics of the respondents are summed up.

Table 36. Characteristics of the sample of the online questionnaire

Number of responses	1102
Male/female ratio	77/23
Age range (mean)	10- 82 (43)
Together/single	75/25
Narrowband/ Broadband ratio	17/83

In order to obtain a broader and a more in depth view of how technology is used we also conducted two other research a diary project and broadband focus groups. In the diary project a relatively small group of broadband and narrow band users (N=26) was asked to keep a diary about their day-to-day activities on the Internet for the period of one month. The goal of the diary project

was to obtain qualitative, in-depth knowledge about user needs. Many of the respondents for this research method were from one part of the City of Utrecht. Both men and women and old and young people were represented. In the broadband focus groups (N=16) participants were presented with real life broadband applications. These broadband demonstrations showed the possibilities of broadband services. The goal of this project is to obtain insight into the latent needs of users by using brainstorm and discussion techniques. The broadband focus groups concentrated on safety and health care.

7.5 Findings

In order to get an idea of the extent to which Internet is used for telework we asked the respondents questions regarding:

- Frequency of teleworking;
- Duration of telework sessions;
- Used applications;
- Expenses covered by employer;
- Reasons and thresholds for teleworking.

Almost 60% of all respondents used Internet for some form of telework in the last three months. That is about 10 % less than in previous research in the Netherlands (Dialogic, 2003), but very high compared with the Dutch working population. Mostly, teleworkers, in our response, use relevant applications several times a week (17%) or at least once a day (13%). Figure 33 shows the differences between people with different Internet connections.

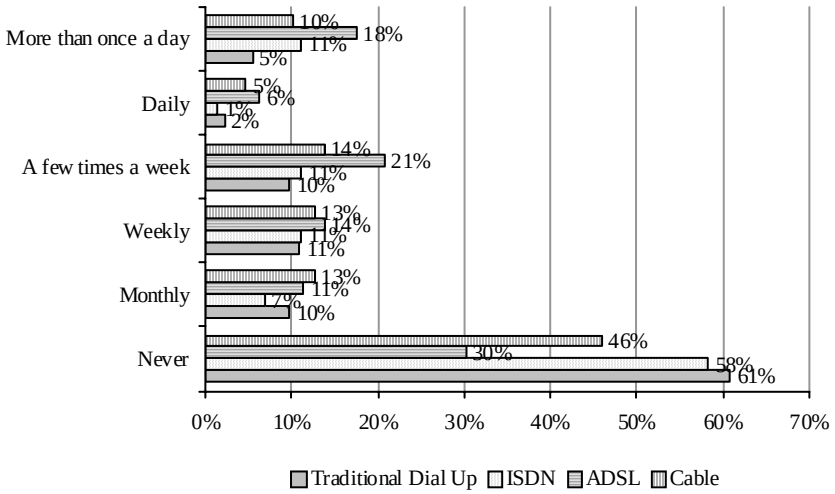

Figure 33 Frequency of telework

In previous research on telework (Dialogic, 2001; Dialogic, 2003) it appeared that respondents with an ISDN connection carry out telework most frequently. In this measurement, however, respondents with an ADSL connection take the lead. 70% of the respondents with an adsl connection went online at least once for their job. With dial-up, ISDN and cable users these figures are respectively 39, 42 and 54%. These figures contribute to assumption, based on earlier findings (Dialogic, 2005), that most teleworkers switched form an ISDN to an ADSL connection between 2003 and 2004. When we look at the frequency it appears again that adsl users (24%) use their Internet connection at least once a day for the purpose of telework. Among cable users this percentage is 15%, whereas among ISDN and PSTN users this is 13% and 8%.

With regard to the duration of telework we asked respondents show long they *actively* used Internet for teleworking. Just as in a previous research (Dialogic, 2003) it appears that among broadband users a telework session lasted on average longer than among narrowband users. Especially respondents with an ADSL connection need more time (30% more than two hours).

Apart from the Internet there are more devices that can support telework (although many of those devices make use of the Internet, such as webcams and VPN). We asked respondents which other devices they used for telework apart from their Internet connection. Almost everybody uses e-mail for teleworking (89%). Telephone (36%), access to the company network via FTP or VPN (34%), and intranet (31%) follow. Videoconferencing is used hardly

(3%), but with the advent of the webcam (8%) a growing share of teleworkers uses video communication (11%).
The opportunity to combine work and private life and to reduce time needed to travel to and from work are important reasons for people to telework (35 and 31%). This is followed by an increased productivity compared to carrying out work at the office (24%) and employers who expect employees to do their work at the office (12%). This picture emerged previously as well. An improved productivity often is stated by broadband users (32%) whereas narrowband users more often state that the combination of work and private life is an argument to telework.

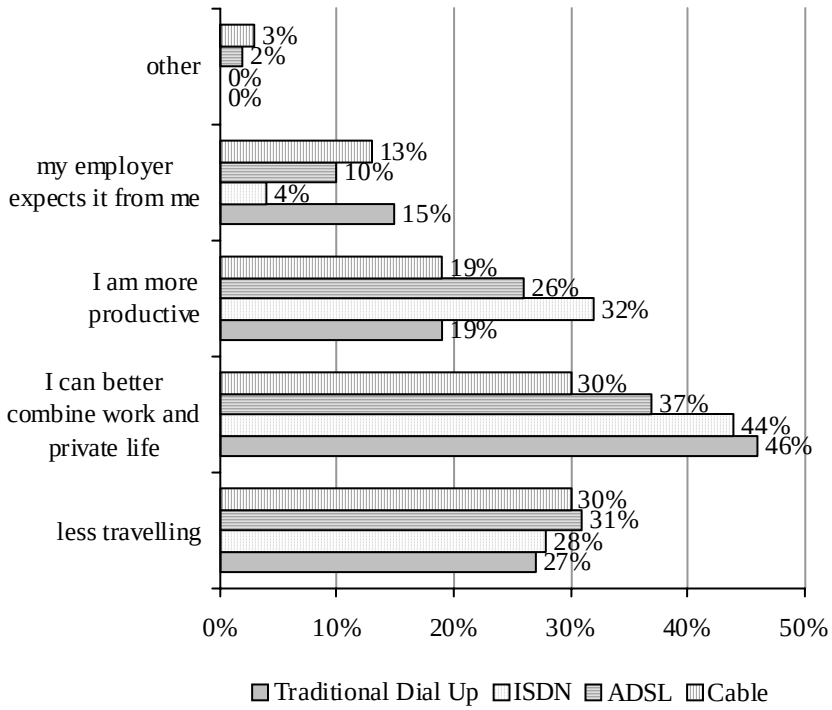

Figure 34 Reasons to telework

Respondents that do not telework explain that their job does not require a computer (34%) and their work requires them to be present at the office (32%). Besides they lack digital access from home to the company network (12%) and their employer forbids teleworking (9%). There hardly are any differences between the Internet users with different types of Internet connections.

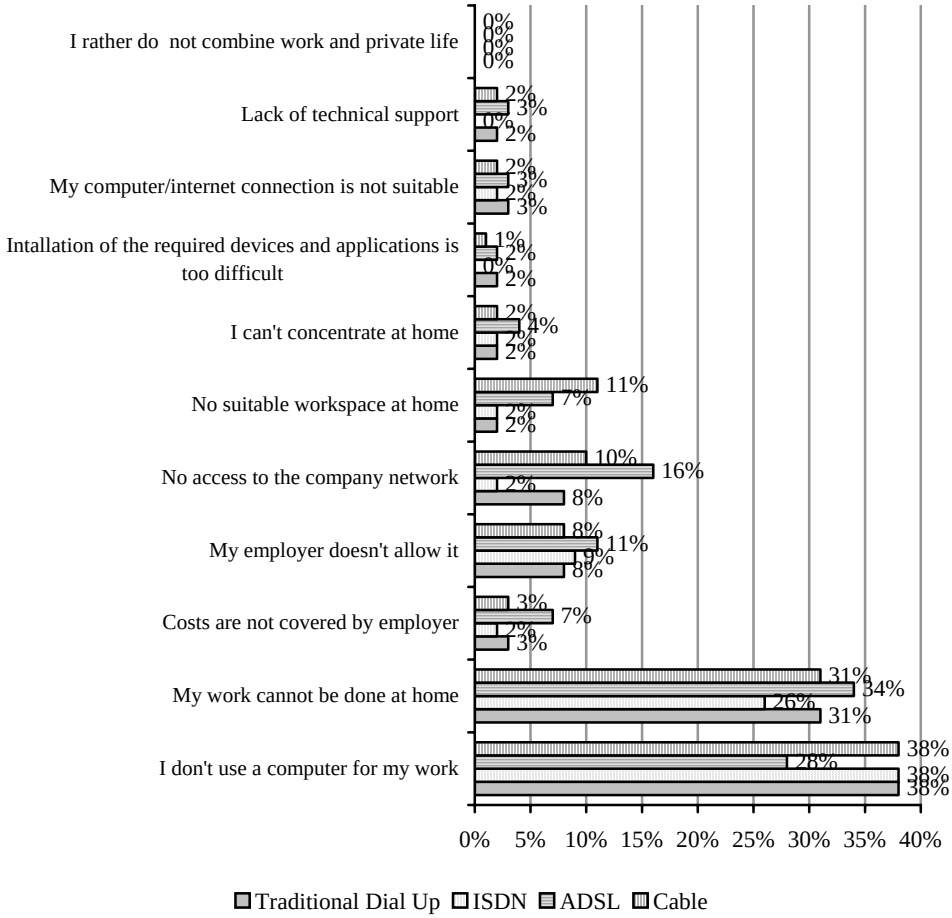

Figure 35 Reasons for not teleworking

The absence of financial compensation for teleworking by employers is no threshold for employees to telework. However, 56% of the teleworkers does not get any compensation at all. A computer and/or hardware devices are compensated for among 28% of the teleworkers. A smaller group (17%) also gets compensation for the use of the Internet infrastructure.

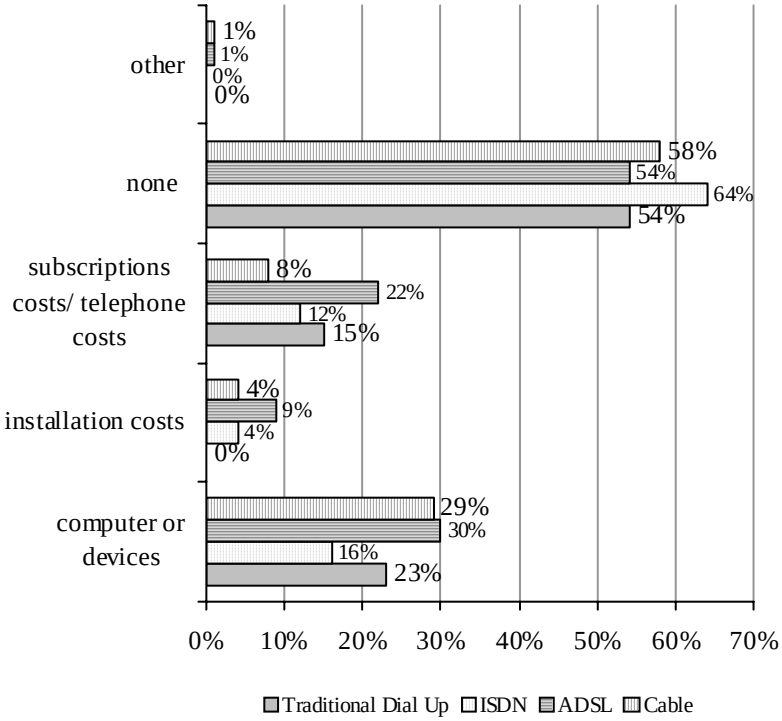

Figure 36 Costs covered for teleworking

The diary research also paid attention to teleworking. This was done in the "issue of the day". Every day the respondents were confronted with a different broadband related question that they were to answer in essay style. In the case of telework this issue was: *Teleworking (working from home with Internet access to the company network) is often associated with being more productive, less traffic jams and better combining private life and work. Do you ever telework or have you ever done so? Why do you do this or why do you never telework? Do you think in the future there will be more teleworkers? And what are the advantages and disadvantages of that?*

Participants do not agree on this matter. A large group did not telework, because their jobs do not allow this (this confirms results from the online questionnaire). Most respondents describe advantages of teleworking. The most important advantage for the respondents of the diary research is a decreased need for mobility (and the linked problems for the environment). This is also seen as the most important reason why teleworking will increase in the future. Other important reasons participants mention are the possibility to operate more independently (planning times and tasks), to be more productivity and to combine work and other tasks, such as taking care of children and carry out household tasks.

However, many respondents pointed out a reduction of social contacts with colleagues. Telework is not always a suitable substitution for small coffee talk or professional consultation. Telework could mean isolation, less sociability and less sharing of knowledge. The performance of the technical facilities is very important for a good implementation of teleworking. Some quotations from the diaries:
"I don't think that telework has such an immense future as people sometimes predict. There are a lot of duties and jobs that are not suitable to perform by computer. Apart from that people like to leave the house every once in a while!!"
"Yes, I think telework is perfect and it can solve a lot of problems such as traffic jams environmental problems etc. But if everybody will telework it will be a cold and individual society!"
"At home you can work more effective and more concentrated. No doubt that teleworking is going to be more popular."

Health
In the online questionnaire and in the diary research we addressed health with the following issues:

- General health condition;
- The perceived role of Internet in health issues;
- Internet activities related to health: already undertaken; and
- Internet activities related to health: possible future role of broadband.

Almost 35% of the respondents were in need of health care or had "a loved one" in such a situation, because of a chronic condition, handicap or illness in the last twelve months. The elder, the more need for health care (ranging from van 20% for 0-19-year olds to 38% for 60-plus). 31% of the respondents confirmed that the Internet played a role in providing the needed care, such as e-mail contact with some one they know in hospital. For 30 to 39-year olds this was slightly higher (40%). A quarter of the respondents stated that Internet has contributed to the improvement of their health condition. In order to get more insight information we have asked about the kinds of health related activities people carried out on or with support of the Internet. 39% of the respondents stated that they never did something with the Internet with regard to health issues. This means 61% had used the Internet for health related activities. Five important Internet activities in relation to health identified from this research include: visiting a website of a health institution (45%), sending a comment or question to a health institution via email of web form (13%), consulting waiting lists (12%), price quality comparison of health products and services (7%) and buying of health products and services (7%). These examples are not real broadband services. This is caused by health institutions (from general practitioners to hospitals) that hardly use

broadband applications and services in their contact with patients. This argument is confirmed by the fact that broadband users do not use real health broadband services more than narrowband users. Broadband users have the opportunity to use the services, but if the health institutions they want to communicate with, do not offer for example video conferencing with patients, it simply is not an option. Video communication with health institutions is only done by 1% of the broadband users.

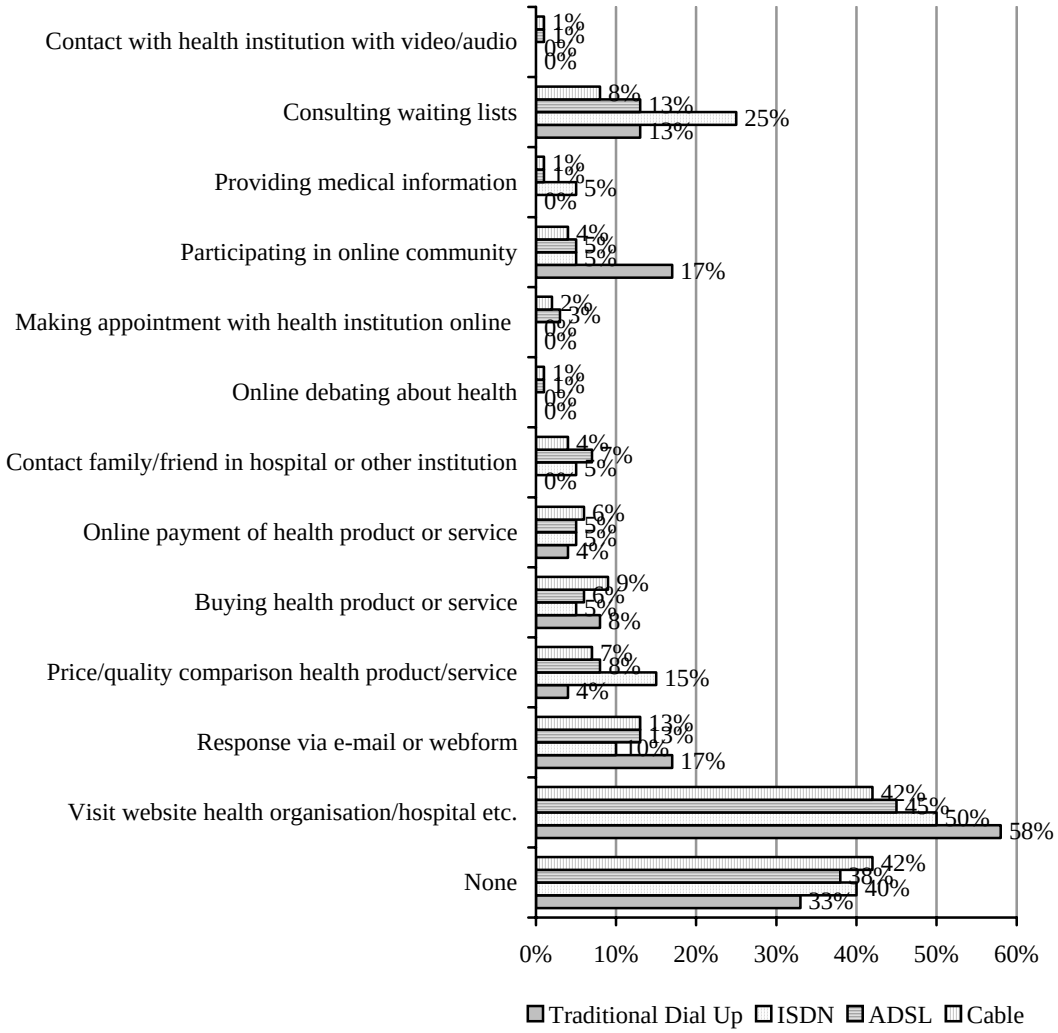

Figure 37 Internet activities regarding health: what have people done already?

In the diary research health and Internet was also an item. The issue of the day that people responded to was:

With broadband infrastructure all sorts of healthcare services are possible: online help groups to thrombosis measurements etc. A doctor can diagnose a patient's illness from a distance. What do you think of these developments? What are, in your opinion, the advantages and disadvantages of health care at a distance?

Most reactions on distance health care are positive. According to respondents, this broadband service improves contact with health practitioners (speed, comfort), Also elderly and disabled people become less depended, because some need for health care can be dealt with in their own living room. Another positive point of broadband in health care is video communication, through which it becomes easier to ask second opinions. But some problems and concerns are also brought up. The digital divide also appears in this domain. Especially people in need of health care (the elderly and disabled people) suffer from this divide, because they have less computer access and skills. The (positive) fact that elderly and disabled people can now take care more for themselves, can stimulate social isolation. Real life contact with a health practitioner often is considered an important social aspect in the daily life of elderly and disabled people. Furthermore, respondents consider online diagnosis in the end a poor substitute for face to face diagnosis. Verbal and non-verbal communications are not always transmitted well via Internet based communication systems, even though it is supported by video and audio. This is in line with the objections raised by the sociologist Putnam. He states that "[E]lectronic support groups for elderly shut-ins might be useful complements to (not substitutes for) regular personal visits. The key, [in his view] is to find ways in which Internet technology can reinforce rather than supplant place-based, face-to-face, enduring social networks" (2000, p. 411). Privacy is also a concern of the respondents, although not mentioned as the primary concern. Some quotes from the diaries that indicated the above discussion are:

"Health care will get faster, doctors will be better accessible. This is why I am positive. As a disadvantage I see, just as in other modern developments, that a large group of people does not have enough capacities to join in. Apart from people that do not have computer skills, I see many people with language problems. Internet is al about language."

