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Ioanna Constantiou
Brunel University, Copenhagen, Denmark, ic.inf@cbs.dk

Anastasia Papazafeiropoulou
Brunel University Uxbridge, United Kingdom, anastasia.papazafeiropoulou@brunel.ac.uk

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Is there a viable future for residential IP-Telephony users? Exploring providers' and end-users' perspectives

Dr Ioanna Constantiou [1]
Dr Anastasia Papazafeiropoulou [2]

[1] Copenhagen Business School
Brunel University
Department of Informatics
Copenhagen Business School
Copenhagen, Denmark
Email: ic.inf@cbs.dk

[2] School of Information Systems and Mathematics
Brunel University
Uxbridge, United Kingdom
Email: anastasia.papazafeiropoulou@brunel.ac.uk

Abstract

The emergence of IP telephony as a lower-priced alternative to traditional phone services has raised questions of what users want and what vendors have to offer. In this article we investigate the views of both users and vendors on critical issues for IP telephony diffusion based on diffusion of innovation theory. We draw our conclusions from the study of a dynamic IP-telephony market where we interviewed IP telephony providers and surveyed residential users. Our results indicate that vendors' main concern is users' lack of technical skills, while users are comfortable with technical complexity, and are interested in price reductions.

Keywords

IP telephony, innovation diffusion and adoption, task and technology compatibility, task complexity

INTRODUCTION

The Internet telephony market came into the spotlight due to the massive increase in users, worldwide, over the last two years. The successful case of Skype has been discussed by both the research community (Rao and Angelov 2005) and practitioners (Cook 2003), while its recent buy-out from eBay can be partially explained by this increased market attention. Internet telephony, or IP-telephony, has been available since the mid-nineties (Cawley 1997). However, it took five years for most of the elements for successful deployment to be put in place. In terms of technological infrastructure the high bandwidth availability and consequently service reliability (Hovell et al. 2005; Varhney et al. 2002; Zubey et al. 2002) led to wide diffusion of broadband networks and the increased capacity of global backbones, which facilitated the supply of IP telephony services. In terms of market demand, the numbers of Internet and PC users have increased considerably, leading to a technologically mature community that could use more "advanced services" in comparison to basic fixed telephony calls (Corrocher 2003). Finally, in supply terms, IP telephony providers have developed a variety of technological solutions and services (Varhney et al. 2002).

Current research points to issues of technological complexity involved with the use of IP telephony services, especially by novice users (Corrocher 2003; Varhney et al. 2002), making the creation of a critical mass difficult while confining network externalities. Varshney et al. (2002) identified a set of attributes affecting adoption that include cost, service quality, security, pricing, and value adding potential (e.g. service integration of voice and data). Additionally, Corrocher (2003) collected and analysed empirical data from a survey in Europe and the US on IP telephony providers' perceptions of market demand, concluding that business users would drive the market evolution, while residential users would follow at a later stage due to a lack of infrastructure (i.e. they need a PC at home and high bandwidth Internet access). These studies take a single view of the IP telephony adoption and diffusion processes by focusing on the vendor's perspective. In this article we investigate the adoption and diffusion of IP telephony by taking the perspectives of both users and vendors in order to identify consensus points or perception gaps between them as a way to develop a better understanding of market dynamics. We use empirical data from a dynamic national setting, collected through an online survey to residential end-users, and semi-structured interviews with key vendors from Denmark during January 2005.

Our objective is to explore the interplay between technological complexity and compatibility, as viewed by both users and vendors. We use Copper and Zmud's model (1990), which addresses technology compatibility and complexity issues within the adoption and diffusion of IT.

Accordingly, our main research questions are:

- o What are the interplays of compatibility and complexity in the adoption and diffusion of IP telephony as viewed by vendors and end-users?

- o What are the projections for the future for IP telephony according to the views taken by both the supply and demand sides of a mature in IP-telephony use market such as Denmark?

The article's contribution is three-fold. First, it applies a well-known model for organisations implementing IT in a volunteer service market. Second, it contributes to the information systems research by underlining the need to examine both the demand and supply sides of emerging technologies in order to better understand rapidly changing phenomena. Finally, it provides insights to practitioners such as vendors and policy makers involved in the IP-telephony market, exploring end-users' perceptions and needs.

