Mobile end-user service adoption studies: A selective review

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Abstract

Even though technological, business strategic and behavioral requirements should be met to obtain widespread adoption of the end-user 3G services, the behavioral demand-side adoption requirements are focused upon in this paper. To understand the adoption requirements of end-users, analyses of their context-specific and role-specific behavior when adopting such services should be conducted. Much research has already been conducted on end-users' adoption of traditional mobile networks services, such as voice and messaging services. In this paper, we provide frameworks for categorizing this research and present representative research on adoption behavior. Using the frameworks, we also identify research questions and areas of research that have been given little attention in existing research, but may be of particular importance to understanding the adoption of 3G services.

1. Introduction

End-user services in third generation mobile telephony (3G) networks are being developed using more complex service models than those of previous wireless networks. Examples of such services are channel integrating, network mediating and mobile commerce end-user services. To obtain widespread adoption of these services, a set of requirements should be met. These requirements are technological, business strategic and behavioral (Frambach, 1993, Pedersen, 2001a). First, complex services require an integration of network technologies, network, content and supplementary services.

Second, adoption on the demand side requires widespread adoption of technology-and service platforms among application developers and service providers. Finally, end-users implicitly specify a set of demand-side requirements that the services should meet. These requirements are behavioral, and will vary according to end-users, contexts and roles. To understand these requirements, analyses of the context specific behavior of end-users should be conducted. These *behavioral, demand-side adoption requirements* are the focus of this paper.

Social scientists, industry researchers and mobile informatics researchers have studied the adoption of simple mobile network services like voice and messaging for the past decade. Much of this research is highly relevant to understanding the adoption of more complex end-user services, and some of it may be less relevant. Because researchers of such diverse areas have been involved in this research, it is hard to find any reviews covering the whole research area. Nor are there any reviews of end-user services in 3G networks that try to develop conclusions based upon present research on behavioral theories and models of adoption.

This paper intends to categorize research conducted in industry, sociology, marketing and mobile informatics on end-users' behavior when adopting and using mobile services. The review is selective in that it highlights research we feel are most important in providing conclusions that are also relevant to understanding the adoption of end-user services in 3G networks. The review is organized in four parts. We first focus what has been the *object of study* in these contributions. While some studies have focused mobile phones as terminals, others have focused end-user services or end-users. The studies of end-user services also vary with respect to the complexity of the services being studied. Second, we provide some ways to characterize the *perspectives* applied when studying adoption of mobile end-user services. We have identified three "schools of thought" and suggest categorizing studies within these schools of thought in a typology with two dimensions, namely the level and purpose of study. Third, we present several ways in which the *contexts* of end-users and service usage have been categorized in mobile service research. The purpose of most context categorizations is to contrast the adoption and usage patterns

between different contexts of use. However, recent research has shown more interest in users' multiple contexts and roles when adopting mobile end-user services than in contrasting given contexts. Finally, we present some of the *methodological* approaches used when studying the adoption of mobile end-user services. Within each category, we present illustrative examples of research that are relevant for understanding the adoption of both existing and new mobile end-user services. We conclude the review with identifying perspectives, contexts and methodologies that we find underrepresented in the research identified, and that we feel may successfully be applied to increase our understanding of the adoption of future mobile end-user services.

2. Objects of study

As noted in the introduction, the objects of study in research on the adoption of mobile end-user services may be the terminals, the services or the users. We have identified research combining the study of more than one of these objects, but even in these studies, particular attention is given to the terminals, services or users.

We find that there are at least two types of *terminal* oriented studies. One is those that focus on design elements (e.g. Chuang et al., 2001). These studies are often proprietary studies commissioned by various industry or marketing research groups that are used to guide the physical design of terminals. Another category of terminal-oriented studies focuses the terminal as an object of expression (e.g. Skog, 2000). In this category of research, the value of the object of expression is context dependent. We elaborate somewhat more on this kind of studies in Section 4. Common to both categories of study, however, is a lack of interest in the services the terminal is used to access. Despite their lack of service orientation, these studies are still relevant to understanding the adoption and use of 3G end-user services. There is no reason to believe that the importance of terminal design and terminals as objects of expression will be less among 3G users than among current 2G users, at least when it comes to the early adopters of these services.

Service-oriented studies are most often usability studies focusing on the interface between service and user (e.g. Kim, 2001). These studies are applied in prototype

development projects in mobile informatics and in evaluation studies to improve the usability of present services, either those that are resident in the terminal itself or those that can be downloaded from the network. Service-oriented studies may also be categorized according to the underlying service being studied. Most studies are of users accessing simple network services like voice and messaging services (e.g. Eldridge and Ginter, 2001). Correspondingly few studies focus the kind of complex and integrating services that will be typical of 3G services like e.g. mobile commerce services (see Pedersen et al., 2001). That said, the complexity of 3G services primarily represents a challenge to obtaining widespread adoption among service providers on the supply side. On the demand side, this complexity should to a large extent be "hidden" to end users perceiving end-user services as seamlessly integrated services. Thus, behavioral studies of simple network services are also relevant to understand the adoption requirements of future 3G services among end-users.