"I think the developments are wonderful. But still I say that personal contact is much better, unless you are dependent on somebody else in order to get out of the house."

"Fine development. Especially for the elderly and handicapped. Disadvantage: chance of not seeing other people anymore"

"Excellent development, if the security of the data is well taken care of and if the continuity of the service is secured."

"The advantaged appear to be very big. [...] Personal contact however diminishes and that, while personal contact is very important. A question and answer 'game' is often needed in order to make a proper diagnosis. Broadband services can very well be implemented on short term as for as standard tests goes: blood sugar levels, blood pressure etc."

Safety

In this research we look at the role of broadband Internet in reducing feelings of safety in the direct surroundings of people (in home, on the street of in the neighbourhood). In the online questionnaire the following aspects were addressed:

- General feeling of personal and public safety;
- Activities carried out to improve (feeling of) safety;
- Role of Internet with the above activities;
- Internet activities with regard to safety: already carried out;
- Internet activities with regard to safety: what are people interested in?

The first question on safety was if people had ever felt unsafe in their neighbourhood in the last 12 months. Almost 17% of the respondents have felt unsafe in the past year. Especially in the age 20 to 29 almost a quarter had felt unsafe. For other age groups this is around 15%. The people that did feel unsafe to some extent, we asked whether they had ever taken action to reduce the feeling of unsafety in their neighbourhoods, with or without neighbours. Approximately 22% of the respondents who felt unsafe have taken action to increase the feeling of safety. Surprisingly, the group that feels the least safe (20-29 year olds), take the least action to reduce the feeling of unsafety (5%), whereas 60 plus people take action quite often (37%). Finally, the role of Internet in the safety domain is addressed. Over 3% of *all 1,102* respondents stated that Internet has played a role in reducing the feeling of unsafety. This figure appears to be low, but has to be placed into context with the fact that 'only' 17% of the respondents feel unsafe sometimes. People, who feel perfectly safe in their neighbourhood, will not be likely to take online action to further improve the feeling of safety.

In the following figure we see that 42% of the respondents never carried out activities online with regard to public or personal safety. This means that almost 60% did carry out online activities in order to improve the feeling of safety. Services and applications that are popular are: visiting websites of institutions or organisations concerned with public and personal safety (27%), searching functional information such as addresses and opening times (23%), communication with institutions or organisations concerned with public and personal safety via e-mail or web form (14%), price quality comparison of safety products (14%), buying of safety products (7%), digital reports of crime (6%) and security web

cams (6%). A real broadband service (a service that requires a fair amount of bandwidth) such as contacting a safety organisation, supported by video and sound, is hardly ever done. This is, like is the case with broadband health care services, most likely because these kinds of services are not offered on a large scale yet.

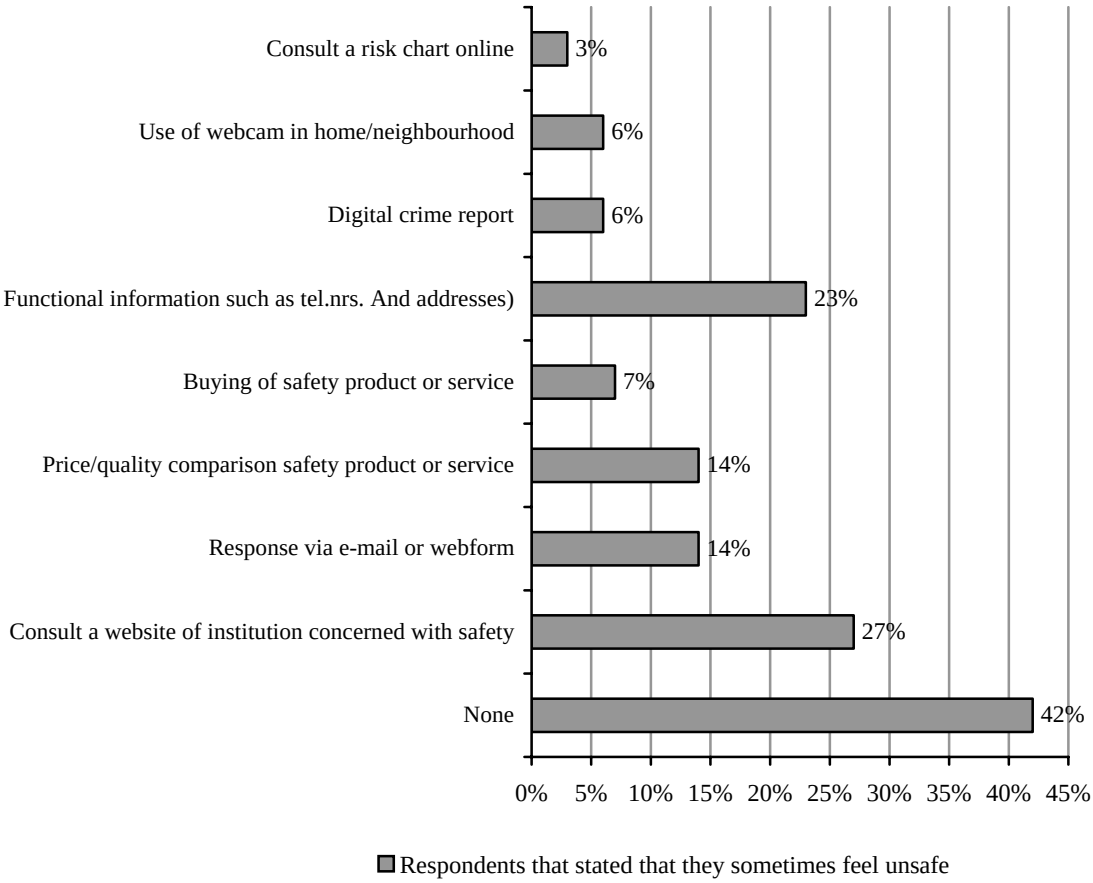

Figure 38 Internet activities with regard to safety

A small majority of the respondents do not think they will ever need or use broadband applications and services for safety (51%). This is possibly related to the fact that, as we saw before, most people do not feel unsafe and to the fact that Internet (at this point) only plays a moderate role in reducing feelings of unsafety. The other half (49%) of the respondents feel, however, that they will need and use Internet safety in the future. A relatively large group is interested in camera surveillance via the Internet. This interest decreases, as the camera physically is placed further away from the neighbourhood. A camera in and around the house is wanted by 23% of the respondents, whereas 17% wanted a camera watching over the neighbourhood while 5% wanted a camera that covers the

whole county. The differences between broadband and narrowband users are virtually non-existent. Contact via Internet with emergency centres, for example the police and fire department, supported by video and audio, are also wanted by respondents (16%).

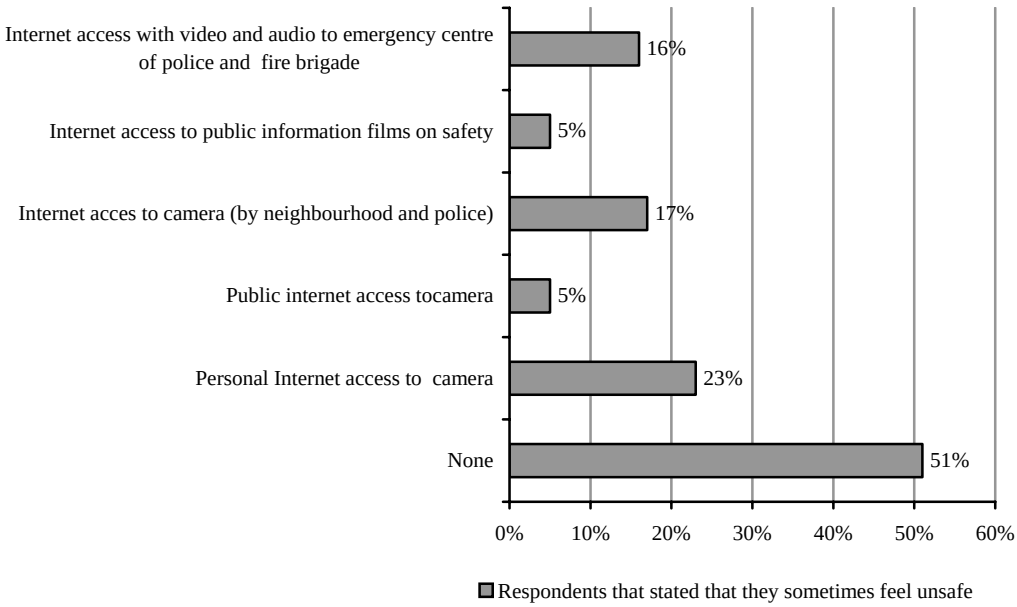

Figure 39 Internet activities with regard to safety (wishes)

The picture of public and personal safety can differ geographically. Large cities usually perform badly on inhabitants feeling of safety. This also appeared in the focus group on safety. This was in a neighbourhood that suffers from social problems (crime, unemployment, ethnic tensions). It is reasonable to expect that safety problems that came up here are also applicable to other large Dutch cities. In the focus group no important role for Internet in the safety domain was perceived by the respondents. Some of the reactions:

"Camera` surveillance hardly ever works preventative."

"Security via ICT for individuals is very expensive; a collective approach is needed to attack safety issues in an affordable way."

In the diary research also attention was paid to safety. In the issue of the day people could respond to the following issue:
A lot of people in the Netherlands sometimes feel unsafe in and around their homes, on the streets etc. Do you recognise this feeling? Can broadband play a role in reducing the feeling of unsafety? For example by camera surveillance. Are there any no go areas?

An analysis of the reactions (again) points out that most people feel safe. Towards the role that broadband can play, people are rather sceptical. They see the advantages of camera surveillance, but they do not see radical changes in safety matters. First, with camera surveillance in one place, the behaviour that causes the unsafe feeling will simply relocate. Second, privacy matters are often more important to people than camera surveillance. For some people privacy matters can never be an argument to not add camera surveillance to the range of means for improving public and personal safety. Coincidentally, this issue of the day was right after a well known Dutch television celebrity was murdered in the streets of Amsterdam. A selection of reactions to the issue of the day on safety:

" I never felt unsafe until recently. But if you see what happens these days, something has to change! I am in favour of cameras everywhere! They can see and check everything!"

"No, I don't think the Internet will take away feelings of unsafety, it has nothing to do with safety"

"It is possible, but privacy has to be maintained all the time, tapes have to be destroyed after a certain amount of time."

"Even on a day like today (November 2nd; the murder of Theo van Gogh) I do not feel unsafe. That other people do feel like that sometimes, i understand. Cameras may help temporarily, but these sorts of problems you cannot solve with broadband applications. In order to solve them our society has to change."

7.6 Discussion and Conclusion

Broadband Internet potentially has significant influence on social issues such as telework, health and public and personal safety. In order to get an understanding and to predict the adoption of services in these domains, it is important to ask (potential) users of those services about their actual usage of and expectations. This paper explored these issues. First per domain the most important findings are presented. Then an overall conclusion is given, followed by limitations and further research.

A large number of the respondents telework regularly and in long (of lengthy) sessions, especially people with a broadband connection. E-mail is the most important application for teleworking, followed by telephone and access to files through FTP and VPN and Internet. Video communication is growing, partly because of the introduction of webcams. Most teleworkers receive no compensation for the costs made for teleworking. If there is a financial compensation, this is mainly for a computer or hardware device. It can be concluded that telework is partly done voluntarily. If we place this in the context of the arguments given for

teleworking, such as less travelling (less mobility leading to traffic congestion), better possibilities for combining work and private life, it seems socially desirable to encourage teleworking fiscally. There are however limits to the degree that telework is possible; some jobs are simply not suitable for doing at home or on a computer.

Approximately one out of three respondents was in need of health care in the last twelve months (for themselves or someone they know). Of this group 31% says that Internet played a role in this situation. Around a quarter of the respondents stated that Internet has never attributed to changing the health situation for the better. Over 60% of the respondents have carried out activities on the Internet, that were related to health. Popular activities are visiting websites of health institutions (45%), sending a comment or question to a health institution via email of web form (13%), consulting waiting lists (12%), price quality comparison of health products and services (7%) and buying of health products and services (7%). No real broadband services or applications are used yet. This is related to the limited offer of those services to consumers.

About one out of six respondents felt unsafe in their neighbourhood in the past year. Of this group one fifth has done something to change this situation. Internet only plays a moderate role in these actions (in 13% of the cases). Although Internet does not play a very important role if some one feels unsafe, almost 60% occasionally look for information on safety. For example visiting a website of a organisation concerned with safety issues and people look for information such as addresses and opening times of such organisations. Searching for information on and buying of safety products are not very common activities. Also web cams for surveillance in and around the house are not used much.

Overall results from this show that broadband connections, applications and services do not (yet) play an important role in the social domains for end users covered in this research. This is understandable, since many real broadband services are not yet offered on a large scale. When looking at the perceived positive aspects of broadband services and applications, especially in telework and health care, it seems socially desirable for (for example) government and employers to stimulate telework and the development of broadband health care services. In the public and personal safety domain the role of broadband is not so self-evident for the potential users of broadband services.

Limitations and future research

This research is limited to an exploration. In order to get a full understanding of the issues each domain should be surveyed thoroughly. Although users provide important input to the development of new broadband services and applications, the supply side is important as well. Our exploration reveals that there is a lack of supply of broadband services in different social

domains. Despite the fact that many users recognize the potential benefits of broadband services. The challenge is therefore to create a critical mass of potential end users that are willing to use broadband services in different social domains. This is quite difficult, because many end users still do not know which added value broadband services can provide in the field of health and safety whereas suppliers of broadband services will not invest in these services as long as the potential market (e.g., paying end users) remains unclear. The government can help to overcome this dilemma by setting an example (providing broadband government services) and to educate/stimulate consumers and providers. Future research can investigate the mutual shaping of both demand and supply.

References

Bailey, D.E. & Kurland, B. (1998) A review of telework research: findings, new directions, and lessons for the study of modern work. *Journal of Organisational Behavior*, Vol. 23 No. 4, pp. 383-400.

Bauer, J. M., Gai, J., Kim, T. A., Muth, S., & Wildman, S. (2002). Whither Broadband Policy. *Proceedings of the Telecommunications Policy Research Conference*, Alexandria, VA.

The Broadband Expert Group (2002), Netherlands Broadband Land: Recommendations to the Cabinet from the national Broadband Expert Group for achieving a national lead in the field of broadband infrastructures and applications, The Hague.

Field, M.J. & Grigsby, J. (2002). Telemedicine and Remote Patient Monitoring. *Journal of the American Medicine Association*, Vol. 288, No. 4, pp. 423-425.

Firth, L., Gillwald, A., Houghton, J., Morris, P., Prosperetti, L. & Merini, M. (2002). Broadband: Four Nation's Experiences. J*ournal of Network Industries*, Vol. 3, No. 2, pp. 183 – 222.

Kennedy, I.G. & van Olst, R. (2004). Is the new entrant telecommunications operator dead on arrival? *AFRICON*, Vol. 2, No. 2, pp. 913-920.

Maltha, S. & Zegveld, W. (2004), Naar een nationale strategie voor breedband, *Advies van de Impulscommissie Breedband*, Utrecht.

Warschauer, M. (2003). Technology and social inclusion. *Rethinking the digital divide*, MIT Press, Cambridge, Massachusetts.

Haddon, L. (1989). Home Automation. Screen Digest, Londen

Haddon, L. & Silverstone, R. (1992). Information and Communication Technologies in the Home: The Case of Teleworking *Working Paper 17*, SPRU CICT, University of Sussex.

Hailey D., Roine, R., & Ohinmaa, A. (2002). Systematic review of evidence for the benefits of telemedicine. Journal of Telemedicine and Telecare, Vol. 8, No. 1, pp. 1–7.

Huws, U. (1988). Remote possiblities: some difficulties in the analysis and quantification of telework in the UK. In: Korte. W, Robinson, S. & Steinle, W. (eds) *Telework: present situation and future development of a new form of work organisation*, North Holland, Elsevier, pp.61-76

Nammacher, M. & Schmitt, K. (1998). Consumer use of the Internet for health information: a population survey. In: Proceedings of the AMIA symposium, American Medical Informatics Association

DeSanctis, G. (1984). Attitudes toward telecommuting: implications for work-at-home programs. *Information and Management*, Vol. 7, No. 3, pp. 133–139.

Bagley, M. and Mokhtarian, P.L., (1997). Analyzing the preference for non-exclusive forms of telecommuting: modeling and policy implications. *Transportation*, Vol. 24, No. 3, pp. 203–226.

Maltha, S., Bongers, F., Schuurman, K., Vandeberg, R., Vermaas, K., & Wijngaert, van de, L. (2003). Breedband en de Gebruiker. Dialogic. Utrecht
Mokhtarian, P.L. & Salomon, I. (1996). Modeling the choice of telecommuting 2: a case of the preferred impossible alternative. *Environment and Planning*, Vol. 28, No. 5, pp. 1859–1876.

Savage, S.J. & Waldman, D.M. (2004). United States Demand for Internet Access. *Review of Network Economics,* Vol. 3, No. 3, pp. 228-247.

OECD (2003). *Working Party on Telecommunication and Information Services Policies: UNIVERSAL SERVICE OBLIGATIONS AND BROADBAND*. At http://www.oecd.org/dataoecd/4/23/2496799.pdf (accessed 22-12-06)

Stanek, D.M. & Mokhtarian, P.L. (1998). Developing models of preference for home-based and center-based telecommuting: findings and forecasts. *Technological Forecasting and Social Change*, Vol. 57, No. 1/2, pp. 53–74.

Theo, T.S.H., & Lim, V.K.G. (2000). Gender Differences in Internet usage and task preferences. *Behaviour & Information Technology*, Vol. 19, No. 4, pp. 283-295.

UCLA (Center for communication policy). (2003). *Surveying the Digital Future*. URL: http://ccp.ucla.edu/index.asp (consulted 25 November 2004)

Ministry of Economical Affairs, Press release, 26 April 2006

Vermaas, K., & Wijngaert, L. (2005). Measuring Internet behaviour: Total Time Diary and Activity Diary as Research Methods. *Journal of Information Technology Theory and Application (JITTA)*, Vol. 7, No. 1, pp. 121-134

Wanless. (2002). Securing Our Future Health: Taking A Long-Term View. http://www.hm-treasury.gov.uk/ (consulted 25 March 2006).

Putnam, R. D. (2000). *Bowling alone. The collapse and revival of Americam community*, Simon & Schuster, New York.

Rogers, E.M. (1995). *Diffusion of innovations*. New York : Free Press

Warschauer, M. (2003). *Technology and Social Inclusion: Rethinking the Digital Divide*. Cambridge: MIT Press

Chapter 8

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Seeking Health information on the Internet: Different genders, different uses, different risks

Keywords: health information, health, Internet, usage, gender differences, risks

Abstract

The primary objective of this research is to obtain insight into information seeking behaviour on the Internet with regard to health information. Theories from two research areas are used to explain the use of the Internet for health information: health behaviour and the adoption and use of new technologies. The data was gathered through a pencil-and-paper questionnaire (N=123), between August and October 2003. In this research a convenience sample is used. All respondents were experienced with using the Internet to seek health information. Using both linear and logistic regression we investigate how demographic differences (e.g. age, gender, marital status), internet accessibility (e.g. physical, use patterns) and user needs (e.g. general health situation, limitations) influence: 1) the frequency of going online for health information 2) the kind of health information that is sought after, 3) the online sources that people use for health information (e.g. portals, newsletters, various websites). Results show that gender, Internet experience and physical limitations are significant for the frequency of going online. For the kind of information that people look for only gender has significant influence. Furthermore, the places that people look for health information are influenced significantly by gender and (to lesser extent) whether people have an Internet connection at home.

There is also a significant difference between men and women with regard to the number of websites visited and in the way they use the gathered information. This investigation shows that men and women seek information differently. As a consequence different groups are confronted with different risks.