The article is organised as follows. The following section discusses the applicability of diffusion of innovation theories in the study of IP telephony and presents the research framework. This is followed by a brief presentation of our research approach. The next two sections present the results on vendors' and end-users' perspectives, respectively. The article then discusses the current market dynamics as depicted from the analysis of vendors' and users' perspectives. Finally, it concludes by underlining the research contribution, as well as future research directions for the IS field.

A THEORETICAL APPROACH TO THE ADOPTION AND DIFFUSION OF IP-TELEPHONY

New technologies often experience challenges when it comes to the acceptance of potential users. One of the most widely used theories that attempts to explain the reasons behind innovation adoption is Rogers' diffusion of innovation theory (1995; Rogers 2003). This theory aims to trace and explain the path of an innovation's acceptance through a given social system over time. According to Rogers (2003), and other rational diffusion theorists (Agarwal and Prasad 1997; Moore and Benbasat 1991), there are certain characteristics of innovations which affect their rate of adoption. Although it is acknowledged that social and economic influences may impede or facilitate the process, emphasis tends to play on the innovation itself. Rogers' theory has been criticised for not taking into account the particularities of complex information technologies (Lyytinen and Damsgaard 2001). The theory has been judged as poorly equipped to facilitate the understanding of how different groups interact in the production and provision of an innovation, as well as lacking attention to acts of reinvention and the consequences of innovation adoption (Allen 2000; Elliot and Loebbecke 2000; Kautz and Pries-Heje 1996; Papazafeiropoulou 2002). A point on which we agree with Rogers is that all innovations are not the same, and there are some elements of the innovation itself that the potential users perceive as important (or not) during their decision to adopt or reject it. Nevertheless, we believe that apart from the potential users, other relevant social groups, including the vendors, have their own interpretation of the characteristics of the innovation, which can be very different to what the users actually believe and want to take out of it.

In previous work on diverse viewpoints in the innovation diffusion process it has been demonstrated that the supply side might have a completely different view on the maturity of the innovation under investigation from the demand side (Papazafeiropoulou et al. 2005). Thus, different social groups are expected to cater for their individual needs and drive their own agendas. It is our intention to use this observation in order to see how these perspectives shape the diffusion process. In the case of emerging technologies such as IP-telephony, the providers' willingness to offer a new service is not always based on the usefulness of the technology for the consumers but also on the economic terms to their advantage. For example, user readiness (technical and financial), together with ongoing support and maintenance, may signal a non-profitable investment in the short run and mitigate against initial supply (Brown and Lockett 2004). Alternatively, even though a new technology might be perceived as useful, advantageous and innovative, this does not always lead to adoption by the consumer mainstream market. In the case of IP-telephony for instance, a user may consider the value of using a fixed-telephony network before choosing to adopt an IP telephony solution, as well as the costs involved in such decision, which may be higher than the expected benefits in case of incompatibility with existing networks.

In this article we adopt Cooper and Zmud's (1990) model on IT adoption and use it to investigate not only the users' perspective on the technological characteristics of the innovation but also the vendors' views on IP-telephony adoption and diffusion. This model postulates that compatibility has positive effects while complexity has negative effects (see figure 1) on the adoption of IT innovations by organisations. We intend to show its

applicability to the IP-telephony adoption process that has a voluntary nature for end-users acting as individual consumers rather than organisations. We need to emphasise that we use this model as an exploratory rather that explanatory tool, as we use its elements not to explain specific phenomena but as list of themes that lead our research effort.

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┌──────────────────────┐
│ Task Characteristics │───────────┐
└──────────────────────┘           │
                                   ▼
                          ┌─────────────────┐        +     ┌─────────────────────────┐
                          │  Compatibility  │──────────▶   │ IT                      │
                          └─────────────────┘              │ IMPLEMENTATION          │
┌──────────────────┐               ▲                       │ - adoption              │
│ Technology       │───────────────┘                       │ - infusion              │
│ Characteristics  │                                       │                         │
└──────────────────┘                                       │                         │
                          ┌─────────────────┐        -     │                         │
                          │  Technology     │──────────▶   │                         │
                          │  Complexity     │              └─────────────────────────┘
                          └─────────────────┘
┌──────────────────┐               ▲
│ Task Complexity  │───────────────┘
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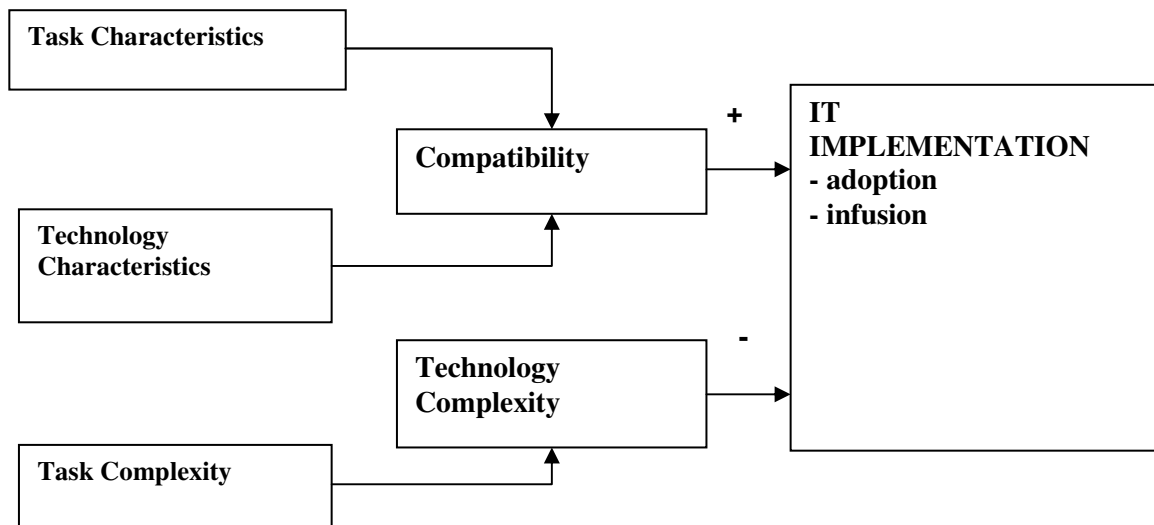
Figure 1. The IT adoption model by Cooper and Zmud

In the next section we present our research approach on collecting quantitative and qualitative data according to this framework in order to answer our research questions.

RESEARCH APPROACH

This article explores the IP-telephony market through data collected from Denmark during January 2005. Denmark is among the most advanced European countries in the Information and Communications Technologies sector (i.e. for the Information Society Index Denmark is in the first place) and has a high Internet penetration rate of almost 70%, including 48% of users with broadband connections.[1] This environment has enabled the shaping of a dynamic IP-telephony market with seven providers (excluding Skype and MSN), four ISPs and three IP-telephony providers. Market penetration is increasing and expected to reach 12% of the Danish population during 2006 (NITTA 2004). This market may offer useful insights and indicate trends to be observed in other markets in the Western world.

We investigated the Danish market by collecting qualitative and quantitative data. In particular, we conducted interviews with the major market players in order to explore the vendor's perspective, and developed an online survey for capturing the end-user's perspective. The following subsections describe the two research instruments used to collect data.

Qualitative data collection

We started by collecting information on existing models of IP-telephony service delivery through direct contact with the key market players. Figure 2 presents these players. The business relationships between them can be divided in two different instances that correspond to the main available types of end-user's access devices (Mason 1998). These instances involve offering PC-to-PC or PC-to-phone calls. In the case of PC-to-PC communication, the service flow between Caller and Receiver includes only the Internet Telephony Provider (ITP). In the case of PC-to-phone calls the Reseller intermediates between ITP and Network Provider. However, Internet telephony might be offered by an ISP. In such cases the ISP has direct access to the Network Provider and the role of Reseller is eliminated.