8.1 Introduction

Research on health information on the Internet is conducted quite frequently. We have identified two prominent types of research that have been conducted. First there is research that concentrates on the activity of seeking health information online and secondly, research on the risks involved with carrying out that activity. Studies that focus on online activities of people provide figures on the quantity of people that go online to gather health information (Teo & Lim, 2000; Maltha, Bongers, Schuurman, Vandeberg, Vermaas & Van de Wijngaert , 2003; UCLA, 2003; Nammacher & Schmit, 1998). These studies show that many people nowadays go online to find health information. Maltha et al. (2003), in their research into the use of (broadband) Internet, for example found that 51% of 2.404 Dutch Internet users goes online for that purpose. Internationally, comparable figures were found. Health information on the Internet is one of the top 10 activities (UCLA, 2003). According to PEW (Fox and , 2003) 80% of the US citizens looks for health information on the Internet. This relatively high percentage is due to the fact that assisted recall was used. These kinds of studies are important because they show the scale of the usage.

Another example of research into the online seeking of health information are studies on the use of and needs regarding the internet in specific circumstances, for example among oncology patients, HIV patients and primary care patients (Weissman, Gotlieb, Ward, Greenblatt, Casper, 2000; Metz, Devine, DeNittis, Stambaugh, Jones, Goldwein, Whittington, 2001; Sciamanna, Clark, Diaz, and Newton, 2003; Kalichman, Weinhardt, Benotsch, DiFonzo, Luke, Austin, 2002; Rozmovits, and Ziebland, S. 2004). These studies provide insights into the use of the Internet for health information by specific groups of patients. Results show that a significant number of cancer patients utilize the Internet to obtain information about cancer and treatments (Metz et al, 2001). The question however is whether people who are not directly patients use the Internet in the same way as people with specific diseases and limitations.

This paper complements the two aforementioned types of studies in the following ways. It complements research that focuses on the exact figures of Internet users that search for health information by gaining more in-depth information on what people actually do with the online health information. Moreover, the research places the

use of the Internet in specific circumstances in a broader context: the everyday lives of people that are not necessarily patients. And finally, this paper investigates the *potential* threats that are related to the use of online health information. The effect of false health information may be very harmful, but the *actual* risk also depends on the chance that this effect will occur (risk = chance * effect).

Therefore this study focuses on the issues of *how people use the Internet to gather health information* and *how they use the collected information in their health decisions*. More specifically, it focuses on possible differences in usage patterns of different kinds of people. Insights in these differences may be important for government information and awareness campaigns, because they can better determine target groups.

8.2 Theoretical framework

As becomes clear in the introduction, the issue of this research covers two research areas: the area of health behaviour and the area of the adoption and use of new technologies. In order to understand how people use the Internet to gratify their health information needs the first step is to explain why people want to find health information in the first place. After that the question rises which factors influence the decision to use the internet as a medium to gather the health information.

- *Health information seeking and behaviour:* One of the first models designed to understand health behaviour as a reactive process is the Health Belief Model (HBM) (Hochbaum, 1958, Rosenstock, 1974, Becker & Maiman, 1975). The basic assumption is that an individual in the absence of any symptoms will not take action to avoid a disease unless that person is psychological ready (when somebody feels vulnerable to a disease), believes the preventive measure is feasible and efficacious or a stimulus occurs to trigger any action (advice of others, illness of family or friends). A similar approach is taken in the Fear Appeals Theory (Witte, 1992). This theory explains how fear of becoming ill can motivate (preventive) health behaviour. The Activation Theory of Information Exposure, that can be applied to research on health communication argues that people do not only seek for (health) information to just fulfil the need for information, but also to fulfil the need for stimulation or entertainment (Donohew, Lorch & Palmgreen, 1998).

- *Needs:* In fact, the concepts of Health Belief Model and Fear Appeals Theory are quite similar to some theories on the adoption (Rogers, 1995) and use (Katz, Blumler and Gurevitch, 1974) of technologies: there has to be a need in

order for people to act (to look for health information and to use the internet doing so). In the context of health information on the Internet one can imagine that the task (looking for health information) or need (for health information) depends on the health situation of the person, the fear someone has to become ill or the intensity of the proactive need someone feels to be avoid becoming ill. Also, for example, the need for information on sensitive topics such as sexually transmitted diseases or mental diseases and the anonymous character of the Internet is possibly a good fit.

- *Demographics:* The decision whether or not to use new technologies instead of more traditional means to gather information, is not likely to be the same for every person. Demographical characteristics are measured in many studies on technology use and it is often fortified with evidence that adopters and users of new information and communication technologies have higher incomes, are younger and better educated than people who lag behind (Atkin & Larose, 1994, Lin 1998).
- *Internet experience and access:* Another factor that might influence the usage of the Internet is the experience of the user with this technology. The more experience an individual has with a particular technology; the more likely it is that that an individual will use it (Fulk, Schmitz and Steinfield, 1990; Venkatesh and Davis, 2000). 'Mastery experience' is also the most influential determinant of self-efficacy (Bandura, 1986).

The relation of the variables that were presented and the empirical research is outlined in Figure 40. The dependent variables in this model are online and offline health behaviour. The online behaviour involves the gathering of online health information. This is divided into three items: the frequency of looking for health information, the kind of information that is looked for and the online sources that people use for the required information. The offline behaviour reflects what people actually do with the acquired information.

According to the research model demographics (income, gender, work situation, household situation, education an age) influence this behaviour. The demographical characteristics may influence the way people look for and use (online) health information. Internet access at home, the type of connection and Internet experience may influence the way people use the Internet for health information. Also the health situation has influence on online health behaviour. The health situation involves: the general medical condition people are in, whether they or anybody they know have a handicap, chronic disease or discomfort that limits

them in their daily lives (further referred to as 'limitation'), but also the fear of becoming ill. The health situation influences the particular health needs people have and in turn, these needs influence health behaviour.

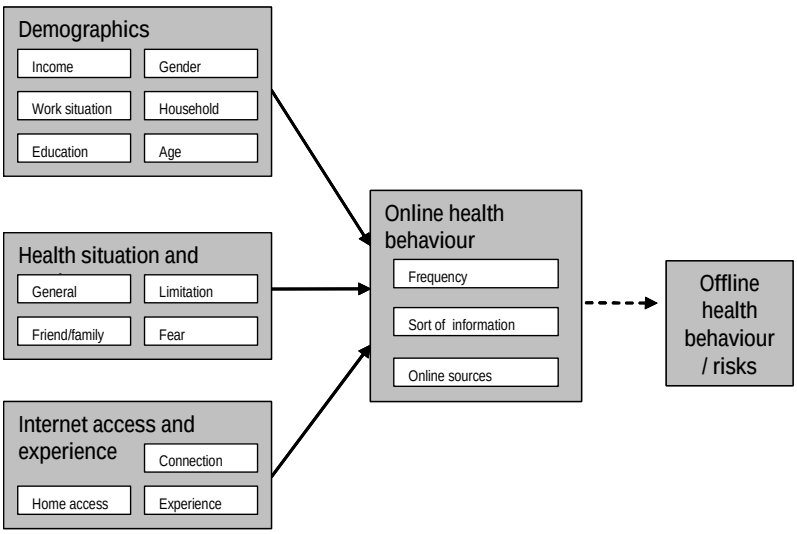

Figure 40. Research variables

8.3 Research method and data-analysis

The respondents for this study were recruited between August and October 2003. In order to reach respondents from different parts of society the respondents were gathered at several locations: a Dutch academic hospital, a fitness club and a women's union. First people were asked whether they had ever used or regularly use the Internet to look for health information. Only the people that answered confirmatively were requested to fill in the questionnaire. Consequently, the sample in this research is a convenience sample. As a result a total of 123 Internet users completed the questionnaire. The respondents filled in a printed questionnaire at the supervision of a researcher. This was done because in this way the researchers could gain more in-depth information on the topics of the questionnaire (the respondents were sometimes asked to give additional information about their answers). The demographical characteristics of the respondents are depicted in Table 37.

Regression analysis was performed to determine whether demographic characteristics, health characteristics, Internet experience and Internet access were significant predictors of the frequency of Internet usage (to gather health information). Of the characteristics that showed to be significant predictors cross

tabulations were run to determine what the differences were exactly. These characteristics are generally comparable with overall statistics of Dutch citizens.

Then the patterns of Internet usage were examined (what kind of health information do people look for and through which online means (e.g. portals, forums, websites) do they look for that information? etcetera). Logistic regression was performed to determine the predicting factors. Afterwards again cross tabulations were run to determine the exact differences. The second research question on the use of the gathered information and the decisions is examined by running frequencies and cross tabulations.

Table 37. Demographical characteristics of the respondents

Variables	Values	%	Variables	Values	%
Gender	Male	56	Work situation	full-time job	67
	Female	44		full-time study	14
				part-time job	7
Age	Mean/std.dev.	37.04/13.72		retired	5
	12 - 25	25		without or between jobs	7
	26 - 35	29			
	36 - 45	21	Education	primary school	3
	46 - 55	13		pre vocational secondary education	27
	56 - 65	10		vocational	31
	66 and higher	2		university's or UPE	33
Household	couples without children	30	Income	0-15.000 euro	25
	singles without children	28		16-30.000 euro	29
	single parents	24		31-45.000 euro	29
	couples with children	19		46-60.000 euro	6
				no answer	12

* *Translation of the Dutch education system. This may not be entirely comparable to other education systems (source: The Dutch Ministry Of Education, Culture And Science)*

8.4 Results

In general the respondents were in good (51%) or reasonable (31%) medical condition. 10% was in excellent condition. 8% of the respondents state that they are in bad medical condition. These figures are comparable with overall statistics in the Netherlands (CBS, 2003). One third of the people often fear that they will become seriously ill (31%). Another third worries about that sometimes (32%) and just as many respondents (32%) hardly ever have the feeling that they are vulnerable to a disease. 88% did not

have a limitation that causes trouble with working or studying. The overall percentage of people with a limitation in the Netherlands is around 14% (CBS, 2002). 85% Does not know someone with such a handicap, limitation or a chronic disease.

For the purpose of this study only Internet users were recruited. Most respondents (52%) were quite new users, having Internet experience for up to 3 years, whereas 33 % had been using the Internet between 4 to 6 years. 15% of the respondents had been using the Internet for 6 years or more.

Furthermore the respondents had different Internet connections. The largest group (62%) consisted of people that go online though a traditional telephone line and a modem. This is somewhat more than the overall percentages of Dutch Internet users: 50% has such a narrowband (dial up) connection (CBS, 2004). Then there was a group that had cable access (17%) (26% of all Dutch citizens according to CBS, 2004). ISDN (16% of all Dutch citizens according to CBS, 2004) and ADSL users were also represented (both 7%). Finally 5% of the respondents did not have access to the Internet at home and had to go somewhere else if they wanted to go online.

This section will further focus on answering the research questions. First the following research question on how people use the Internet to gather health information will be addressed. Moreover the demographical and health characteristics, Internet experience and access are taken into account.

8.5 Seeking online health information

Frequency of internet use for health information

Most of the respondents (42%) look for online health information a few times a year. Also vast amounts of people (20%) visit the Internet more than once a week or everyday (11%) to search for health information (4% had already been online the day they filled in the questionnaire). Remarkable is that 12% of the respondents say they do not go online frequently (less than once a year), but when these respondents were asked when they last did that 13% had been online the day they filled in the questionnaire, 40 % in the same week, 27% in the same month and for 20% it had been less than six months ago. This could indicate that people tend to underestimate the frequency they look for online health information when not reminded of specific days.

Regression analysis shows that the frequency of Internet usage in order to obtain health information can only be associated with gender and Internet experience (table 37). Other demographic characteristics, the health situation of the respondents and Internet access do not account for the decision to go online for health information or not.

Table 38. Regression analysis: factors that predict the frequency of going online.

		Beta	Sig
Demographics			
	Income	-.006	.927
	Gender	.637	.000
	Work/study situation	-.009	.889
	Marital Status	.021	.750
	Children	.013	.847
	Education	-.015	.811
	Age	-.108	.117
Internet			
	Access at home	-.008	.904
	Connection (narrow/ broad)	.084	.224
	Experience	.244	.000
Health situation			
	General	.054	.414
	Limitation	.147	.035
	Limitation friend/family	-.065	.350
	Fear of becoming ill	.125	.062
	Constant		.064

R Square	.600
Adjusted R Square	.546

These results do not support the Fear Appeals Theory. It does however support the idea of Mastery Experience; the more experience people have using the internet, the more they will used it to find the required information. Also some evidence is shown for the Health Belief Model as people with a limitation go online more frequently.

Because the model explains much of the variance with only two significant (at 0.001 level) influencers, we have checked for interaction effects. However, no significant interaction effects were found. The odd result for friends/family with a limitation (people that do know somebody with such a limitation look less for health information than those who do not know somebody with a limitation) can be explained by the skewed distribution. 85% does not know somebody with a limitation.

Further analysis shows the differences between men and women with regard to the frequency of going online for health information (table 39). Women are online more frequently in order to satisfy their need for health information than men. For example none of the men say they go online every day, while a quarter of the women say they do. Most men (59%) go online a few times a year or less than once a year (20%).

Table 39. Frequency of going online for health information and differences between men and women

		Frequency					**Statistics**		
		Every day %	A few times a week %	month %	year %	Less than once a year %	Chi² Value	df	Sign.
Gender	Male	-	2.9	17.4	59.4	20.3	60.282	4	0.000
	Female	24.1	42.6	11.1	20.4	1.9			
Internet experience	0-3 years	4.4	14.7	8.8	58.8	13.2	27.717	8	0.001
	4-6 years	22.5	30	17.5	22.5	7.5			
	More often	6.7	20	33.3	20	20			
Health Situation	Limitation: Yes	5.9	52.9	41.2	-	-	30.703	4	0.000
	Limitation: No	9.8	14.7	10.8	51.0	13.7			

Sort of health information that people look for on the Internet

Table 40 shows the nature of the health information people look for on the Internet. It is clear that a large variety of health information is accessed through the Internet. Information on chronic diseases (49%) and weight or fitness (42%) is the most required information. Also information on medication (37%), new diseases (diseases, discomforts or symptoms that people have not had before) (34%) and alternative drugs and treatments (32%) are sought after. Furthermore the Internet seems to be a good way to learn more about sensitive topics such as sexual transmitted diseases (28%) and mental heath problems (24%). Diseases of family and friends (24%) are also reasons for people to go online. People that want to know more about certain treatments also find their way to the Internet (20%). The online health information that is least popular is information on insurances (13%), addictions and physicians, hospitals or clinics (12%).

Logistic regression was conducted on each sort of information separately. For five sorts of information none of the variables (demographical, health situation and internet experience) could explain the variance (use the internet for that sort of health information or not). For the remaining seven only the demographical characteristic 'gender' proved to be associated with going online for that sort of health information. In table 40 only the characteristics significantly associated with the kinds of information people look for are shown.

Table 40. Kinds of information sought after

Kinds of information: * More than one answer was allowed	Have looked for this info %	Characteristics associated
Physicians, hospitals or clinics	12	-
Addiction	12	-
Insurance	13	Gender
Treatments	20	-
Depression/mental health	24	Gender
Disease family/friends	24	Gender
Sensitive	28	Gender
Alternative drugs/treatments	32	-
New diseases	34	Gender
Medication/drugs	37	Gender
Weight / fitness	42	-
Chronic disease	49	Gender

Further examination of the differences between men and women shows that men look for a greater variety of health information (Table 41) on the Internet. They look more often for information on depression and mental health, sensitive topics, new diseases and medication. Women more often look for information on chronic diseases and tend to fulfil a more caring role with regard to their health information need; women look more often for health information on the Internet if it is for family and friend with health problems. This could be caused by the traditional role of women as caretakers for their children. Also women look more often for information on health insurance.

Table 41. Kinds of information sought after; differences between men & women

Kinds of information: * More than one answer was allowed	Gender		Statistics		
	Male %	Female %	Chi² Value	df	Sign.
Insurance	31	69	4.611	1	0.03
Depression/mental health	83	17	11.951	1	0.00
Disease family/friends	37	63	6.083	1	0.01
Sensitive topics	82	18	13.152	1	0.00
New disease	83	17	19.210	1	0.00
Medication/drugs	74	26	9.470	1	0.00
Chronic disease	38	62	15.010	1	0.00

The online sources that people use for online health information

People look for health information on different places on the Internet. Table 42 shows that most respondents look for health information on commercial websites and forums (40%). Again logistic regression was conducted for the sources people use for health information. For commercial websites, portals (saved as

favourite) and newsletters gender is associated again. No significant differences were found on the basis of age, education, work situation, marital status, having children or not, income, Internet experience, access at home and type of connection. The use of forums for health information is associated with whether or not people have Internet access at home.

Table 42. The online sources people use for information

The online sources people use for information: * More than one answer was allowed	Have looked on such a site %	Characteristics associated
Commercial websites (manufacturers medic./drugs)	40	Gender
Websites of hospitals, health institutions, MD's	3	-
Forums	40	Connection at home
Portals (saved as favourite)	28	Gender
Patients' association	19	-
Newsletters	18	Gender
Portals (not saved as favourite)	16	-

A closer look shows that especially women turn to sites of the health industry (drug manufacturers etcetera). Portals that are visited regularly (saved as 'favourite') and forums are important information sources for both men and women (respectively 44%/56% and 57%/43%). Medical newsletters are more of a men's thing (82%). Furthermore, people that have Internet access at home more often use forums.

Table 43. The online sources people use for information; differences between men and women

The online sources people use for information * More than one answer was allowed				Statistics		
	Gender	Male %	Female %	Chi² Value	df	Sign.
Commercial websites (manufacturers medic./drugs)		41	59	7.722	1	0.005
Portals (saved as favourite)		44	56	2.738	1	0.098
Newsletters		82	18	7.197	1	0.007
	Internet at home	yes %	no %	Chi² Value	df	Sign.
Forums		67	33	3.015	1	0.065

Most of these website are found by search engines (46%) and by surfing the WWW (38%). Also many respondents got the addresses of friends or family (28%). In less than 7% of the cases the website is recommended by a physician. In general most respondents find the needed information in most of the cases (68%) but almost 10%

does hardly ever find the needed information. Most people consult one or two places on the Internet to find out more about their health questions (66%). 22% visits three to five places and 11% between six and ten. Less than one percent visits more than 10 sites online. Men visit more websites per disease or medical discomfort. This may explain the fact that men more frequently say that they find the required information.

8.6 Using online health information

In this section the question of how people use the collected information in their health decisions will be addressed. If we look at online health information as preparation, replacement or complement, the following results can be depicted.

Pandey, Hart and Tiwary (2003) point to the fact that women increasingly use the internet as a supplemental source for health information. In their research only women were represented and therefore no comparison was made between men and women. Table 44 shows that most of the time the health information that people find on the Internet is used as a preparation of a doctor's visit (59%). A quarter (26%) of the information is searched for after paying a visit to a physician. Also a vast amount of information is used to replace a visit to a physician (29%).

Again, the differences between men and women are examined. The biggest difference between men and women here is that men use it more than women as a replacement of a doctors' visit (83%).

Table 44. Use of health information

Using health information:	**Have used info as/to %**	**Gender**		**Statistics**		
		Male %	Female %	Chi^2 Value	df	Sign.
As a preparation of a doctors visit	59	47	53	5,554	1	0.018
As a replacement of a doctors visit	26	83	17	15,330	1	0.000
To gather some extra information after a doctors visit	29	47	53	2,701	1	0.100
other	3	50	50	1,494	1	0.222

* more than one answer was allowed.

Furthermore a third (33%) of the respondents say they decide on a certain treatment for their health problems. Here also there is a difference between men and women: women more often decide to want a certain treatment based on online information than men (F 65% - M35%, $Chi^2 = 10.713$, df=1, sign. = 0.001).