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[1] IDC's market analysis for 2004 including four infrastructures: compute, telecom, Internet and social. It is available at http://www.idc.com/groups/isi/main.html
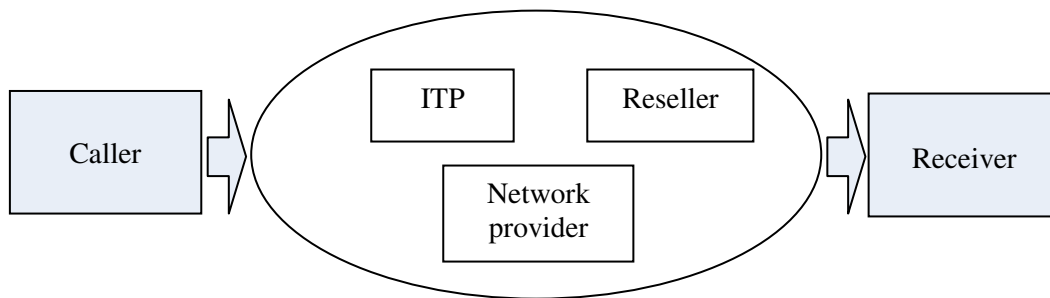
Figure 2. Players in the Internet telephony market

We then chose seven companies, representative of the key stakeholders, to collect empirical data. In particular, two ITPs and two ISPs that have different service flow models were chosen for the interviews as they represent a substantial market share. In order to obtain as complete a set of empirical data as possible we interviewed three additional market players that have a key role in the service delivery chain, namely the incumbent telecommunications operator (i.e. network provider), a network reseller, and a different type of ISP that serves specific communities defined by the physical proximity of the members. These three companies have plans to expand their activities in the IP-telephony market in the near future (i.e. the next 12 months). The sample allows for systematic observation of the different perspectives, directly through companies currently active and indirectly through new entrants. Table 1 offers information on the profile of those companies.

Organisation Type	Organisation coding	Current Service Offerings	Interviewee
Internet Telephony Provider	Company A Company B	Internet Telephony	CEO Co-founder & Sales Manager
Internet Service Provider	Company C Company D	Internet Access Internet Telephony	Sales Manager for residential & ADSL market Project Manager on IP-telephony
Community Internet Service Provider	Company E	Internet Access	Technical Manager
Network Service Reseller	Company F	Resale network services	Sales Manager
Telecommunications Operator	Company G	Fixed telephony, wholesale network services, Internet access	Manager of Broadband telephony Unit

Table 1. The profile of selected companies

The interviews were based on our theoretical framework as presented in the previous section and conducted in January 2005 (one interview per day), and lasted between 60–85 minutes. The exploratory nature of this study did not allow for a pilot testing of the interviews. Data were collected in Danish, transcribed, and finally translated into English. The interview guide included 27 questions divided in two sections. First, a generic section included 6 questions on the company's history, profile and business activities. Then, the second part included 21 questions covering the key elements of the extended research framework. The questions were open-ended in order to allow for follow up, when new and unanticipated information appeared because of the questions posed.

Quantitative data collection (the home user's view)

We developed the survey instrument targeting residential Internet users in Denmark. The survey instrument was based on the theoretical insights and the particular characteristics of the technology as derived from reported studies (i.e. the trade-off between low cost and quality of service). The survey instrument was initially developed in Danish. It was pre-tested among the participants of a research group (5) and then pilot-tested using students of a master course (25) where 50% had prior experience with IP telephony use. The questions were revised based on their written and oral feedback. Following revisions, the survey was launched on the Internet using an online tool. An intense advertising campaign including announcements in newsletters, newspapers and business

meetings was made. The survey ran in Denmark during January 2005. In light of reports on the falling response rates of surveys (Taurangeau 2003), and in order to compensate Internet users' opportunity costs of spending time online (Brennan et al. 1999), we offered incentives in the form of three award tickets to participate in the lottery of a commercial chain store in Denmark.

The survey instrument included 53 questions organised in five different categories. They involved profiling of respondents in terms of technology use and innovativeness (8 questions), Internet use (4 questions), fixed-line telephony usage patterns for domestic and international calls (10 questions), and IP telephony usage patterns, economic factors, adoption and diffusion process characteristics (22 questions),

The sample comprises of 654 usable respondents and is not representative of the Danish population. The sample is representative of the young segment of Internet users, students or private sector employees, the majority of which (67%) have ADSL connections at home. The respondents' profile is in line with the national statistics of Denmark for IP-telephony users (NITTA 2004). This sample was chosen to offer an in-depth understanding of end-users' perceptions according to the proposed framework. Table 2 presents the demographics of the sample split into two groups of users and potential users.

Demographic Characteristics		Users	Potential Users
	Size	238	416
Gender	Female	23%	42%
	Male	77%	58%
	<20	1%	1%
	20-30	61%	64%
	31-40	27%	24%
	>40	11%	11%
Education	Primary, Secondary and no tertiary	20%	20%
	Tertiary	21%	26%
	Quarternary	59%	54%
Occupation	Private sector	36%	27%
	Students	49%	52%
	Public-semi public sector	15%	21%
Monthly Household Income	<1350€*	34%	44%
	1351 €-4050 €	44%	36%
	4051 €-6750 €	17%	17%
	> 6751€	5%	3%

*amounts were rounded in Danish Coronas

Table 2: Demographics of the sample

We analysed qualitative and quantitative data using the extended framework presented in figure 1. We applied a thematic analysis to the qualitative data from the interviews to tease out vendor perceptions of the impacts of complexity and compatibility on IP-telephony adoption and diffusion. We organised quantitative data based on the two groups of users and potential users and followed a similar thematic analysis. The next two sections present the analysis of the two datasets in our effort to answer the research questions by acquiring vendors' and end-users' perspectives.

THE VENDORS' PERSPECTIVES OF THE DANISH IP-TELEPHONY MARKET

This section presents the vendors' perspectives and offers an analysis of the elements involved in the framework, based on the responses we received from the interviewees.

Compatibility task characteristics

In the case of IP-telephony, task compatibility refers to the possibility of users continuing to use telephone services without having to go into a lot of changes in the way they are used to making phone calls. Changes relate to both device use and network services. It appears that there are strong influences in task compatibility from similar technologies that users have been used to for a long time. In particular, a critical attribute is the quality of service (Mason 1998), and fixed telephony offers a direct reference point for comparisons. During the interviews, this was a recurring theme, addressed as a main challenge for providers. For example, ISPs already experienced in dealing with service quality in the Internet market highlighted the challenge in the case of IP telephony. One representative of the ISPs (from company D) said: *"P-telephony will never offer better quality than the PSTN [public switched telephone network]. It is naïve to think that. PSTN in Denmark is of a very high*

quality and it will always deliver voice better, with less echo and faster than the Internet ever will be able to." Similarly another interviewee from company E said: *"There is an expectation among our customers that it [quality of service] is the same as PSTN. This is not always the case. We have had some problems explaining noise on the Internet. I don't think the quality of our IP-telephony will be as good as PSTN. We are dependent on the network we use."* These views are in line with the theoretical insights for markets with network effects, where compatibility shifts the focus of competition according to performance parameters.

Besides, vendors also underline the challenge raised from users' difficulty to adjust their practices when it comes to using new devices for IP-telephony. An interviewee in company B said: *"Some people don't buy the adaptor but use headsets just as with Skype, but they can't receive calls. I don't think that is smart."* Moreover, in case of services such as video telephony that might be valued in specific tasks such as video conferencing, the main challenge is the availability of hardware and user-friendly interfaces, as pointed out during the interviews. *"You can imagine and say all kinds of things, but what is it the customers need and are willing to pay for? Video-on-demand could be very practical, but is it a screen interface for e-mail you want to use when you are used to a PC or a laptop?"* (interviewee in company G). It appears that vendors are concerned about the quality of service provided as well as how IP-telephony solutions will be domesticated by end-users.