Most use the information as a preparation for a visit to their physician. This could be because the respondents do not find the

information particularly useful. When we look at attitudes towards and experiences with online health information we see that more than half of the respondents (53%) is neutral towards the usefulness of online health information, 20% state that they find it useful and 17% says it is very useful. Towards the trustworthiness of the information respondents tend to be more positive: 60% says the information is very trustworthy. That seems to be in contrast with what the respondents say about false health information that was ever given to them: 58% has ever received incorrect health information via the Internet. The consequences of this wrong information however have not been severe for most people; they (or someone they know) have not been damaged in any way by this information. In stead many respondents (41%) say that they or someone they know have been helped by the health information found online. That may explain that 20% of the respondents say that their hope of a cure for their problem is increased based on online information, despite the fact that their physician tells them otherwise. This is especially so for women (F 67% - M 33% Chi ^{2} = 6.274, df=1, sign. = 0.012). Furthermore, for a quarter of the respondents the way they regard health in general changes, because of what they have found on the Internet. This is especially the case with men (F 69% - M31%, Chi ^{2} = 2.811, df=1, sign. = 0.094). Results show that the fear of becoming ill has no significance influence on how online health information changes people's thoughts on health in general.
The fact that much information is gathered does not imply that all of it is used in health decisions. Many times people decide to not use the gathered information (61%). The reasons for this are that the visited websites appeared unprofessional (51%), the source was unknown (31%), the websites were of commercial parties (27%) or that the website provided different information than a physician (17%). A significant difference between men and women is that men (68%) tend to value the source more than women (32%) (Chi2=3.391 df=1 sign.= 0.066).

8.7 Conclusion and Discussion

The results from this research do not support the Fear Appeals Theory. It does however support the idea of Mastery Experience; the more experience people have using the internet, the more they will used it to find the required information. Also some evidence is shown for the Health Belief Model as people with a limitation go online more frequently.

The fact that women are more frequently online visiting mainly commercial sites with health information, but look for less health topics than men, seems so support the Activation Theory of Information Exposure. Women seem to not only fulfil needs for

information on specific health topics, yet they seem to surf the web looking for stimulation.

For most topics of this research the main differences are between men and women. Women turn to commercial websites (that are more likely to provide less trustworthy information) and depend on the first (two) website(s) they visit, but they use this information mainly as a preparation for a visit to a physician in which they discuss the found information. The opinion of that physician however does not always seem to influence their expectations: their hope of a better treatment or miracle cure increases through what they find on the web, despite the opinion of the physician.

Men look for health information on places that are more likely to provide trustworthy information (newsletters and websites of patients' associations), consider the source of the website before using the information and look for the information on more than two websites. With this information they seem to be less at risk than women, but their pit-fall is that they more often replace a visit to a physician with a visit to the Internet. Moreover the online information changes their view on health in general.

From this it can be concluded that men and women are at risk in different ways when accessing and using online health information: the risks of women seem to be more in the process of collecting the information, whereas men are more at risk in the process of using the information.

Limitations of the research

The results that were presented in this research is based on a relatively small sample. The conclusions should therefore be handled with care. Moreover, the sample was drawn in The Netherlands. Currently we are not able to oversee to what degree the results generalise to other parts of the world. In order draw further conclusion it is important to formulate hypotheses and test in a larger sample.

Further research

As the internet becomes more important in people's lives it is not surprising that people also search the Internet to satisfy their needs for health information, especially on chronic diseases, weight and fitness and medication. In this research we did not make comparisons between people that do and people that do not use the internet for health related questions. Comparing the two groups and the origins of their decision whether to go online for health matters or not, could provide important additional insights in this matter.

The frequency of visiting the Internet to look for health information is strongly associated with gender and Internet experience and somewhat with having a limitation (see summarizing Table 45).

Table 45. Summarizing table

	Demographical characteristics	Health Situation and needs	Internet access & Experience
Frequency of going online for health information	Gender	Limitation	Experience
Sorts of health information	Gender		
Online sites looked at for health information	Gender		Access at home

People with a limitation visit the Internet more often to find health information than those who do not have such a limitation and people with little experience go online less frequently than people who have been online longer (and see the internet as an logical source of information). These findings seem very plausible. Less straightforward is the explanation of the differences found between men and women. Women go online more frequently than men with regard to health information, look for different subjects and look at different websites. The explanation cannot be found in the use of internet, as in most research men go online more often. Recent research however shows that (highly educated) women are more willing than men to use the Internet to find medical information to manage a chronic health problem (Campbell, 2004). It could be that women are more interested in health related topics than men, also in the offline world. For example (Dutch) women's magazines seem to pay more attention to health than magazines for men. Also women tend to visit a physician more often than men. Van Zoonen (2002) states that all household appliances have their own gendered uses and gender codes which results in different articulations of gender with the Internet.

People mainly look for health information on commercial websites and forums. This could be due to lack of awareness with regard to websites of patient associations and accredited or official institutes. It would be interesting to see whether the respondents were or were not familiar with or aware of such institutes.

As this research is a first step in understanding online health behaviour and as it is impossible to explain everything involved in this complex subject with the variables derived from the theories in our theoretical framework, there is an urge for a new theoretical underpinning, that focuses on needs and how those needs are gratified. This could be done through for example a policy capturing approach, in which the factors that influence the decision to look for certain information becomes apparent. In order to prevent underestimation of the frequency of using the Internet for health information other research methods could be used, such as a diary research.

Furthermore, this research is about Dutch Internet users that look for health information. Comparing results from different countries

could also provide more insights on what the influence is of online health information. Also, although this research provides information on how people use the Internet to gather health information and how they use this information, the sample of 123 people could be enlarged to get a more accurate view.

References

Atkin, D., & Larose, R. (1994). Profiling call-in poll users. Journal of Broadcasting & Electronic Media, 38, pp. 217-227.

Bandura, A.(1986) Social Foundations of Thought and Action: A Social Cognitive Theory, Englecliffs, NJ: Prentice Hall

Becker, M.H. and L.A. Maiman (1975). Socio-behavioural determinants of compliance with health and medical care recommendations. Med. Care 13, pp. 10–24.

CBS, (2002) http://statline.cbs.nl, CBS, (2003) http://statline.cbs.nl

Campbell R. (2004). Older women and the internet. Women Aging, 16(1-2), pp.161-74.

Davis, F.D. (1989). "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," MIS Quarterly, 13:3, pp. 319-341.

Donohew ,L., Lorch, E.P., & Palmgreen (1998) Applications of a theoretic model of information exposure to health interventions, Human Communication Research, 24, pp. 454-468

Fulk, J., Schmitz, J., & Steinfield, C. (1990). A Social Influence Model of Technology Use. In J. Fulk, & C. Steinfield, Organisations and Communication Technology. pp. 117-140. Newbury Park: Sage.

Fox, S. and D. Fallows (2003). Internet Health Resources. Washington, PEW INTERNET & AMERICAN LIFE PROJECT. 20036 202-296-0019 http://www.pewinternet.org/

Hochbaum, G.M. (1958). Public participation in medical screening programs: a sociopsychological study. Public Health Publication 572, Washington DC, US Government Printng Office.

Kalichman, S.C., Weinhardt, L., Benotsch, E., DiFonzo, K., Luke, W., Austin, J. (2002). Internet access and Internet use for health information among people living with HIV-AIDS. Patient education and counseling .46 (2) pp: 109-116

Katz, E., Blumler, J. G., & Gurevitch, M. (1974). Utilization of mass communication by the individual. In J. G. Blumler and E. Katz, (Eds.), The uses of mass communications. Current perspectives on gratifications research. Beverly Hills, CA: Sage.

Lin, C.A. (2002). Perceived gratifications of online media service use among potential users. In: Telematics and Informatics, Volume 19 (1), pp 3-19.

Maltha, S., Bongers, F., Schuurman, K., Vandeberg, R., Vermaas, K., Wijngaert, van de, L. (2003). Breedband en de Gebruiker. Dialogic. Utrecht

Metz, J.M., Devine, P., DeNittis, A., Stambaugh, M., Jones, H., Goldwein, J., Whittington, R. (2001) Internet utilization by radiation oncology patients. International journal of radiation oncology, biology, physics , Volume: 51, Issue: 3, pp: 100-101

Nammacher, M, Schmitt, K. (1998) Consumer use of the Internet for health information.

Pandey, S.K., Hart , J. and Tiwary, S. (2003). Women's health and the internet: understanding emerging trends and implications. Social Science & Medicine,56 (1) , pp. 179-191

Rickert, A. & A. Sacharow (2000): 'It's a Woman's World Wide Web' [WWW document] URL http://www.rcss.ed.ac.uk/sigis/public/backgrounddocs/womenontheweb2000.pdf

Rogers, E.M. (1995). Diffusion of innovations. New York : Free Press

Rosenstock, I.M. (1974). Historical Origins of the Health Belief Model. Health Education Monographs, 2, 328-335.

Rozmovits, L., Ziebland, S. (2004) What do patients with prostate or breast cancer want from an Internet site? A qualitative study of information needs. Patient education and counselling , 53 (1), pp: 57-64

Venkatesh, V. and Davis, F.D. "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies," Management Science, 46, 2000, 186-204.

V. Venkatesh and M.G. Morris (2000), Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behaviour, *MIS Quarterly* 24:1, 115 – 139

RVZ (Council for Public Health and Health Care) (2000). Patient en Internet. Zoetermeer

Theo, T.S.H., & V.K.G. Lim (2000). Gender Differences in internet usage and task preferences. Behaviour & Information Technology, 19 (4), pp. 283-295

UCLA (Center for communication policy) (2003), Surveying the Digital Future URL: (consulted 25 November 2003) http://ccp.ucla.edu/index.asp

Weissman, A., Gotlieb, L., Ward, S., Greenblatt, E., Casper, R.F. (2000) Use of the Internet by infertile couples Fertility and sterility , 73 (6) , pp: 1179-1182

Witte, K. (1992b). Preventing AIDS through persuasive communications: A framework for constructing effective, culturally-specific, preventive health messages. International and Intercultural Communication Annual, 16, 67-86.

Zoonen, L. van (2002) 'Gendering the internet: claims, controversies and cultures'. *European Journal of Communication*, vol.17(1), 5-23.

Chapter 9

An abridged version of this chapter has been accepted for presentation at the 18th ITS Europe conference, Istanbul, 2-4 September 2007 as: Vermaas, K., L. van de Wijngaert & S. Maltha (2007). Broadband and its Dutch users

Overview and concluding remarks

The definition for broadband used in this work is based, not on exact speeds, but on the following characteristics: "*a connection that is 'always-on', has a "flat fee" and is suitable for good quality video and audio applications and for exchanging extensive data files.*" For the purpose of our research, ADSL, cable and fibre optics are considered as broadband.

When our research began in 2001, it was not clear at that time how broadband internet would develop in the residential market. Of course we know now that things certainly moved very rapidly in the Netherlands. By 2005, when the final part of this research was completed, 55 percent of Dutch households had a broadband connection, compared to only 13 percent three years earlier (CBS, 2005).
In order to gain more insight into the reasons and thresholds for the adoption of broadband, it is important to study these concepts from a user perspective. Researching new technologies from a user perspective, however, is often neglected. Especially when it comes to broadband, research and investments are still greatly driven by technology. Whilst we acknowledge the importance of the technology perspective, it cannot replace research from a user perspective. It is important to monitor the adoption and usage processes of broadband as this information will help researchers, policy makers and practitioners to understand the issues that determine potential users' acceptance or rejection of new technologies. Also, by taking a closer look at what people do and do not do, we can find solutions for future services. Because the penetration of broadband in Dutch households is high compared to other countries, the Netherlands make a good case for investigating the adoption and usage processes.

The main goal of this dissertation was to gain insight in and to understand the adoption and the usage patterns of broadband internet from a user perspective. The definition that Rogers (1995) gives suggests that diffusion involves the adoption of new

innovation, its usage and subsequent impact of usage. In this research we focus on the adoption (acceptance of and subscription to broadband) and the usage of broadband.
The adoption process was investigated by looking at the reasons and thresholds for switching from narrowband to broadband and changes over time were considered (chapter 4). The usage of broadband was explored by monitoring what information, communications, entertainment and transaction (ICET) functions of broadband people use (chapters 5 and 6) and what activities they carry out with their internet connection with regard to health, safety and telework (chapters 7 and 8).
The subgoal of this research was to gain insight into the possibilities and limitations of (combinations of) research methods for measuring and monitoring the adoption and usage of new technologies. These research methods involved ways to collect empirical data as well as carrying out systematic literature reviews. During this research project, literature reviews as well as our experience were used to gain insight into the possibilities and limitations of the research methods, because combining both of these provides a more valuable picture than literature reviews or experiences alone (chapter 2 and 3).

This chapter contains an overview of the results and provides overall concluding remarks. Using the results of the online questionnaires, focus groups and diary research, we will answer the research questions that were presented in chapter 1. The research questions are each presented with an overview of the results and concluding remarks.

9.1 Research methods for insight in the adoption and use of new technologies

There are several research methods to gain insight into the adoption and usage patterns of new technologies. Due to the complex nature of adoption and usage issue, it is logical to use more than one research method in order to gain more in-depth information. Combining the results from different research methods which complement each other, results in a fuller understanding of the subject.
The question is, however, in what way do these research methods contribute to our knowledge of adoption and usage processes. In this research we have taken a parallel method approach consisting of online questionnaires, diary research and focus groups for the empirical part. We also performed a meta analysis of previous empirical research carried out by other researchers. The literature on these research methods combined with our experiences during this project enabled us to provide answers to the following research question:

RQ1 *What are the possibilities and limitations of (combinations of) various research methods to gain insight into the adoption and use of new technologies?*

Our main source of information consists of several online questionnaires. Online questionnaires form an attractive alternative to both postal and telephone surveys, because of high costs and time consuming aspects involved in the last two data collection methods. In addition to their operational benefits, online questionnaires could reduce data entry error and increase flexibility in visual presentation and design. They are more suitable for studies such as those with particular goals and populations than for other studies. Judged in the context of our research, where the population is Dutch internet users, online data collection seems more appropriate than in many other studies. While there is still some concern about the external validity of online survey results, existing research supports using the internet as an effective method for collecting survey data, particularly when the population to be studied is known and identifiable, or as in this research consists of "all internet users".

The second research method used is rather innovative. Diary research enables researchers to create an image of what people do with technology and perhaps more importantly *why* they do it. These insights into the role a particular technology plays for people are of considerable importance to those involved with understanding the adoption and the usage of new technologies and information systems. Conducting diary research can lead to more understanding of the underlying needs of (potential) customers and the results can be useful in the development and shaping of new technologies that better match peoples' needs.

A Total Time Diary (all information, communication, entertainment and transaction activities, 24 hours a day, all media used) provides a general insight into human (internet) behaviour. It places certain activities into the broader context of peoples' daily lives, thus providing us with a general, slowly changing view of how people use old and new media and technologies. This approach towards diary research offers the opportunity to better understand human behaviour in a very broad sense. By grasping what people consider frustrating, time-consuming and constraining in their daily lives, we can deduce which new technologies and services offer possibilities to overcome these frustrations. Also, time shifting between activities can become clear by using a total time diary. Thanks to recent developments it is for example already possible to watch television programs at a self chosen time. The question is whether people actually use these services.

In contrast to Total Time Diaries, Activity Diaries concentrate on specific behaviour, in this case internet behaviour. We believe that an Activity Diary is useful if there is a clear direction or domain with regard to which new technologies will be applied. An Activity

Diary can provide insight into specific behaviour, such as online health behaviour or interaction with e-government.
Although the diary as a scientific research instrument to study internet behaviour needs further refinements (for example a clear justification for choosing either *total time diary* or *activity diary* or a combination, and determining the effects of sample size), the two diary studies appear to be a valuable step in the evolution of a valid instrument to measure internet behaviour. The insights gained through diary research give more depth to the results of online surveys and web statistics. The results tend to be more qualitative and detailed; telling the stories behind the figures. Compared to focus groups, the diary approach tends to provide more quantitative results, especially if the diary research is conducted with a larger group of respondents. But as diary research is very demanding for the respondent, the response is likely to be lower than from questionnaires.

Besides the online questionnaires and diary research, we also formed groups of internet users in order to gain more insight into the future possibilities of certain special uses of broadband, such as e-health, e-learning, tele work and safety. With the aid of an Electronic Meeting System, small groups of people were encouraged to extensively debate the role of broadband in certain domains in the years to come. Although the focus groups provided a myriad of qualitative information, this is mainly used as background information, as we chose to use the quantifiable information from the online questionnaires as our main source. The focus groups, although in theory very valuable for research purposes, were used to interlard the findings with quotations and helped with the interpretation of data in the online questionnaires. The reason for that is that during the focus group sessions we asked the respondents to answer directly about their future usage. Although people can to a certain extent tell what they would like broadband internet to bring them in their daily lives, they cannot predict with any certainty if and how their usage will change. It is more valuable to look at what people do over a period of time, including experiences and frustrations, and from that deduce what developments lie ahead.
We identified the characteristics of the three methods used for obtaining data on internet usage.

Table 46 gives an overview.

Table 46. Characteristics of different methods for gathering information on Internet usage

	Need to rely on (selective) memory	Risk of over or underestimation	Obtrusiveness or intensity	Contextual Information
(Online) Survey	High	Medium	Medium	Medium
Focus Group	High	High	Medium	High
Diary	Low	Medium	High	High

The fourth research method used to gain insight into the adoption of broadband was a meta analysis. The main sources of information for this method are the variables and hypotheses which are posed in the analysed papers.

The first issue we wish to mention is the availability of literature. Despite subscribing to many journals, we were not able to get a hold of all the articles we wanted to include in our research. However, a meta analysis such as this one can help determine which theory is best used as a conceptual model for further research. The meta analysis performed is new in two ways: by using the OpenKI tool and by performing network analysis. The advantage of using the OpenKI tool for meta analysis is that researchers are forced to systematically distil the hypothesis from an article. Also, the database expands as more researchers add data, which makes way for new and more inclusive meta analyses. If the database expands even more in the future, also other items collected in the database, such as research method or strength of the relationships can be further investigated. In this way the database works as a repository of research methods and theories for different problems in the IS field. Ultimately this will provide insight into the question of which research theory or combination of theories is best used for which kind of topics, and which research method is most suitable for which kind of topics and theories. Once the database is filled with large amounts of literature, it could also help the process of finding and selecting literature. Criteria could be for example: all articles on TAM, empirically tested, or only journal articles with an ISI score of at least 1.

This study focussed on empirical research, in which hypothesis are clearly stated. For theoretical and qualitative studies it is much more difficult to use OpenKI, because the system forces the researcher to fill out independent and dependent variables. Furthermore, OpenKI is a rather new tool and it needs further refinement in terms of user friendliness. For example, adding a new method is not possible yet.

With the aid of network analysis of hypothesized and validated relations and variables, a measure of overall empirical support for a theory can be given. The advantage of using network analysis for meta analyses is that with network analysis, relations can be visualised, with measures of strength, incoming and outgoing lines, core constructs and variables with less explaining power instead of mentioning what variables are present in which previous study. The next step in developing a useful method for performing meta analyses is integrating a network analysis tool into the OpenKI tool. Additionally, further research could focus on the additional possibilities of network analysis (for example power, structural holes etc.).

Furthermore, the network analysis tool used here was Netminer, but experiments with other network analysis tools may match this type of analysis better, as the aggregation was not always stable. Another issue with performing network analysis and the corresponding aggregation, is that the aggregation is dependent on the interpretation of the researcher, even if measures are taken to make it as objective as possible, and therefore, to some extent subjective.

Overall, we conclude that because every research method and design to gain insight into the adoption and usage processes of new technologies such as broadband show some disadvantages and limitations, a combination of different research methods and designs is advisable. A meta analysis with the OpenKI tool combined with network analysis can provide insight into the empirical support for hypotheses in previous research and can help determine which theory is best used as a conceptual model for further research. Ideally, this should be done before performing the empirical investigations, as the results of the meta analysis can help build a conceptual framework. Furthermore, although quantitative and qualitative results are not always perfectly matched, it is important to maintain a parallel method approach as this provides much more in-depth information and gives the researcher much more understanding of the subject.