Compatibility technology characteristics

Compatibility in technology characteristics is very important for the adoption and diffusion processes of IP-telephony in the light of network externalities involved in communication services. During the interviews vendors seemed aware these fact. As an interviewee in company C said: *"It does not matter if it is VoIP or VoATM as long as the telephony is working. What is important is that you have a quality product that can be communicated and positioned. We advertise that you can drop your fixed line subscription. We don't want to open up a debate on whether this is as good. It is."*

Yet, in the incumbent telecommunications operator they believe that customers are very satisfied with what they already have, and that the challenges for IP-telephony diffusion are stronger, *because those customers that adopt IP-telephony are those that use fixed line today and perhaps mobile users. The customers today are very satisfied with the solutions they have"* (interviewee in company G).

Moreover, IP-telephony providers acknowledge the costs involved for new customers and the need to offer compatible solutions as well as full network coverage to a new customer. *"We had a policy that if we were going to do this [launch IP-telephony application], it had to be compatible with anything called IP-telephony. It had to be compatible with all the hardware and software standards that exist within IP-telephony . . . It has to work, the most important thing to a new IP-customer is that it works first time he lifts the handset and calls and that it works tomorrow and the day after that"* (interviewee in company A). Vendors are aware of the importance of compatibility on maintaining the network externalities that users already benefit from in the case of fixed telephony. However, in the case of switching costs they do not perceive them to be of high importance in the adoption and diffusion processes.

Task complexity

Technological complexity may have negative effects on IP-telephony diffusion bearing in mind the explicit comparison made by the end user between IP and fixed line telephony. Most of the interviewees experienced challenges when dealing with end-users' requirements of lower complexity and seem aware of complexity's negative impact upon the adoption and diffusion of IP-telephony. One of the interviewees in company C said: *"Take that Skype phone that is being offered. It is not being sold. It is complicated and not competitive. People don't understand it".*

Task complexity becomes more important in the case of people with limited technical knowledge that may not possess a PC, as pointed out during the interviews. *"You can always put something out on the Internet, like Skype and if it works it is fine, but to our parents' generation, this is not a feasible way. It will never gain a foothold among the broad public"* (interviewee in company C). Some providers move into stimulating the demand but are quite uncertain about the anticipated results: *"We just signed a deal with a housing association of 200 apartments. They just got fibre optic cables by a supplier that is our partner and they wanted IP-telephony. They consist of grand parents as such without PCs"* (interviewee in company A).

The research on the supply side shows that there is a great concern from the vendors' point of view about the users' ability to use IP-telephony services due to the difficulties involved in learning how to use the new equipment, and the change of practice from traditional telephony services. The vendors do not seem to be prepared to invest in training users or to offer simpler devices as they believe that the market potential of voice telephony for residential users is rather limited. They depict the mass market of residential users as relatively

immature for the new technological solutions, while seeing a market potential for business users. In the next section we discuss the end users' (i.e. residential) perspectives on these matters, based on the online survey's results.

THE END-USERS' PERSPECTIVES OF THE IP-TELEPHONY MARKET

This section presents end-users' perspectives and offers an analysis of the elements involved in the framework based on the responses we received from the survey.

Compatibility task characteristics

We investigated respondents' tasks characteristics through fixed telephony usage patterns focusing on foreign calls, offered at a lower price through IP-telephony. The majority of users (68%) and potential users (49%) call abroad, mainly speaking to friends and family, for less than 30 minutes per week. Users have domesticated IP-telephony on foreign calls, since the majority (87%) stated exclusive use.

We then explored end-users' perceptions of the main performance characteristic of the quality of services. We asked users to compare their experienced quality of IP-telephony relative to fixed telephony services. The majority of users (48%) perceive the quality of the IP-telephony service to be worse than fixed telephony, while 37% of users perceive it as the same. However, when we asked respondents how often they encounter problems related to specific performance measurements of the quality of services, they claimed that they were rare. In particular, the majority of users (80%) stated that they experienced voice fall out, latency, echo and jitter once in a while and disconnection very rarely (77%). Thus, it appears that the quality of service is not a main concern for the respondents, despite the different perceptions of vendors.

Compatibility technology characteristics

Compatibility between technologies may play a decisive role in the decision of a user to switch from one solution to another. We asked respondents about their willingness to switch to IP-telephony if different value-added services were included in the proposed offer, using a 5-point Likert scale (1: totally unimportant to 5: very important). To further elaborate on the results we compared the means of the two groups through t-statistics.

Value-added services	Users' Means	Potential Users' Means
Video-telephony	2.80	2.75
Email	2.82	2.88
Teleconferences	2.96	2.72*
Information services (e.g. weather forecasts, TV programme, public transportation schedule)	2.76	2.80
Use of existing telephone device	3.33	3.69*

significant difference at p<0.01
Table 3: End-users' perceptions on value-added services of IP-telephony solutions

The results of Table 3 underline that the most important requirement for both groups is full compatibility with the existing telephone device while performing the tasks involved. Potential users assign significantly higher importance than users, indicating the high switching costs of the physical investment on new equipment and the potential impact of network externalities from existing communication infrastructure. This is in line with the observation of vendors on users' reluctance to use new equipment (i.e. adaptors). The second most important value-added service for users is teleconferencing, and for potential users is email. It is worth noting here that video telephony scored relatively low from both groups. This observation contradicts the current vendors' plans to expand their service offerings to this specific service.

To investigate information investment in terms of brand name and technological uncertainty we asked respondents to reveal their reasons for choosing an IP-telephony provider. The majority of users opt for a new company (39%), followed by an established fixed telephony provider (31%), and then ISP (21%), while the majority of potential users (36%) opt for an established fixed telephony provider, followed by an ISP (20%) and a new IP-telephony provider (15%). It appears that potential users have issues switching costs involved to both psychological and information investment, which may explain their reluctance to adopt IP-telephony solutions.

We also asked respondents to choose between different amounts of one-time payment subscription to switch to IP-telephony. The highest percentage of both users (28%) and potential users (26%) stated less than 30 Euro,

followed by 20% of users and 25% of potential users stating 50–75 Euro. Moreover, in order to identify incentives that may counterbalance switching costs we proposed four introductory offers to potential users, including lower prices in communication services and a free IP-telephony device. The highest percentage of respondents chose the free IP-telephony device option (33%), while 20% of respondents didn't know, and 13% chose free voice services with 4 persons of their choice possessing fixed lines. It appears that the main concern of potential users is the switching costs involved in the physical investment in new equipment.

Task complexity

To elaborate on issues of task complexity we asked users about their perceptions of related attributes, such as ease of installation and use, use experience and satisfaction with IP telephony, using a 5-point Likert scale (1: completely disagree to 5: completely agree). 52% of users completely agreed that it is easy to use IP-telephony solutions. At this point it is important to note that our user sample includes young, technologically mature individuals with experience in the use of Internet services. In terms of ease of installation, 37% completely agreed with the statement, while the rest of the respondents took a less positive and neutral position. This observation underlines a potential switching cost in the case of installation that requires specific technical competency. Using the reference situation of fixed telephony we ask the respondents for their perception of the statement "IP-telephony is like fixed telephony but over the Internet," and users seem to disagree or take a neutral position (67%). Finally, we asked them whether they were satisfied using IP-telephony, and 74% agreed or completely agreed with the statement.

While admittedly the sample used in the study is relatively mature in terms of technology use, the technological complexity does not seem to be a major obstacle for current and potential residential users. The responders seem to be more interested in switching cost issues and compatibility to benefit from network externalities. It seems that full compatibility with existing telephone devices and the low cost of new equipment are the most frequently reported needs from users. Finally, potential users seem to be reluctant to use new ITPs and would rather use known players in the market such as ISPs, highlighting that uncertainty surrounding the various IP-telephony solutions available has raised further switching costs involved because of information investment.

In the next section we discuss how the two perceptions (vendors and users) of the IP-telephony market in Denmark are forming the current market dynamics.

DISCUSSION-CONCLUSIONS

This article illustrates the manner in which vendors' and users' perceptions may affect the diffusion process, focusing on the compatibility of IP-telephony and the complexity of tasks involved. By analysing the qualitative and quantitative data collected we found perception gaps between vendors and end-users that we believe have important implications for practitioners.