9.2 Residential adoption of broadband internet

In the previous section we argued that the parallel use of research methods is desirable when investigating complex issues such as the adoption and usage of new technologies. But complexity is not the only problem. People and their decisions within a changing market are not as predictable as researchers and marketing specialists might hope; and adoption triggers and thresholds are dynamic. Thresholds to use new technologies may change drastically over the course of time and developments can certainly not be captured in a one shot research design. For example, the

threshold for an individual to adopt broadband may initially be that there is no need; but at a later stage, when the need for broadband does emerge, it may appear to be too expensive. Because usage patterns are not likely to be static, it is important to monitor the developments over time. Moreover, in the Netherlands, where penetration figures of broadband have been relatively high in the past few years, the changing patterns can be more easily observed than in countries that are still at the beginning of adoption.

With regard to this issue, there are practical implications for Internet Access, Service and Content Providers and government. If for example the accessibility of a new technology such as broadband is not adopted rapidly due to lack of availability or costs, these organisations are able to either change the situation or create circumstances that will change the situation. The scientific relevance lies in the use of insights gained by this research to further model the adoption and usage processes of new technologies. This is important as appropriate and tested theoretical or conceptual models specific to the adoption of broadband are lacking. The repeated (longitudinal) approach of this research provides answers to the following research question:

RQ2 *Which developments can be recognized with regard to reasons and thresholds for residential adoption of broadband internet between 2001 and 2005 and how can these developments be understood from a user perspective?*

One of the main conclusions is that not 'killer applications' but 'convenience at reasonable costs' seems to be important in the decision whether to adopt or reject broadband. The unique characteristics of broadband have shown to be so beneficial that these features are reasons to adopt it. Especially high speed, always on and flat rate are features that, over the years, offer internet users the convenience they are looking for. Broadband functions such as online gaming and sharing large files are not as important triggers as sometimes claimed.

Furthermore, this research shows that in order to adopt broadband, potential users have to be willing and able to do so. For this study, two types of thresholds that people face when deciding whether to adopt broadband or not, were distinguished and found significant: the *willingness* threshold and the *ability* threshold. The willingness threshold involves the existence of a fit between the technology and a need or task (Task Technology Fit or TTF). The fear of negative outcomes (unwanted information, abuse of privacy etc.) is also a potential influence on the willingness of people to adopt broadband into their homes. We also have to bear in mind the ability threshold, the physical availability (is broadband offered?), the financial threshold (is the price to high?), the technical and

cognitive thresholds (do people have the technical and cognitive skills to use the broadband connection?).
Figure 41 shows the threshold model for the adoption of broadband.

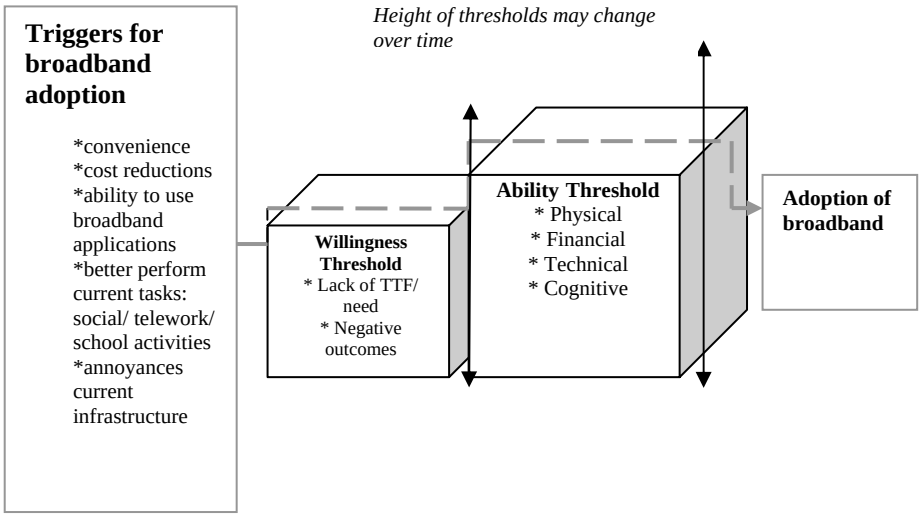

Figure 41 threshold model for the adoption of broadband from a user perspective

With regard to broadband adoption, the availability threshold and financial threshold have changed quite dramatically. The *ability* to adopt broadband internet grows as subscription prices drop (many offers have been made by cable and ADSL suppliers due to competition in the market) and the infrastructure is ubiquitous. But low prices and extensive availability do not mean that everyone will adopt broadband internet.
Cognitive and technical (ability) thresholds have proven to be less important over the years for deciding to adopt or subscribe to broadband. This possibly has to do with the fact that as far as the average internet user is concerned, technologically speaking, it is hardly any different from narrowband internet: to use it does not require any extra skills and also the interface is in most cases of residential usage the same as that of narrowband internet. Perhaps, when entirely new broadband services emerge, the cognitive and technical thresholds may play a role in the ability to use those services.
In chapter 4 we saw that many thresholds have become less important. What remains are the internet users who are quite satisfied with their current connection and feel no need to adopt broadband. In other words, their willingness threshold is higher than the triggers they experience. It is hard, if not impossible to convince these people of the usefulness of broadband unless alternatives are taken away. The task technology fit (TTF) threshold

is probably an important factor here. As long as these people do not have reasons or interest to use broadband, as long as they see no added value, they will not adopt it.

In the thresholds model (figure 41) we identified different adoption developments. Here the way internet users experience the triggers and thresholds is the key issue, not the absolute amount of triggers or the amount of costs. The reason for that is the fact that what may be a trigger for one person may not be important to another; for example flat fee and always on may be more important to people who play online games on a daily basis than for people who only check their emails once a week. Also, what may be expensive for one may be very affordable for others. There is a balance between the triggers and the thresholds. Once the triggers outweigh the thresholds, adoption will take place. To illustrate this, we present three ways in which the triggers and thresholds can be perceived. Note that these developments are not the only ones that can occur. For example, the perception of thresholds and triggers may vary over time, showing wavy lines.

1) For these individuals already from the introduction of the new technology, the triggers outweigh the thresholds and the triggers increase. whereas the perceived thresholds decrease: innovators, early adopters.
2) For these individuals the triggers remain constant, whereas thresholds at some point decrease, especially ability thresholds: majority, laggards
3) For these individuals the (willingness) thresholds, although decreasing, remain higher than the triggers: non adopters.

Figure 42 shows these three possible developments of perceived triggers and thresholds.

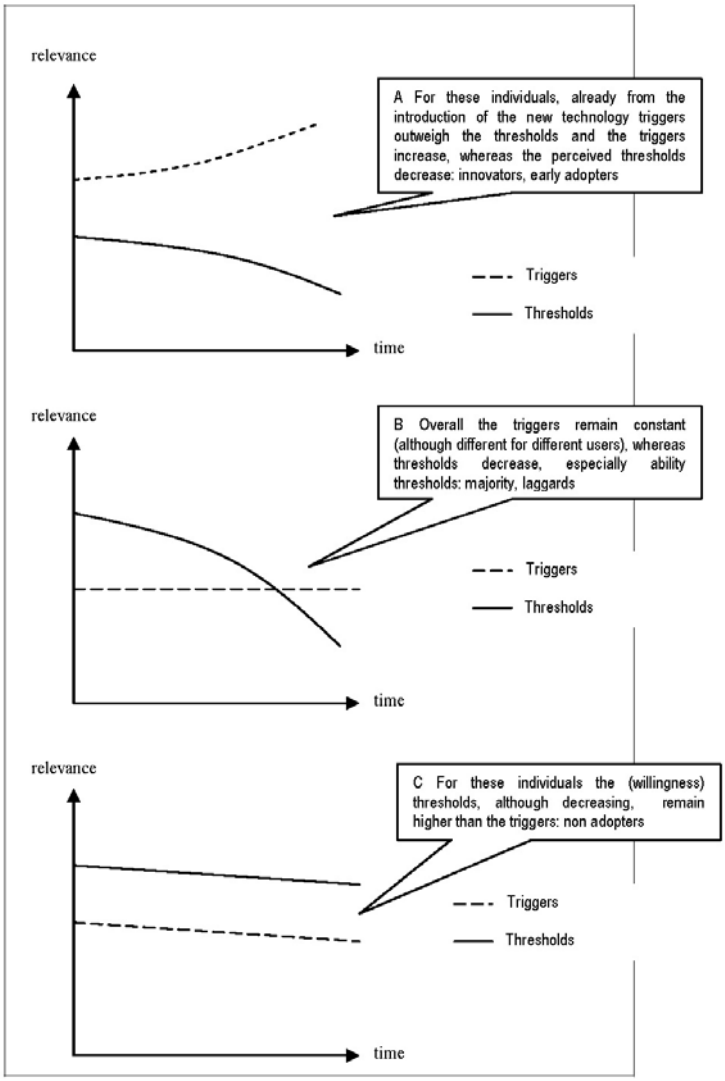

Figure 42 Three of the possible developments of the perceived adoption triggers and thresholds over time for different groups of people

This picture is comparable to the one provided by the qualitative results from the diary research. Although the latter is a more qualitative and static picture (no changes over time were measured), different points of view on the future of broadband emerge.

Figure 43 shows these points of view. Firstly, there are individuals who see that broadband technologies could change the world, but

do not want to participate themselves. Their willingness for the time being is rather low. Secondly, there are individuals who have a very positive view of broadband technology in the future. According to them, the world is going to change through this technology. This pleases them because they see the Internet and its services as a hobby. Their willingness is very high. Thirdly, we can distinguish individuals who are very negative towards broadband technology, in other words: their willingness is very low. They do not have any experience with broadband technology and primarily see dangers. And fourthly, there are individuals who are torn between two views. On the one hand they like to work with the Internet and its services, but on the other hand, they see dangers lying ahead. Their willingness is rather neutral and probably availability thresholds (is it available and affordable) are decisive factors.

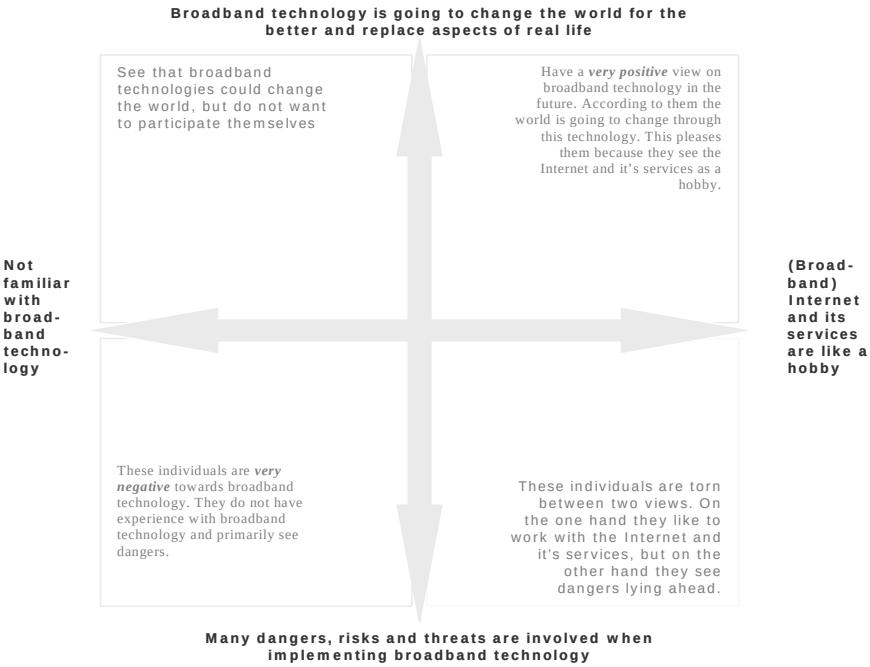

Figure 43 Point of views of internet users on the future of broadband (2003).

At this moment in the Netherlands, overall, the *ability* to adopt is increasing as prices drop and new infrastructures are reaching all parts of the country. The *willingness* to adopt, however, is more complex. Even though prices drop and broadband is ubiquitous, there will be people that do not feel a need for broadband. Perhaps, when new 'real' broadband applications and services emerge that fit or trigger their needs, they will find a link and want to adopt

broadband too. But this remains uncertain, as this research does not without doubt show proof of specific services being the trigger for adoption. When other options are no longer available, these people will make the step from narrowband to broadband internet. This is comparable to the transition from black and white tv to colour tv.

In summary, the main conclusions from this part of the research on reasons and thresholds for residential adoption of broadband are:

- It seems tempting to take a one shot approach and argue that the adoption factors are investigated and determined. This repeated cross sectional (longitudinal) research however, shows that the time dimension and therefore monitoring in a repeated approach is tremendously important.
- This research shows that not 'killer applications' but 'convenience at reasonable costs' are decisive factors for people to adopt or reject broadband. Most likely, this will also be the case with other future ICT.
- From this research we also learn that adoption triggers and thresholds are not absolute but subjective and the broadband adopter/user does not exist. This results in three different patterns in which people experience the weight of reasons and thresholds.
- Partly because a lot of research on the adoption of new technologies is still technology driven, the main thresholds that people identified are ability thresholds. Other research concentrates on needs and task technology fit. This research shows that both the ability and willingness thresholds for adopting new technologies are important.

9.3 Developments of usage patterns

Once the thresholds for adoption have been passed, the usage of the new technology or infrastructure starts. Monitoring the usage of broadband functions such as information, communication and transactions (ICET) and looking at changing patterns, might contribute to understanding usage patterns of future technologies. Also, it can help in determining which ICET functions are less used and successful than others. Another issue that is of interest is whether having broadband changes online behaviour. The research question that will be clarified in this section is:

RQ 4 *Which developments in residential broadband usage patterns can be recognized between 2001 and 2005, with regard to information, communication, entertainment and transaction*

functions and how can these developments be understood from a user perspective?

In order to map the developments in usage patterns, we introduced the ICET typology as a framework. Although we acknowledge that many services will integrate for example entertainment and transactions or information and communication, this framework has proven to be a useful way of grouping information, communication, entertainment and transaction functions of (broadband) internet.
The results of this research show that broadband as well as narrowband internet is mainly for information and communication, but overall, broadband users are heavier internet users in the sense that they are more frequently online and stay online longer. The question here of course is whether broadband users were already online more often and longer when they had a narrowband connection and therefore had a need for broadband (because it offers more convenience and control of costs), or whether having broadband caused more intensive use of internet and its ICET functions. Having broadband itself does not stimulate more frequent usage. Mostly, broadband subscribers do not use their new connection considerably more frequently than before, supporting the notion that people choose broadband because they feel the need as they experienced the limitations of a narrowband connection. The convenience they experience is likely to cause the extending duration of being online.

When taking a further look at the ICET usage patterns of narrowband and broadband users, it appears that contrasts are getting more noticeable over the years. In 2005 almost a double amount of significant differences in frequency of use was found compared to 2001. In entertainment activities the differences were already evident in early measurements as broadband users more often play online games, or watch films, tv, video recordings, download or listen more often to music via internet.
But in later years, also the usage frequencies of information, communication and transaction functions differed in several ways. For example, information via audio and video is used more by broadband users than by narrowband users and it is increasingly important to broadband users. Offering information through their own websites is also becoming more popular for broadband users, whereas for narrowband users this is less. In communication, chatting is becoming more popular for broadband users and also web logs are accessed more often by broadband users (narrowband users are reading web logs less frequently in 2005 than in 2001). Webcams for communication were not included in the 2003 measurement, but are used significantly more by broadband users than by narrowband users. The most dramatic changes we see are in transaction activities. In 2003 there were no significant differences between narrowband and broadband users, but in

2004/5 there were four: broadband users more often buy products and services online, buy or sell through online auctions, do telebanking and make reservations than narrowband users.
Thus, usage patterns of broadband users have become more distinct from the usage patterns of narrowband users. Here again the question is raised whether these changing patterns are caused by the mere fact of having broadband (and that broadband incites new needs), or whether broadband users have different (latent) needs and with broadband get the chance of fulfilling these needs. If we compare this with the frequency which was not raised by having broadband, the indication would be that the usage of broadband itself does not incite new needs, but having certain (latent) needs that can (finally) be fulfilled in a convenient and affordable way, results in broadband adoption. For example, people that explicitly do not have the need (cf. willingness threshold) to chat online or to communicate via a webcam or other services and functions that require high bandwidth, will not suddenly adopt broadband.
As stated in chapter 5, the use of technology such as broadband is in fact the subtraction of the technological possibilities and the (latent) needs people have. And this is a very personal and individual matter. Technologically speaking, much is possible, but not all of these possibilities are used. On the other hand, however, there are some wishes that people have, but those wishes have not been picked up by the broadband service and content providers.

The distinction between narrowband users and broadband users is not the only distinction that can be made. The aim of the cluster analysis presented in Chapter 6 was to identify a small number of relatively homogeneous groups of internet users, based on their usage patterns. The aim was to find for example typical 'gamers' or 'serious information seekers'. If these groups can be determined, this would help the conceptual understanding of broadband or ICT usage. Also, for service and content providers it would be useful for the development of services that are most likely be used frequently, as they can focus on the largest clusters, considering their preference for certain functions. From this research, however, it appears difficult to attach labels to people in different clusters, such as ‘communicators’ or ‘creatives‘. On the other hand, we do see cluster characteristics recurring over the years. Every year five clusters were found with usage characteristics such as: internet users with interest in discussion groups and newsgroups, clusters with a great liking for entertainment, those with moderate functional usage patterns, or extensive online transactions. Nonetheless, these results did not enable us to discern five clusters that were stable over the course of time. In other words, the clusters found in 2001 are not comparable to the ones in 2003 and 2005. This again shows that usage patterns are changing over time. Demographics, experience and the connection used (broadband vs.

narrowband) do not seem to play an important role in forming the clusters.

With regard to services, we see some developments over time. The most significant conclusion we can draw from the cluster analysis of usage patterns over 2001, 2003 and 2005 is that there are two dimensions in the diffusion process whereby broadband services are developed. The first dimension is the intensity of use. This is the frequency with which the function is used, regardless of the amount of people that use it. For example, a function is used mainly once a day by only one hundred users of all two hundred thousand users of that function. Relatively few people use it, but the intensity of use is high. Another function may be mainly used only once a year by all five hundred thousand users. Many people thus, use the function, but the intensity of use is low.
The second dimension is spread over (internet) society. This refers to the various groups of internet users that use the function. When an internet function, service or application is introduced, people may have to get used to it or gain experience before many different groups of internet users will use it. On the other hand, new functions may also trigger the curiosity of a broad range of people so that in the first months it is used by relatively many people, but in later stages used by fewer people.
In *Figure* 44 we present four types of development directions of internet functions:

A) Specialties: Usage of this function gets more intensive (higher frequency), but this function is only used by one or a few specific clusters of users (e.g. messenger);
B) Stragglers: Usage is not frequent and also not spread over the different groups of internet users (e.g. communities);
C) Daily basics: Usage is intensive and also spread over different groups of internet users (e.g. search engines);
D) Incidental basics: This function is used by many different groups of internet users but the usage is not intense (e.g. downloading photos).