More specifically we recognised that task complexity and quality of service seem to be the main concerns for vendors. Existing difficulties described in task and technology compatibility sections develop an interesting interplay of features leading vendors to shift their offerings from basic telephone call services to more advanced ones, such as video telephony. After collecting and analysing the data we realised that by taking the vendors' approach we could draw conclusions about IP-telephony adoption, not as we know it at the moment (plain phone calls) but as a future technology that is mostly addressed to advanced and business users exploiting features such as video calls. In our effort to answer our research questions we came to the conclusion that the existing situation, with issues involved in technical and task complexities of IP-telephony, makes the less technically capable users less of a target as the cost to train them or provide them access to necessary software and hardware is not part of the vendors' agenda. The competition with existing fixed telephony services seems to also be a disadvantage that IP vendors want to eliminate by developing value-added services (such as video calling) that fixed telephony is not able to offer. As one of the interviewees in company B clearly described: *"We have standard IP-services such as caller ID, knocking on. Other services? Absolutely, video calling. This is something we definitely are going to make money on. However, new services are mainly seen as being directed towards the business side."*

Vendors are mainly focusing on business users' needs since they perceive them to be their main revenue source. Business users need new value-added services to integrate IP-telephony into their organisations. However, vendors admit that the majority of their users are currently residential. The rapidly developing market of residential users emphasises the need for full compatibility and lower switching costs both in terms of physical investment (e.g. equipment) and information (e.g. uncertainty on new technology and vendor). Besides, in a market with network externalities and switching costs, residential users expect lower costs in order to switch to a

new communication network, underlining the ongoing price war for maintaining a market share in the phone calls market.

Turning to switching costs revealed by end-users, most of them are not willing to pay more than 50 Euro to switch to IP-telephony. It appears that ITPs are not in line with market demand, offering adaptors at 80 Euro and 100 Euro, while ISPs are offering discounts of up to 70% if the new customer chooses a six-month subscription.[2] At this point it is worth mentioning that one interviewee explicitly raised a concerned regarding physical investment for the end-user, underlining the importance of that cost: *"In order for people to switch from PSTN, we have to do like the mobile telephony. In order to reach the broad market there can't be a 600 kr. [80 Euro] investment. It has to be something that the customer pays 1 kr [0.14 Euro] for an adaptor and signs a six-month commitment and has to have a minimum usage of some kind . . . It is not the product (adaptor) you make money on"* (interviewee in company B).

This article has chosen a wide socio-economic view to explore IP-telephony adoption and diffusion. In addition, it has also offered projections on the residential IP-telephony market by combining key players' perceptions from supply and demand sides. To achieve this we extended a well-known IT diffusion framework addressing issues of compatibility and complexity. We argue that this framework can be enhanced further. More specifically, we believe that a number of economic characteristics, such as network effects and switching costs, are useful elements in a framework trying to analyse IT adoption and diffusion. For example, alleviating or decreasing user's switching costs to IP-telephony because of physical investment, and offering compatibility with existing network technologies, may be vital for mass adoption, which in turn will increase network effects.

The results presented in this article are from a relatively mature market where the users are advanced in the use of new technologies. Thus, as with most academic work, there are challenges related to their applicability in other contexts. As the focus of the research presented in this article has been on understanding the interplay of compatibility and complexity in IP-telephony diffusion, the insights generated can prove valuable for other markets in the Western world. Thus, while the market readiness may vary, the influential place of compatibility and switching costs in IP-telephony adoption and diffusion remains critical.

The results of this research are not strictly related to IP-telephony. We see IP-telephony as an example of a technology that can be successfully diffused or not, but what is more important is to understand that the emergence of new technologies is part of a wider phenomenon of constant change. In this article we advocate that getting a better understanding of more than one viewpoint gives us a clearer idea of how the technology could be played out in the future. We believe that information systems research can gain from such an approach and move on from isolated views on technology diffusion and adoption. Further research in this domain could also explore different national or cultural settings that may affect the IP-telephony diffusion process. Research on new technologies adopted at a macro (national and international) level is not abundant. This article is an effort at furthering research in this domain, illustrating the potential benefits of expanding our theoretical repertoire.

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