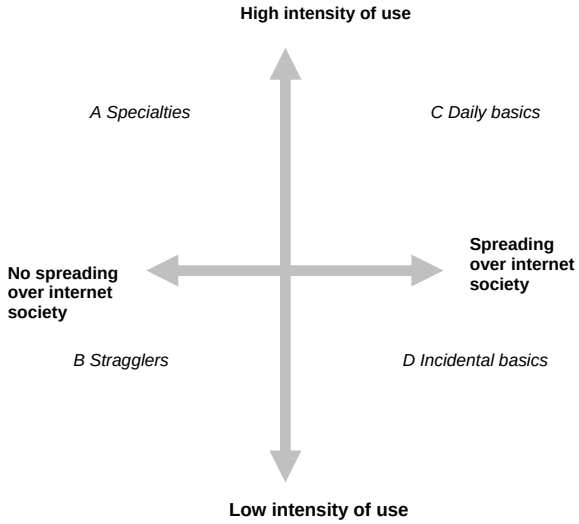

Figure 44 Dimensions of changes of internet functions over time: intensity and spreading over internet society

Projected to the ICET typology, the picture regarding information shows that search engines are being used by each cluster, each year and that the frequency of use is increasing. In other words, usage is getting more intensive. In contrast, portals have not been used more frequently over the years, but do get used by more clusters; it is spreading over (internet) society. Information gathering via audio and video downloads shows some ups and downs. In 2001 it was used by three clusters of internet users, in 2003 by one and in 2005 by two. Usage has not become more or less frequent over the years. What is remarkable, is that it only gets used very intensively by one single cluster. This is an internet function that is some sort of specialty, very convenient for only a small group of internet users. This is also the case for information via discussion groups, but they get used less even by the only cluster that uses them. Sharing information via your own website was not something for many internet users between 2001 and 2005 nor is it used very frequently.

Concerning communication, we found that email is used frequently by each cluster each year. Messenger was popular from 2001 to 2005. The major changes we see, are that fewer clusters of internet users use it, but the usage is more intensive. Special websites for chatting (chat rooms) were used quite intensively by one cluster in 2001, but in 2003 and 2005 these were not in the top three of any of the clusters. Webcams and web logs are lagging behind and did not get into the top 3 of internet functions of any cluster in any year.

Apart from changes in usage patterns of communication and information functions, there are also changes in entertainment

functions. For example, with regard to gaming, we see that the number of clusters practicing online gaming initially increased and then decreased, but that the intensity, especially in one cluster, increased. A similar pattern was observed with downloading music. This seems to be something many internet users have tried, but it will only be a true leisure pursuit for a few internet users. Downloading photos was done by all clusters and quite frequently, but over the years the usage has become less frequent and by fewer clusters. Fun surfing is done constantly by many internet users and quite frequently. The remaining function of ICET is transactions. In 2001 transactions were, apart from telebanking, only completed by one cluster, whereas in later years usage has become much more widespread in (internet) society. Buying products and services from a website of an official supplier has become more widely and intensively used.
New research in 2007 will demonstrate whether these patterns have changed further and whether some functions have become more integrated into people's lives or if the situation is stable.

In summary, the main contributions from this research with regard to the residential usage patterns of broadband are:

- The ICET typology is, despite the increasing extent of integration of functions, a useful typology when investigating the usage patterns of broadband from a user perspective and most likely is also useful for other infrastructures, such as mobile broadband.
- Although new technologies like broadband can fulfil latent needs, the mere fact of having broadband will not incite completely different needs.
- The use of technologies such as broadband is in fact the subtraction of the technological possibilities and the (latent) needs people have.
- There is no such thing as *the* broadband user and also broadband users are not easily captured in a few characteristics. This corresponds with the absence of one killer application: there is no application that will fulfil all ICET needs of all broadband users
- More likely, some functions or services will become daily basics. Others will develop into incidental basics, specialties and in the most negative case, stragglers.
- As was the case with investigating the adoption triggers and thresholds, here also the importance of the time dimension and *repeated* cross-sectional research is stressed as usage changes over time.

9.4 Special domains: broadband for health, safety and telework

In the previous section we looked at the changing usage of ICET functions. Information, communication, entertainment and transactions can also play a role in certain social domains such as health, telework and personal or public safety. As these domains were stressed by the Dutch government as desirable domains for the use of broadband, in this research they were investigated from a user perspective. The following research question is addressed here:

RQ5 *Which developments in residential broadband usage patterns can be recognized between 2001 and 2005, with regard to health, safety and telework services and how can these developments be understood?*

Broadband potentially has a significant influence on social issues such as telework, health and public and personal safety. In order to get an understanding and to predict the adoption of services in these domains, it is important to ask (potential) users of those services about their actual usage and expectations.

Almost 60 percent of the respondents in the questionnaire of 2005 used internet for some form of telework in the last three months. Reasons for not teleworking are: the job is not carried out with a computer and the job requires the employer to be present at the office. E-mail is most frequently used to work from home. Videoconferencing is hardly used and figures on usage of webcams video communication are low. This shows that typical broadband functions and applications do not play an important role in teleworking for most people.
Regarding health, the most important internet activity identified from this research was: visiting a website of a health institution for information. This also does not require a lot of bandwidth. Video communication with health institutions is not common.
In relation to safety, 60 percent of the respondents carried out online activities in order to improve the feeling of safety. Popular services and applications are: visiting websites of institutions or organisations concerned with public and personal safety, searching functional information such as addresses and opening times, communication with institutions or organisations concerned with public and personal safety via e-mail or web form and price quality comparison of safety products (14%). Again, these are activities that require relatively little bandwidth.
Overall results show that broadband connections, applications and services do not (yet) play an important role in the social domains for end users covered in this research. This is understandable, since many real broadband services are not yet offered on a large scale. When looking at the perceived positive aspects of broadband services and applications, especially in telework and health care, it

seems socially desirable that government and employers for example stimulate telework and the development of broadband health care services. In the public and personal safety domain, the role of broadband is not so self-evident for potential users of broadband services.

Because looking for health information appeared to be the most frequent online activity with regard to health, an additional and more in-depth survey was set up. The results of this questionnaire show that while in other parts of our research, gender was hardly an issue, it is important with regard to online health information. Women turn to commercial websites (where there is no control over trustworthiness of the information provided) and depend on the first (two) website(s) they visit. But they use this information mainly as preparation for a visit to a physician during which they discuss the information they have found. Men look for health information on places that are more likely to provide trustworthy information (newsletters and websites of patients' associations), consider the source of the website before using the information and look for the information on more than two websites. With this information they seem to be less at risk than women, but their pitfall is that they more often replace a visit to a physician with a visit to the Internet. From this it can be concluded that men and women are at risk in different ways when accessing and using online health information: the risks of women seem to be more in the process of collecting the information, whereas men are more at risk in the process of using the information. Governments and other organisations involved need to communicate with and inform these two target groups in two different ways, warning for different risks. As indicated above, gender was not really significant in our research. This shows once again that *the* broadband user and his usage pattern are not so easy to identify. There is not so much one type of broadband user. Rather, there are many different kinds of broadband users and usage patterns depending on the type of function or service.

9.5 Implications

Now that we have provided answers to the research questions, it is time to treat the implications of the results for other technologies, service development, policy and for other countries.

Implications for other technologies

This research has shown that the adoption and usage of new technologies are not constant, but rather evolve over time. Furthermore, patterns of technology adoption and diffusion are never fully predictable (Rogers, 1995), but this research shows that some factors recur. First of all, with the transition from narrowband to broadband such as cable and ADSL, users were

offered more speed and new features such as always on and flat fees, which provided more convenience. On the other hand, broadband service development for ADSL and cable has not been very rapid and innovative. The main reason for people to adopt broadband (cable and ADSL) was more convenience at affordable prices. The transition from cable and ADSL to fibre optics will not have such a great impact on the convenience that end users experience. In addition, the price of fibre optics is higher than ADSL and cable, partly because the fibre optics market is not (yet) facing the same level of competition that the cable and ADSL market achieved in the Netherlands. Therefore, from a user perspective it may not seem very profitable to adopt fibre optics at this moment. With fibre optics, however, service development could play a role for adoption in residential areas. Unless new and highly innovative services can be developed with fibre optics or prices drop to compete with those of cable and ADSL, many users will not experience the added value or relative advantage and consequently, will not actively adopt fibre optics in their homes. Although not covered in this research, because at the time of the data collection it was not widely available and known to the average end user, Triple Play services, in which telephone, television and internet are combined and offered for fixed prices might be a trigger for people to adopt fibre optics (Fibre to the Home) as it probably provides cost control for many people.

Now that fixed broadband has been established in the Netherlands, a new form of broadband is being introduced: mobile broadband. Our research also gives some pointers for mobile infrastructures. Some of these pointers are the convenience aspects such as speed, always on, and flat fee that were vital in the adoption of fixed broadband and more important than certain (killer) applications. The fact that people are able to use mobile devices to go online, may already be such an important convenience asset, that people will settle for less convenience in terms of small devices, less speed. However if mobile infrastructures do not provide the user with more convenience than fixed broadband, more emphasis may be necessary on new innovative services. In addition, as always on and flat fee (controlling costs) were such important issues in the adoption of fixed broadband, the way users pay for mobile services may also be an important factor. As long as time spent on the internet through mobile devices is charged per unit of time or per amount of data transferred, this resembles narrowband and the chances of success are small. This also brings us to new ideas on charging for fixed broadband, namely by charging per amount of data uploaded or downloaded (Cisco, 2005, Racz & Stiller, 2004). On the basis of this research it is questionable whether this method of traffic or content related pricing is accepted by users. Possibly, if cable and ADSL are charged per unit again (amount of kilo bits transferred instead of time online), fibre optics will be chosen above ADSL and cable by users.

Implications for service development

There is potential for broadband service development as, at this point, the ability to adopt broadband is quite high for most people in the Netherlands and many already have a broadband subscription. However, there seem to be contradictory ideas about the factors that influence the success of broadband connections and services. From a provider's point of view, it is often suggested that one killer application will or should be developed. On the other hand, this research shows that many users value broadband for other aspects, without a killer application. If we look at the reasons for adopting broadband and at popular functions such as search engines and portals, the importance of convenience for the success of services is evident. The advice here is not to look for a killer application. In addition, the results of this research show that there is no such thing as *the* broadband user and therefore, it will be next to impossible to develop one single service that is successful for every broadband user. General information and communication services such as email and search engines are often used by many internet users, but there is almost no business case for such services as they are often integrated in publicly available software (e.g. hotmail, gmail, MSN messenger).

For this development we should consider the two axes on which most services are based. This means that some services will be used by many broadband users (daily basics, incidental basics) while others will remain for a small group of people, but the frequency of usage can be high (specialties). Service developers of new broadband services may want to specify which kind of service they are aimed at and thereby form appropriate expectations.

Basic needs and functions of media are probably stable while information, communication, entertainment and transactions are likely to remain the basis of many new services. Also, services that are popular now such as email and search engines are not the services that require a lot of bandwidth. This does not necessarily mean that service providers should abandon their drive to develop innovative services. As stated, with the emergence of fibre optics (Fibre to the Home), new and innovative services could be important for adoption as the added value will not lie directly in more convenience for many end users.

Implications for policy makers

The aim of the Dutch government is to be a front runner in the world with regard to broadband developments. Apart from the advantages of being ahead of the world with regard to ICT in general such as a favourable establishment climate, the key domains to which broadband can contribute are health, telework and safety. One of the many conditions to be met is that Dutch citizens are ready for these services. The Netherlands have a large group of broadband users compared to many other countries and this research also shows that broadband users go online quite frequently for a large variety of activities. These facts indicate that

Dutch internet society is ready for broadband services in social and economically desirable domains. But because these services are not widely offered yet, people might have trouble envisioning those services in their lives. Pilots and presentations of the potential for health and telework in peoples' daily lives might help. Attention should be paid to the convenience and ease of use of the services, and potential users should be involved in the development of such significant services. One thing we must bear in mind is that just as with the adoption of broadband infrastructure, it is very likely that even if we are able to adopt broadband services in social domains, the willingness to adopt is multi-faceted; sometimes the only way to get everybody on the same track is to remove other options. But important services in social domains could be a risk as the digital divide should be avoided for all the obvious reasons.

Our results also show that activities involving online health information can lead to serious risks (such as using questionable online information as a replacement for a doctor's visit) which may also emerge with telemedicine, broadband services for personal safety and tele work. While these risks should not be a reason to abandon the development of new services, governments should address this issue as it can also be a threshold for people to adopt these services.

Although not a central issue in this research, it is likely that the same people who use the internet extensively to look for information and to communicate, would also like to communicate with the government in this way. Further research on factors that influence the adoption and usage of such e-government services is of interest to the Dutch government.

Implications for other countries

This thesis is also intended to provoke thought about how the diffusion of broadband might take place in other countries. Our research may benefit other countries because they have not yet taken the same steps in the adoption and usage process which have already happened in the Netherlands. Research in other countries where broadband uptake is not as fast as in the Netherlands, such as the United Kingdom and the United States of America, shows support for the notion that broadband is perceived by end users as a quick, easily accessible source of information and communication (Anderson et al., 2002; Horrigan & Rainie, 2002; UCLA, 2003; Dwivedi & Choudrie, 2003) and there does not seem to be a killer application (Middleton, 2003). However, our research findings provide clues to determine which factors are likely to influence the adoption and usage of broadband. Firstly, there may be differences in culture, legislation, regulations and market mechanisms which influence adoption, but it is likely that in every country, potential users of broadband will face willingness and ability thresholds. In some countries the ability threshold may decrease faster than in others, but adopting broadband will still be a matter of being willing and able to adopt. Secondly, in other

countries and cultures, convenience (in terms of always on and speed) and controlling costs (flat fee) will probably be important factors in the adoption of broadband. Services will also probably develop as daily basics, incidental basics, stragglers or specialties all over the world.

9.6 Limitations and further research

As with all studies, there are limitations to this research. We will discuss the shortcomings of this research and also present several opportunities for further research.

One of the limitations involves the samples of the online questionnaires. Because of the online convenience of the samples, the segmentation of demographical characteristics may not be fully representative. This should be addressed in future in-depth research on the relationship between demographical and lifestyle characteristics and technology adoption. But in order to do so, an accurate sampling frame should be available. Another limitation lies in the fact that those who do not have an internet connection at all, because they do not want it, cannot afford it, do not understand it etcetera, are not included in this research. Insights into the digital divide for example could therefore not be conveyed. Furthermore, we were not able to put questions on the three measurements to a panel. This limits the monitoring of developments of certain internet users, their adoption process and usage patterns. For new technologies or services it would for example be interesting to do the cluster analysis with one single panel over the course of four years. In addition, this research is about Dutch Internet users. Although as stated before, the Netherlands are a good example thanks to the high penetration of broadband, it would be interesting to compare our results with research done in other countries. The Netherlands are forerunners in the adoption of broadband and maybe there are different thresholds in other countries. Combining results would create a broader picture, which is of both practical as well as scientific importance. Furthermore, the exact relative importance of one ICET functions compared to another is not known, because the respondents were asked to give the top three for information, one for communication and also the top three for entertainment and one for transactions. Respondents could not for example state eight entertainment functions (because they carry out a lot of online entertainment activities) and one communication activity (because they do not do this very often).
With regard to the additional survey for health information, the sample of 123 people should be enlarged to get a more accurate view. Another limitation of this research and opportunity for further exploration is that although other theories were used as stepping stones for our empirical investigations, the number of

theories that we looked at in depth is rather small. The Technology Acceptance Model and Diffusions of Innovations provide insight, but it would be interesting to utilize other theories and map how these theories relate to each other in order to get a broader understanding of the complete adoption and usage process.
A final remark on the limitations of this research is that, due to the fact that the last measurement was in 2005, newer trends such as user generated content had not yet emerged from our usage data. In order to include this development, a new survey along the lines of the three measurements in this thesis will be held in 2007.

9.7 In conclusion – The fast diffusion and broadening use of broadband

Overall we can conclude that the residential adoption and use of broadband internet in the Netherlands have come a long way. Although for a certain (but declining) group the willingness to adopt broadband remains low, the adoption rate of broadband in the Netherlands has been fast, expanding from 3.8 subscribers per 100 inhabitants in 2001 to 28.8 in 2006 (OECD, 2006). This was mainly due to lowering of the ability threshold, in other words the disappearance of the financial and availability thresholds for end users (broadband internet is offered throughout the whole country at relatively low prices). The adoption is not so much influenced by killer applications, but much more by convenience (speed, flat fee, always on) at a reasonable price. Furthermore, the usage of many information, communication, entertainment and transaction (ICET) functions has broadened and spread over internet society. Thus, the adoption and usage patterns are not fixed, but change over time. This brings us to the issue of longitudinal research. These conclusions could only be made after conducting a longitudinal study. One shot designs may give information, but only in longitudinal research are we able to see motives and thresholds change.
Only by carrying out further research and maintaining a user perspective can we grasp the true meaning of new technologies in peoples' daily lives. By doing so, we get to know the potential adopters and their behaviour and thus better predictions can be made. The meaning of broadband for most users is a comfortable and inexpensive way to find and share information, to communicate, to entertain and be entertained, and to complete transactions. It is not so much the sophisticated technology itself that counts for people, but what they can do with it and whether they can do it in a comfortable, not too expensive way.

References

Anderson, B. Gale, C., Jones, M.L.R., and McWilliam, A. (2002). Domesticating broadband-what consumers really do with flat rate, always-on and fast Internet access. *BT Technology Journal*, 20 (1), 103-114.

Cisco (2005). Cisco Service Control Solutions To Facilitate Content-Based Charging. http://www.cisco.com. Accessed at 08-04-07

Davis, F.D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13:3, pp. 319-341.

Dwivedi Y.K. and Choudrie J. (2003), Investigating the Impact of Broadband upon the Users' Online Habits and the Usage of Internet Services. In the Proceedings of the International Telecommunication Society's Asia-Australasian Regional (ITS) Conference, Perth Australia, June 22 – 24, 2003.

Horrigan & Rainie (2002). The Broadband Difference: How Online Americans' Behavior Changes with High-Speed Internet connections at home. Pew Internet and American Life Project, Washington, DC.

Middleton, Catherine. A. (2003). What If There Is No Killer Application? An Exploration of a User-Centric Perspective on Broadband. *Journal of Information Technology*, 18(4), 231-246.

OECD (2006) Organization for Economic Cooperation and Development, The Development of Broadband Access in OECD Countries. http://www.oecd.org. Accessed at 10-04-07

Racz, P.& B.Stiller (2004). "Content-based charging support for multiple interworking providers". In the proceedings of the 13th IEEE Workshop on Local and Metropolitan Area Networks, pp. 199 - 204

Rogers, E.M. (1995). *Diffusion of innovations*. New York: Free Press

UCLA (2003). The UCLA internet report : surveying the digital future year 3. UC Regents, Los Angeles.

Nederlandse samenvatting

Snelle diffusie en breder gebruik
Een onderzoek naar de residentiele adoptie en gebruik van breedband in Nederland tussen 2001 en 2005

Inleiding
Technologie kenmerkt zich doorgaans door snelle veranderingen. De ontwikkelen op het gebied van breedband internet zijn daarin niet anders; de ontwikkelingen zijn er snel gegaan. In de negentiger jaren was internet nog maar beschikbaar voor een kleine groep mensen. Nu is het geluid van het traditionele modem alweer aan het uitsterven en zijn er allemaal nieuwe manieren om online te gaan; via de kabel, adsl en zelfs glasvezel. Natuurlijk waren er veel voorspellingen over de grootse effecten die breedband zou hebben en er waren ook meer gereserveerde visies, maar toen dit onderzoek begon in 2001 was het niet duidelijk hoe de breedbandmarkt voor thuisgebruikers zou ontwikkelen. Nu weten we dat de ontwikkelingen op het gebied van breedband elkaar snel opvolgen. Wat gisteren nog breedband was, is vandaag alweer midband. In 2005, toen de laatste metingen voor dit onderzoek gedaan warden, had 55% van de Nederlandse huishoudens een breedbandaansluiting (CBS, 2005), terwijl dat drie jaar daarvoor nog maar 13% was en had Nederland van alle OECD-landen de op een na hoogste penetratie van breedband met 22,5 abonnees per 100 inwoners (OECD, 2005)

Het gebruikersperspectief
In verschillende theorieën die zich richten op de adoptie van nieuwe technologieën of innovaties, wordt duidelijk gemaakt dat de (toekomstige) gebruiker van de technologie of innovatie een grote rol speelt in het succes of falen ervan. Hoewel er onderzoeken vanuit gebruikersperspectief zijn gedaan, blijft het onderzoeken van nieuwe technologieën vanuit het perspectief van de gebruiker relatief onontgonnen terrein. Vooral wanneer het gaat om breedband, wordt veel onderzoek vanuit het perspectief van de technologie en de technologische mogelijkheden gedaan. Hoewel wij onderkennen dat het technologische perspectief ook belangrijk is, kan het gebruikersonderzoek niet vervangen of overbodig maken. Het is belangrijk het adoptie- en het gebruiksproces te monitoren. Vanuit de dan verkregen resultaten kunnen onderzoekers, beleidsmakers en commerciële partijen veel leren, zoals het leren begrijpen van de factoren die voor de potentiële gebruiker de adoptie of afwijzing van een nieuwe technologie bepalen. Ook kunnen aanknopingspunten worden gevonden voor nieuwe diensten door het gedrag van mensen over een langere tijd te volgen. In plaats van te richten op de technologie zelf, wordt in

dit onderzoek de internetgebruiker in de residentiele omgeving als uitgangspunt genomen. Daarbij gaat het om internetgebruikers in verschillende rollen: van mensen die online entertainment zoeken tot patiënten die op internet zoeken naar gezondheidsinformatie.

Breedband

Net zoals de ontwikkelingen op het gebied van breedband, is ook de definitie van breedband aan snelle veranderingen onderhevig. In dit onderzoek staat niet de technologie, maar de gebruiker van de technologie central. Daarom wordt de definitie voor breedband in dit onderzoek niet bepaald door technologische karakteristieken bepaald, maar door de karakteristieken van breedband die zichtbaar en merkbaar zijn voor de gebruiker ervan: 'always on' en 'flat fee'. Om toegang te krijgen tot een breedbandverbinding is het niet nodig in te bellen en worden er dus ook geen (telefoon)tikken in rekening gebracht: breedbandgebruikers kunnen altijd online zijn voor een vast bedrag per maand. Op basis van deze karakteristieken zijn kabel, adsl en glasvezel breedband. Een traditioneel modem, waarmee men via de telefoonlijn online kan gaan en isdn zijn smalband in dit onderzoek. De focus van dit onderzoek is dus op vaste breedbandnetwerken. Mobiele netwerken, zoals UMTS en GPRS zijn buiten beschouwing gelaten.

Internet functies: de ICET typologie

> *"Ik stuur elke dag wel e-mails naar vrienden. Gewoon om te kijken wat zij aan het doen zijn"*
> *"Mijn dagelijkse portie muziek"*
> *"Het internet is fantastisch. Je kunt werkelijk alles vinden over van alles"*

Deze antwoorden die in het dagboekonderzoek van 2003 werden gegeven, zijn slechts een paar voorbeelden van de vele dingen die men online kan doen: emails versturen naar vrienden, informatie zoeken over vlinders, folkmuziek downloaden, komische films downloaden enzovoorts. Voor dit onderzoek maken we onderscheid tussen vier basisfuncties van internet. Deze indeling is gebaseerd op de Uses & Gratifications benadering (Katz, Blumler and Gurevitch, 1974, Katz, Gurevitch and Haas, 1973). Zij onderscheiden verschillende behoeften (needs) die mensen door het gebruik van verschillende media proberen te vervullen (gratification). Deze behoeften zijn vertaald een typologie die de basisfuncties van internet weergeeft. Deze ICET typologie neemt in ogenschouw informatie, communicatie, entertainment en transacties. De typologie en het denkkader dat gebruikt is voor dit onderzoek is hieronder weergegeven (Tabel 47).

Tabel 47 De ICET typologie

I (informatie)	zoekmachines, portals, websites, naslagwerken, streaming audio/video, nieuwsbrieven, nieuwsgroepen, discussiegroepen, eigen website, informatie formulieren				
C (communicatie)	Messenger, chatten via website, IP-telefonie, webcams, lezen van een weblog, schrijven/publiceren van een weblog, e-mail, SMS (van computer naar mobiel), nieuwsgroepen				
E (entertainment)	Gaming, films kijken, films downloaden, films uploaden, beheren van een community, deelnemen aan community's, tv programma's downloaden/kijken, downloaden/kijken videoclips, delen van videoclips, online muzek luisteren, muziek downloaden, muziek delen, foto's downloaden, delen van foto's, e-mail, fun surfen				
T (transacties)	Kopen van een product of dienst bij aanbieder, online marktplaats voor particulieren, veiling website, telebankieren, reserveringen maken				
Speciale functies	gezondheidszorg, telewerk/mobiliteit en veiligheid				
Breedband als technologische basis	Smalband		Breedband		Breedband +
	modem	ISDN	Kabel	ADSL	Glasvezel > 10 Mbps

Onderzoeksdoel, vragen en relevantie

Het hoofddoel van dit onderzoek is inzicht krijgen in en het begrijpen van het adoptie- en gebruiksproces van breedbandinternet vanuit het perspectief van de gebruiker. Het adoptieproces is onderzocht door te kijken naar de redenen en drempels voor het overstappen van smalband naar breedbandinternet. Daarbij worden de veranderingen in de tijd ook bekeken. De gerelateerde onderzoeksvraag is V2. Het gebruik van breedband is onderzocht door het monitoren van de mate van het gebruik van internetfuncties. Onderzoeksvragen 3 en 4 hebben hier betrekking op. Het tweede doel van dit onderzoek is inzicht krijgen in de mogelijkheden en beperkingen van verschillende onderzoeksmethoden om het gebruik van nieuwe technologieën te meten en monitoren. Dit wordt gedaan door literatuuronderzoek en evaringen tijdens dit onderzoeksproject. Onderzoeksvraag 1 sluit aan bij dit doel.

Het derde doel van dit onderzoek is de status van de theorie te bepalen van twee veel gebuikte theorieën, namelijk Diffusion of Innovations (Rogers, 1995) en Technology Acceptance Model (TAM) (Davis, 1989). Hiervoor wordt de OpenKi methode gebuikt. Onderzoeksvraag 5 heeft btrekking op dit derde doel. Ook andere theorieën worden gebruikt voor de empirische verkenningen in dit onderzoek.

De hoofdvraag van dit onderzoek is:

In hoeverre kunnen ontwikkelingen van adoptie en gebruik van breedbandinternet worden herkend tussen 2001 en 2005 en hoe kunnen deze ontwikkelingen worden begrepen vanuit het perspectief van de gebruiker?

De bijbehorende onderzoekvragen zijn:

V1 Wat zijn de mogelijkheden en beperkingen van (combinaties van) verschillende onderzoeksmethoden voor het verkrijgen van inzicht in de adoptie en het gebruik van nieuwe technologieën?
V2 Welke ontwikkelingen kunnen worden herkend met betrekking tot de redenen en drempels voor residentiele adoptie van breedbandinternet tussen 2001 en 2005 en hoe kunnen deze ontwikkelingen worden begrepen?
V3 Welke ontwikkelingen in residentieel breedbandgebruik kunnen worden herkend tussen 2001 en 2005 met betrekking tot informatie, communicatie, entertainment en transacties functies en hoe kunnen deze ontwikkelingen worden begrepen?
V4 Welke ontwikkelingen in residentieel breedbandgebruik kunnen worden herkend tussen 2001 en 2005 met betrekking tot gezondheidszorg, veiligheid en telewerk en hoe kunnen deze ontwikkelingen worden begrepen?

Relevantie

De resultaten van dit onderzoek dragen bij aan de wetenschappelijke inzichten op het gebied van de adoptie en het gebruik van nieuwe technologieën. Dit is van belang voor wetenschappers in verschillende onderzoeksdomeinen, zoals sociale wetenschap en informatiekunde. Enerzijds geeft het inzicht op basis van longitudinaal empirisch onderzoek op basis van verschillende onderzoeksmethoden en anderzijds geeft het de status van enkele theoretische inzichten. Er is een aanzienlijke hoeveelheid theorieën ontwikkeld in de afgelopen jaren, die de adoptie en het gebruik van nieuwe technologieën behandelen, en ook empirische onderzoeken zijn er veel. Met een systematische review van deze onderzoeken, draagt dit onderzoek bij aan een breder wetenschappelijk begrip van de adoptie en gebruiksprocessen van breedbandinternet. Deze inzichten kunnen bijdragen aan het verder modelleren van het adoptie- en gebruiksproces van nieuwe technologieën.
Ook zullen er meer inzichten zijn in de voor- en nadelen van online vragenlijsten en dagboekonderzoek voor het verzamelen van data over de adoptie en het gebruik van nieuwe technologieën. De inzichten die door dit onderzoek verkregen worden zijn ook

interessant voor beleidsmakers en bedrijven, ADSL-, kabel- en glasvezelaanbieders. Zij houden zich bezig met vragen als: is het haalbaar om een nieuw breedbandnetwerk uit te rollen of een oud netwerk aan te passen naar een breedbandiger netwerk? Gaan mensen dit netwerk ook daadwerkelijk gebruiken, hebben ze er behoefte aan? Zal het onze economie en samenleving drastisch veranderen en wat is de echte meerwaarde van het netwerk? Wanneer aanbieders van infrastructuren en diensten meer te weten komen over hun (potentiële) klanten, kunnen ze beter inspelen op de behoeften van deze mensen.

Onderzoeksaanpak en methoden

De data voor dit proefschrift zijn voor het grootste deel verzameld binnen het project Breedband en de Gebruiker. Daarvoor is gebruik gemaakt van een herhaald cross-sectioneel onderzoek met verschillende onderzoeksmethoden. Er zijn drie metingen geweest in 2001, 2003 en 2005, elk met drie onderzoekmethoden: online vragenlijsten, dagboekonderzoek en gebruikersbijeenkomsten.

Aantal respondenten per onderzoeksmethode per jaar

	N 2001 =	N 2003 =	N 2005 =
Online vragenlijsten	1072	2325	1102
Dagboekonderzoek	17	36	26
Gebruikersbijeenkomsten	34	25	16

Naast de data die werd verzameld met deze drie methoden over drie jaar, werd een additionele (schriftelijke) vragenlijst uitgezet die meer inzicht heeft verschaft over het gebruik van internet bij het zoeken naar gezondheidsinformatie. Hier hebben uiteindelijk 123 mensen aan meegedaan. Afgezien van het empirische deel van het onderzoek is ook een kritische en systematische beschouwing met OpenKi gemaakt van twee theorieën en de bijbehorende empirische bevindingen. Diffusion of Innovations (Rogers, 1995) en het Technology Acceptance Model (TAM) (Davis, 1989) staan hierin centraal.

Resultaten en conclusies

Onderzoeksmethoden om inzicht te krijgen in de adoptie en het gebruik van nieuwe technologieën

Er zijn verschillende onderzoeksmethoden die meer inzicht geven in de adoptie en het gebruikspatronen van nieuwe technologieën. Omdat het gebruiks- en adoptieproces complex is, ligt het voor de hand verschillende methoden in te zetten om meer diepte informatie te krijgen. Elk van de gebruikte methoden heeft sterke en zwakke punten.

Bij online vragenlijsten, bijvoorbeeld, moeten respondenten hun (selectieve) geheugen aanspreken, terwijl dat bij dagboekonderzoek veel minder is. Dagboekonderzoek is aan de andere kant weer veel intensiever en belastender voor de respondent. Over het algemeen

geeft dagboekonderzoek een verdieping ten opzichte van (online) vragenlijsten. De resultaten zijn meer kwalitatief dan bij vragenlijsten: dagboeken geven de verhalen achter de cijfers. Vergeleken met gebruikersbijeenkomsten geeft een dagboek meer kwantitatieve informatie. Omdat elk van de onderzoeksmethoden eigen voor- en nadelen kent, is een combinatie van methoden en designs aan te raden.
Een meta analyse met de OpenKI, gecombineerd met kan inzicht verschaffen in de empirische support voor hypotheses getoetst in voorgaand onderzoek. Daarmee kan deze analyse helpen bepalen welke theorie of combinatie van theorieën het beste als conceptueel raamwerk gebruikt kunnen worden voor verder onderzoek. Idealiter wordt dit gedaan voordat het empirische deel van het onderzoek start.

Residentiele adoptie en gebruik van breedband: redenen en drempels
Naast de complexiteit van de adoptie- en gebruiksprocessen worden deze processen gekenmerkt door dynamiek. Mensen en hun beslissingen zijn, zeker in een snel ontwikkelende markt, niet zo voorspelbaar als veel onderzoeker en marketingspecialisten zouden willen.
Hieronder zijn de belangrijkste conclusies, die getrokken kunnen worden over de redenen en drempels voor adoptie van breedband kort samengevat.
Hoewel het verleidelijk is om met een vragenlijst het vraagstuk van adoptie en gebruik van nieuwe technologieën in kaart te brengen, laat dit onderzoek zien dat een herhaald onderzoek rond dit thema noodzakelijk is. Daarnaast toont dit onderzoek aan dat er geen sprake is van een 'killer application' als beslissende factor om breedband te accepteren, maar veel meer van ' gemak voor een redelijke prijs'. Het ligt voor de hand dat dit ook bij volgende generaties infrastructuren zo zal zijn.
Verder is er sprake van drempels die gekenmerkt worden door willen (willingness) en drempels die gaan om het kunnen accepteren van een technologie (ability). Op het willen is bijvoorbeeld van invloed de match tussen de taak of actie die men wil uitvoeren en de technologie. Ook de angst voor negatieve gevolgen (ongewenste content, misbruik van privé-gegevens etc.) kan de wil om de technologie te accepteren beïnvloeden. Het kunnen accepteren van een technologie hangt bijvoorbeeld af van de beschikbaarheid, prijs en de technische en cognitieve mogelijkheden die men heeft. Wat betreft breedband in Nederland zijn de beschikbaarheid en financiële drempels (beide drempels die gaan om het kunnen accepteren van de technologie) enorm gedaald. In dit onderzoek zien we dat veel drempels lager zijn geworden in de loop van de tijd. Wat overblijft zijn de mensen die helemaal tevreden zijn met hun huidige situatie (met smalband of zonder internet). Met andere woorden: het feit dat breedband beschikbaar is voor een niet al te hoge prijs, weegt toch niet op tegen het feit dat ze geen breedband willen. Het zal lastig zijn om deze groep

mensen mee te krijgen. Wellicht verandert dit wanneer er geheel nieuwe diensten via de breedbandinfrastructuur worden aangeboden. Dit is niet met zekerheid te zeggen, omdat juist ook uit dit onderzoek naar voren komt dat nieuwe diensten tot nu toe geen belangrijker reden zijn geweest om breedband te accepteren (geen 'killer applications'). Ook zullen deze mensen waarschijnlijk overstappen, wanneer andere opties worden weggenomen.
Naast de twee verschillende soorten drempels, leert dit onderzoek ons ook dat adoptieredenen en –drempels niet absoluut zijn, maar veelal subjectief. Bij een lage prijs denkt bijvoorbeeld niet iedereen aan hetzelfde bedrag. Mensen wegen hun persoonlijk gepercipieerde redenen en drempels tegen elkaar af, waardoor er verschillende patronen ontstaan, waaronder: 1) voor deze mensen wegen de redenen direct bij de invoer van de nieuwe technologie al op tegen de drempels. Bovendien worden de triggers alleen maar belangrijker en de drempels steeds kleiner. Zij zijn te vergelijken met Rogers (1995) ' innovators' en ' early adopters' . 2) voor deze mensen blijven de redenen voor adoptie constant, maar de drempels worden lager. In termen van Rogers (1995) zouden de ' majority' en 'laggards' hieronder vallen. 3) voor deze mensen blijven de (willingness) drempels, hoger dan de redenen om de technologie te accepteren: non adopters.

Ontwikkeling van gebruikspatronen
Wanneer de adoptiedrempels gepasseerd zijn, start het gebruiksproces van een nieuwe technologie. Het monitoren van het gebruik van breedband functies zoals informatie, communicatie, entertainment en transacties (ICET) en de veranderingen in gebruikspatronen draagt bij aan beter begrip van gebruikspatronen van huidige en toekomstige technologieën. Ook kan het helpen bij het bepalen welke functies meer en welke minder worden gebruikt en of het overstappen naar breedband effect heeft op gebruikspatronen.
In dit onderzoek is de ICET typologie gebruikt al een raamwerk. Hoewel wij van onderkennen dat veel diensten verschillende functies zullen integreren (bijvoorbeeld informatie zoeken en afrekenen voor deze informatie of informatie zoeken en communiceren met anderen over deze informatie), zijn wij van mening dat het een nuttig en bruikbare typologie is, ook voor andere infrastructuren dan de huidige.
De resultaten van dit onderzoek geven aan dat breedband, net als smalband, voornamelijk gebruikt wordt voor de informatie en communicatie functies. Breedbandgebruikers zijn alleen wel ' zwaardere' gebruikers in die zin dat ze vaker en langer online zijn.
Als we verder kijken naar de ICET gebruikspatronen van smal- en breedbandgebruikers, zien we dat de contrasten groter worden naarmate de tijd vordert. In 2005 was het aantal significante verschillen tussen smalband- en breedbandgebruikers verdubbelt ten opzichte van 2001. In entertainment activiteiten waren de

verschillen al langer duidelijk, maar in latere jaren werden ook de verschillen in communicatie, informatie en transacties duidelijker.
Hoewel nieuwe technologieën, zoals breedband in bepaalde (latente) behoeften kan voorzien, zal net hebben van breedband niet opeens geheel nieuwe behoeften oproepen bij mensen. Bijvoorbeeld: mensen die niet houden van spellen, zullen niet opeens de behoefte krijgen aan het spelen van online games. Wel kan het zo zijn dat breedband helpt bij het blootleggen van deze latent aanwezige behoefte. Het gebruik van nieuwe technologieën, zoals breedband, is eigenlijk de aftreksom van de technologische mogelijkheden en de (latente) behoeften van mensen.
De clusteranalyse van gebruikspatronen over 3 jaar in dit onderzoek heeft ons laten zien dat er niet zoiets is als de breedbandgebruiker en dat bepaalde breedbandgebruikers niet gemakkelijk in enkele karakteristieken te vangen zijn. Hiermee hang ook samen dat er geen killer application lijkt te zijn: er is niet een applicatie, dienst of functie van breedband die voorziet in ieders behoefte. Veel meer zien we dat bepaalde functies of diensten zich ontwikkelen als 'daily basics', terwijl andere diensten en functies zich meer ontwikkelen als 'incidental basics', ' specialties' en in de meest negatieve gevallen als 'stragglers'. Deze indeling komt tot stand door twee dimensies in ogenschouw te nemen. De eerste is hoe intensief de dienst gebruikt wordt (bijvoorbeeld dagelijks of slechts een keer per jaar). De tweede dimensie is de spreiding over de internetmaatschappij. De vraag hier is of de dienst door verschillende groepen (clusters) van internetgebruikers wordt gebruikt of dat het gebruik slechts voor een cluster is. De waarden op deze dimensies varieren over de tijd. Specialties kenmerken zich doordat het gebruik intensiever wordt, maar dat het door relatief weinig clusters wordt gebruikt. De stragglers zijn diensten, die door steeds minder clusters steeds minder gebruikt worden. Daily basics daarentegen worden door steeds meer clusters internetgebruikers steeds vaker gebruikt. Zij hebben echt een plek in het dagelijks leven van mensen gekregen. Zoekmachines zijn daar een goed voorbeeld van. Ook door veel verschillende groepen gebruikt, maar niet erg intensief zijn de incidental basics. Het downloaden van foto's zijn daarvan een voorbeeld. Hier hebben veel internetgebruikers ervaring mee, maar er is vaak een niet dagelijkse aanleiding (bijvoorbeeld vakantie, geboorte van een kind).
Het veranderende karakter van de gebruikspatronen geven net als bij het onderzoek naar drempels en redenen voor adoptie aan dat herhaald onderzoek erg belangrijk is. In één meting is deze complexiteit en dynamiek niet te vatten.

Speciale domeinen: breedband voor gezondheidzorg, veiligheid en telewerk

Informatie, communicatie, entertainment en transacties kunnen ook een rol spelen in maatschappelijke domeinen, zoals in gezondheid, telewerk en persoonlijke of publieke veiligheid. Deze domeinen worden ook door de Nederlandse regering als wenselijke toepassingsgebieden van breedband geïdentificeerd. In dit onderzoek is de toepassing van breedband in deze domeinen onderzocht vanuit het gebruikersperspectief.

Bijna 60% van de respondenten in 2005 gebruikte internet voor een vorm van telewerk. Email is daarbij het meest gebruikt. Toepassingen waar breedband een grote rol kan spelen, zoals videoconferencing en webcams, zijn nog uitzonderingen. Gezien het grote aantal mensen dat ervaring heeft met telewerken en de snelle adoptie van breedband, lijkt meer gebruik van deze echte breedbandtoepassingen in de nabije toekomt niet ondenkbaar. Wel moet bedacht worden dat de redenen om niet te telewerken altijd zullen blijven spelen. Redenen om nooit te telewerken, waren namelijk dat het werk niet met een computer gedaan wordt en de het werk op kantoor gedaan moet worden.

Met betrekking tot activiteiten die met de gezondheid(szorg) te maken hebben, zagen we dat de belangrijkste activiteit het bezoeken van websites van gezondheidsorganisaties was, terwijl videocommunicatie met gezondheidsorganisaties vrijwel niet aan de orde was.

Wat betreft veiligheid geldt dat vrij veel mensen daarmee bezig zijn, bijvoorbeeld door websites van organisaties te bezoeken die zich bezighouden met persoonlijke of publieke veiligheid. Op deze websites zoekt men dan vooral naar functionele informatie, zoals adressen en telefoonnummers. Ook worden email en webformulieren gebruikt. Wederom geen activiteiten die veel bandbreedte vragen.

Met deze informatie kunnen we concluderen dat breedband-verbindingen en –diensten nog geen grote rol spelen voor mensen thuis, als het gaat om de sociale domeinen. Dit is begrijpelijk als we beseffen dat deze diensten nog niet op grote schaal worden aangeboden. Als we kijken naar de (door gebruikers) verwachte positieve aspecten, voornamelijk in gezondheidszorg en telewerk, lijkt het wenselijk dat de overheid en werkgevers telewerk stimuleren en dat de ontwikkeling dan breedband in gezondheidszorg ook een impuls krijgt. Op het gebied van veiligheid ligt de rol van breedband voor eindgebruikers niet zo voor de hand.

Omdat het zoeken naar gezondheidsinformatie een belangrijke online activiteit bleek, is een additioneel onderzoek uitgevoerd naar het zoeken naar en gebruik van online gezondheidsinformatie. Hoewel in andere delen van het onderzoek verschillen tussen mannen en vrouwen nauwelijks gevonden werden, bleek dat verschil hier erg belangrijk.

Vrouwen kijken vaker op commerciële websites waar geen controle is op de betrouwbaarheid van de informatie) en vertrouwen op de eerste (twee) websites die ze bezoeken. Dit is een potentieel risico. Maar dit risico wordt verminderd doordat vrouwen de gevonden informatie aan een arts voorleggen. Internet wordt gebruikt als een voorbereiding op een doktersbezoek.
Mannen laten een ander patroon zien. Zij zoeken op websites, die mogelijk betrouwbaardere informatie geven (nieuwsbrieven en websites van patiëntenorganisaties bijvoorbeeld), ze vinden de afzender van de informatie belangrijk en ze zoeken op meer websites dan vrouwen. Zo lijken mannen minder risico te lopen dan vrouwen. Het risico bij mannen zit in het feit dat zij de online gevonden informatie gebruiken als vervanging van een dokters-bezoek. Vrouwen lijken dus meer risico te open als het gaat om het proces van het verzamelen van informatie, terwijl mannen meer risico lopen bij het gebruik van de gevonden informatie. Wellicht moeten mannen en vrouwen op andere manieren worden aangesproken en voorgelicht door overheid en gezondheids-organisaties.
Dat geslacht hier een belangrijke rol speelt geeft opnieuw aan dat er niet één internet- of breedbandgebruiker te identificeren is, maar dat het gebruik bijvoorbeeld afhankelijk is van de situatie waarin men zich bevindt en welke activiteit men uitvoert.

Betekenis van dit onderzoek

Dit onderzoek heeft laten zien dat de adoptie en het gebruik van nieuwe technologieën niet statisch is, maar dynamisch. Verder zijn patronen van technologie adoptie nooit helemaal voorspelbaar (Rogers, 1995), maar dit onderzoek laat zien dat bepaalde factoren steeds weer terugkomen. Nieuwe aspecten die breedband bracht waren meer snelheid, flat fee en always on. Dit gaf de gebruiker meer comfort of gemak voor betaalbare tarieven. Aan de andere kant is de dienstenontwikkeling voor ADSL en kabel niet erg snel en innovatief geweest. De hoofdreden voor mensen om breedband te nemen was dan ook gemak. De overgang van kabel en ADSl naar glasvezel zal de gemiddelde internetgebruiker niet veel meer gemak geven. Daarbij komt dat de prijzen van glasvezel voor de eindgebruiker hoger liggen dan die van ADSL en kabel. Daarom lijkt het voor de eindgebruiker niet voor de hand te liggen om glasvezel te accepteren. Dienstenontwikkeling zou de adoptie wel kunnen verhogen, maar de hoop op een killer application lijkt niet gegrond.
Ook voor adoptie van mobiele infrastructuren geeft dit onderzoek aanknopingspunten. Hier komt ook gemak aan de orde. Voor sommigen zal het feit dat zij overal online kunnen gaan een dergelijk gevoel van gemak geven dat zij mobiele infrastructuren snel zullen accepteren. Voor anderen zal het feit dat de apparaten over het algemeen klein zijn en dat de snelheid nog minder is dan een vaste infrastructuur ze nog tegen houden de infrastructuur te accepteren. Ook de manier van afrekenen zal invloed hebben.

Always on en flat fees waren belangrijk bij het accepteren van de vaste infrastructuren. Wanneer mobiel wordt afgerekend net als internet via de traditionele telefoonlijn, zal dat sommige mensen ook afschrikken. Deze mensen zullen wellicht wachten op nieuwe diensten voordat ze een abonnement op een mobiele infrastructuur zullen afsluiten.
Voor de breedbanddienstenontwikkeling is veel potentieel; op dit moment kunnen de meeste mensen breedband gebruiken. Veel doen dit ook al. Maar wellicht moeten ontwikkelaars het idee van de killer application voor dé breedbandgebruiker loslaten. Basisbehoeften veranderen niet snel en ook voor nieuwe infrastructuren en diensten zullen ICET functies van belang blijven, dus het verdient aanbeveling om hiernaar te kijken. Ook in de sociale domeinen telewerken en gezondheidszorg valt nog het nodige te ontwikkelen.

Ten slotte – Snelle diffusie en breder wordend gebruik van breedband
De residentiele adoptie van breedband in Nederland is al een heel eind gekomen de afgelopen jaren. Hoewel voor een bepaalde, kleine groep de wil om breedband te accepteren klein blijft, is de adoptie snel gegaan van 3.8 abonnees per 100 inwoners in 2001 naar 28.8 in 2006 (OECD, 2006). Dit is voor een groot deel te danken aan het verminderen van de drempels die het *kunnen* accepteren, beïnvloeden; breedband wordt nu vrijwel overal in Nederland aangeboden tegen een veel lagere prijs dan in de begin jaren. De adoptie is nu zozeer beïnvloed door een bepaalde killer application, maar vooral door comfort of gemak tegen een redelijke prijs. Verder is het gebruik breder geworden, doordat veel informatie, communicatie, entertainment en transactie functies en activiteiten zich over de internetmaatschappij hebben uitgebreid. De adoptie- en gebruikspatronen zijn geen vaste gegevens, maar ze zijn dynamisch, wat herhaald of longitudinaal onderzoek noodzakelijk maakt. Alleen door verder onderzoek, waarbij (ook) een gebruikersperspectief worden gehandhaafd, kunnen we de werkelijke waarde en betekenis van nieuwe technologieën in het dagelijks leven van mensen vatten. Van daaruit kunnen ook betere voorspellingen gedaan worden, hoewel altijd in gedachten gehouden moet worden dat mensen niet zo voorspelbaar zijn als we soms zouden willen. De betekenis van breedband voor de meeste gebruikers is een manier om informatie te delen, te communiceren, te vermaken en vermaakt te worden en om transacties uit te voeren. Het zijn niet de techniek en de technologische mogelijkheden die belangrijk zijn voor de gebruikers ervan, maar wat ze ermee kunnen op een comfortabele en zo niet te dure manier.

References

Anderson, B. Gale, C., Jones, M.L.R., and McWilliam, A. (2002). Domesticating broadband-what consumers really do with flat rate, always-on and fast Internet access. *BT Technology Journal*, 20 (1), 103-114.

Davis, F.D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13:3, pp. 319-341.

Dwivedi Y.K. and Choudrie J. (2003), Investigating the Impact of Broadband upon the Users' Online Habits and the Usage of Internet Services. In the Proceedings of the International Telecommunication Society's Asia-Australasian Regional (ITS) Conference, Perth Australia, June 22 – 24, 2003.

Horrigan & Rainie (2002). The Broadband Difference: How Online Americans' Behavior Changes with High-Speed Internet connections at home. Pew Internet and American Life Project, Washington, DC.

Middleton, Catherine. A. (2003). What If There Is No Killer Application? An Exploration of a User-Centric Perspective on Broadband. *Journal of Information Technology*, 18(4), 231-246.

Rogers, E.M. (1995). *Diffusion of innovations*. New York: Free Press

UCLA (2003). The UCLA internet report : surveying the digital future year 3. UC Regents, Los Angeles.

Appendix A - Publications by Karianne Vermaas

Publications on which this thesis is based

Vermaas, K., L. van de Wijngaert & S. Brinkkemper (2007). Accumulating IS theories using a network approach towards meta-analysis. Paper submitted to ICIS 2007, Montréal, Canada

Vermaas, K., L. van de Wijngaert & S. Maltha (2007). Broadband and its Dutch users. Abstract submitted to ITS Europe, Istanbul, September 2007.

Vermaas, K. & F. Bongers (2007). Broadband in Telework, Health and Safety: the user perspective. International Journal of Internet Commerce: Emerging E-Business and E-Government Issues Special Issue, 6(2).

Vermaas, K. & L. van de Wijngaert (2007). A longitudinal study into the reasons and thresholds for residential users to switch to broadband (2001 to 2005). Accepted for presentation at the 57th Annual Conference of the International Communication Association (ICA) "Creating Communication: Content, Control, Critique", San Francisco, CA USA

Vermaas, K. & L. Van de Wijngaert (forthcoming August 2007). A longitudinal study to investigate consumer/user adoption and use of broadband technology in the Netherlands. In: Dwivedi Y.K. "Consumer Adoption and Usage of Broadband", Idea Group Inc., Hershey

Vermaas, K. & L. Van de Wijngaert (forthcoming fall 2007). Uses of Uses and Gratifications and Broadband. In: Dwivedi Y.K., Papazafeiropoulou, A., and Choudrie, J., "Handbook of Research on Global Diffusion of Broadband Data Transmission", Idea Group Inc., Hershey

Vermaas, K. & L. Van de Wijngaert (forthcoming 2007). Cluster analysis of internet users: a longitudinal examination. In: Haddon, L., E. Mante-Meijer, B. Sapio, K.H. Kommonen, L. Fortunati, & T. Turk (Eds.). Proceedings of COST Action 298 "Participation in the broadband society" conference "The good, the bad and the unexpected", May 2007

Vermaas, K. (2006). Broadband in Telework, health and safety: the user perspective. In the proceedings of IADIS E-society 2006, Dublin.

Vermaas, K. & L. van de Wijngaert (2005). Seeking Health information on the Internet: Different genders, different uses,

Different risks In: Bartmann, D., P. Ein-Dor, J. Becker, F. Bodendorf, F. Rajola, D. Avison, J. Kallinikos, R. Winter, K.H. Kautz, & G. Pernul (Eds.). Proceeding of the 13th European Conference on Information Systems (ECIS): Information Systems in a Rapidly Changing Economy . University of Regensburg, Germany: Institute for Management of Information Systems.

Vermaas, K. (2004). Diaries as research methods to study online behavior. In: Hunter, M.G. & K. Dhanda (2004). ISOneWorld Conference proceedings. The Information Institute, Washington D.C.

Vermaas, K. & L. Van de Wijngaert (2004). Measuring Internet behaviour: Total Time Diary and Activity Diary as research methods. *Journal of Information Technology Theory and Application* (JITTA), 7 (1), pp. 121-134.

Maltha, S., Vermaas, K., & Wijngaert, L. van de (2003). Broadband technology and services from a user perspective. In: L. Haddon, E. Mante-Meijer, B. Sapio, K.H. Kommonen, L. Fortunati, & A. Kant (Eds.), Proceedings of The Good, the Bad and the Irrelevant (pp. 179-185). Helsinki: Medialab, University of art and design.

Other Publications by Karianne Vermaas

Vermaas, K. & S. Maltha (forthcoming August 2007). Broadband in Dutch Education: current use, experiences and impediments. In: Dwivedi, Y. et al. "Consumer Adoption and Usage of Broadband". Idea Group, Hershey

Smidts, M. & K. Vermaas (2007) Nulmeting Schoolglas. Schoolglas, Deventer

Wijngaert, L., van de & K.Vermaas (2006). Ad hoc Networking and Grid Computing from the perspective of the user: The case of screen sharing using Wireless Grids. In the proceedings of ICI2006, Tashkent, Uzbekistan

Vermaas, K. & Kaashoek, B. (2006). Gebruikersonderzoek digitale televisie Casema. Utrecht: Dialogic. Commissioned by Casema.

Vermaas, K., Zijderveld, C., Verhagen, L. & Kaashoek, B. (2006). Breedbandmonitor onderwijs 2006. Utrecht: Dialogic. Commissioned by Nederland BreedbandLand (NBL), SURFnet en Kennisnet Ict op School.

Batenburg, R., K. Vermaas, , L. van de Wijngaert, F. Bongers (2006). Expectations that run high: Dutch Citizens om E-government. In de proceedings van EGov06, Brunel University, London, UK.

Bongers, F., K.Vermaas & I. Bujar (2006). Overheidsinformatie op internet. In Openbaar Bestuur, 8, August 2006, Kluwer.

Vermaas, K. (2006). Nieuwe mogelijkheden met glasvezel. Computers op School(COS), June 2006.

Vermaas, K. & F. Bongers (2006). Gebruikersonderzoek www.politie.nl. Utrecht, Dialogic. Commissioned by the Dutch Police Institute (het Nederlands Politie Instituut (NPI)) and Concern Information Management Police (CIP).

Bilderbeek, R., L. Verhagen, K. Vermaas (2005), Computer-based testing, Strategische omgevingsverkenning. Commissioned by Informatie Beheer Groep. Utrecht, Dialogic.

Vermaas, K., H. de Groot en S. Maltha (2005), Breedband Onderwijs Monitor 2005. Utrecht, Dialogic. Commissioned by NederlandBreedbandLand, SURFnet en Kennisnet.
Bongers, F. & K. Vermaas (2005), Een overheid van glas. Utrecht, Dialogic. Commissioned by ICTU.

Vermaas, K. (2005), Een supersnelle internetverbinding. Computers op School (COS) (10/17), december, ESS, Groningen.

Vermaas, K., Maltha S., F. Bongers, J. Segers & L. v/d Wijngaert (2005), Breedband en de Gebruiker 2004/5. Utrecht, Dialogic. Commissioned by the Ministry of Economic Affairs, KPN, Vecai, City of Almere.

Bilderbeek, R., H. de Groot, K. Vermaas & C. Holland, m.m.v. TNS Nipo en Stoas onderzoek (2005). Met een kaart meer instroom? Onderzoek naar de haalbaarheid en wenselijkheid van een "smartcard bèta techniek". Utrecht: Dialogic . Commissioned by Deltapunt, Platform Bèta Techniek.
Vermaas, K. (2004) Broadband and its users, A multi-theory, multi-method and longitudinal investigation into the adoption and diffusion of new information technologies. Research proposal accepted for the ECIS 2004 Doctoral Consortium, Turku, Finland.

Bilderbeek, R., K. Vermaas (2004) Evaluatie Pilot Functieraster opsporing Utrecht: Dialogic Commissioned by the Ministry of the Interior and Kingdom Relations

Bilderbeek, R., K. Vermaas (2004) Evaluatie AOC's online: vertrouwelijk eindrapport Utrecht: Dialogic Commissioned by The Council for Agricultural Education Centres

Bilderbeek, R., K. Vermaas (2004) Evaluatie AOC's online: openbaar eindrapport Utrecht: Dialogic. Commissioned by The Council for Agricultural Education Centres

Bongers, F., C. Holland, K. Vermaas, R. Vandeberg (2004). Burgers aan bod: Elektronische overheidsdienstverlening in het perspectief van de vraagzijde. Utrecht: Dialogic. Commissioned by the Ministry of the Interior and Kingdom Relations

Bongers, F., C. Holland & K. Vermaas (2004). De burger aan bod (in Dutch). Openbaar Bestuur, 11

Holland, C., K.Vermaas (2004) De haalbaarheid van een OnderwijsTV kanaal via Internet Utrecht: Dialogic Commissioned by NOB Cross Media Facilities

Vermaas, K., R. Bilderbeek (2004) Nulmeting website en bureau Traverse Utrecht: Dialogic Commissioned by the Dutch association of consulting engineers (ONRI)

Bekkers, Rudi, Marieke Fijnvandraat, Sven Maltha, Krijn Schuurman, Menno Smidts, Rens Vandeberg, Karianne Vermaas (2004). Analyse breedbandplannen publieke en private partijen- Vooruitgang zonder marktverstoring? BIJLAGE met casussen. (Vertrouwelijk). Utrecht/ Amsterdam: Dialogic / SEO. Commissioned by the Ministry of Economic Affairs

Vermaas, K. (2004). Medische informatie op internet: het gebruik, de gebruikers en de risico's. Utrecht: Dialogic

Vandeberg, R., K. Vermaas, S. Maltha & F. Bongers (2003). Invloed van online videopresentaties. Selectiecriteria van werkgevers en aanbevelingen voor sollicitanten. Utrecht: Dialogic. Commissioned by the City of Amsterdam.

Vermaas, K. & L. van de Wijngaert (2003). The disclosure of personal information on the internet: User motivation, reliability and price as explaining factors. In: Petrovic, O. , Ksela, M. , Fallenböck, M. , Kittl, C. , Trust in the Network Economy, Springer, New York/Wien.

Holland, C., A.W Veenstra, M. van Oosterhout, R. Bilderbeek, R. Bekkers & K. Vermaas (2003). Economische effectenverkenning glasvezelnetwerk Rotterdam.[Exploration of the economic effects of a glass fibre network in the city of Rotterdam]. Utrecht: Dialogic. Commisioned by Rotterdam City Development Corporation.

Maltha S., F. Bongers, K. Schuurman, R. Vandeberg, K. Vermaas & L. v/d Wijngaert (2003), Breedband en de Gebruiker 2003. Utrecht, Dialogic. Commissioned by the Ministry of Economical Affairs, Kenniswijk, KPN, Vecai, Cyburg, Ex'ovision, City of Almere.

Bongers, F., H. de Groot, K. Schuurman & K.Vermaas (2003). Digitaal Kapitaal: Internationale beleidsvergelijking van ICT in het onderwijs en op de arbeidsmarkt. Utrecht: Dialogic. Commissioned by ICT punt.

Maltha, S., K. Schuurman, K. Vermaas, R. Vandeberg, F. Bongers, R. Bekkers & L. v/d Wijngaert (2002), Breedband en de Gebruiker. Utrecht: Dialogic. Commissioned by the Ministry of Transport, Public Works and Water Management, KPN, Vecai, Ex'ovision, City of Amsterdam.

Vermaas, K & L. van de Wijngaert (2002). Name, Address and . . . Social Security Number? Personal Data on the Internet, Paper accepted for presentation at the 51th ICA conference. Seoul, Korea.

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