Finally, the object of study may be the *user* of a mobile terminal and service. Green et al. (2001) describe the studies focusing the users of mobile services in four categories: Social science based studies that treat the user as a social entity or a social actor and industry studies that treat the user as an economic entity or an economic actor. When treating the users as *social entities*, large groups of users are characterized by their usage patterns or by demographic characteristics (e.g. Bakalis et al., 1997). When treating the user as a *social actor*, the individual users are in focus and treated as "*social actors who develop interaction and communication strategies for actively negotiating and managing their numerous identities and relationships through telecommunications*" (Green et al., 2001 p. 150). Industry studies may also be categorized by treating the users as entities or actors, but in this case they are often treated as economic entities or actors. When treating users as *economic entities*, user (or perhaps more accurately customer) segments are identified and analyzed on the basis of their relative economic status and value (e.g. UMTS-forum, 2000, 2001). When treating users as *economic actors,* individual users are identified and monitored on the basis of their rational economic choices. Because industry studies often are proprietary research, few studies of users as economic entities and actors are found in journals and conference proceedings. These studies also have the

disadvantage of not being exposed to the peer review process and thus the integrity of the methods may be open to question. Still, these studies represent an important basis for decisions made by industry players when designing their services, segmenting their users and defining their current and future business models (e.g. Müller-Versee, 1999, Davidson et al., 1999, Müller-Versee et al., 2001).

3. Perspectives

Because mobile end-user adoption is studied by researchers of different traditions, a simple way to categorize perspectives may be by research area or tradition. However, our review indicates that researchers often use the methodology of one tradition when applying the theoretical perspectives of another (see Dahlbom and Ljungberg, 1999). Instead, different "schools of thought" may be identified. In these schools of thoughts researchers of different areas agree on a *set* of relevant theories, methodologies, levels and purposes of research. Not surprisingly, these three schools of thought correspond to the three traditional schools found in studies of the adoption and use of technology in general: The diffusion, adoption and domestication schools of thought.

Diffusion researchers typically describe the aggregate adoption process a posteriori as an S-shaped function of time that may be used to categorize adopters of different kinds (see Mahajan, Muller and Bass, 1990). Rogers (1995) tries to explain the observed adoption behavior using characteristics of the technology being introduced. He also describes the diffusion process as consisting of four elements; an innovation or new technology, a social system, the communication channels of the social system, and time. Of these elements, Rogers (1995) focus on the innovation, the social system and the communication channels when explaining the observed adoption behavior. *Adoption* researchers typically describe and explain the adoption decision of individual end-users applying different individual and social theories of decision making, but three models stand out as the most widely applied - the technology acceptance model (TAM) originally proposed by Davis (1989), the theory of reasoned action (TRA) originally proposed by Fishbein and Ajzen (1975), and the extension of TRA into a theory of planned behavior (TPB) originally proposed by Ajzen (1985). Several hundred studies may be found

applying one of these three theories to explain end-users' adoption and acceptance of different kinds of ICT-systems and applications (see Venkatesh and Davis, 2000). *Domestication* research has a long tradition of studying the adoption and use of technology in everyday life (see Silverstone and Hirsch, 1992). Examples of technologies studied are fixed telephony (see Fisher, 1988), television (Silverstone and Haddon, 1996a) and personal computers (Silverstone and Haddon, 1996b). The perspective is dominated by sociologist researchers and consequently, descriptive studies often characterize the adoption and use of technologies by demographic variables such as sex, age and gender. However, the main focus of domestication research is on the societal consequences of the domestication of technology; that is the process in which the use of technology becomes integrated into our everyday life.

The three schools of thought may be characterized by their applied level of analysis and purpose of study. The simplest way to categorize the level of analysis is to distinguish between *macro-level* studies of aggregate groups and *micro-level* studies of individual end-users. We suggest categorizing studies based upon their purpose in three categories, i.e. descriptive studies, explanatory studies and studies of consequences. Descriptive adoption studies try to *describe* and characterize the adoption and usage patterns of end users. Thus, these studies focus on the observed behavior of end-users. Other studies, however, go beyond pure description, and provide *explanations* of why a certain adoption behavior is observed. Thus, these studies focus on identifying the antecedents and determinants of the observed behavior. Finally, some studies take certain usage patterns for given, and are more interested in predicting what *consequences* this behavior may have in society. Combining these two categorizations, we suggest a typology of studies. The typology is shown in figure 1 with the applied level and purpose of study identified in the three schools of thought identified.

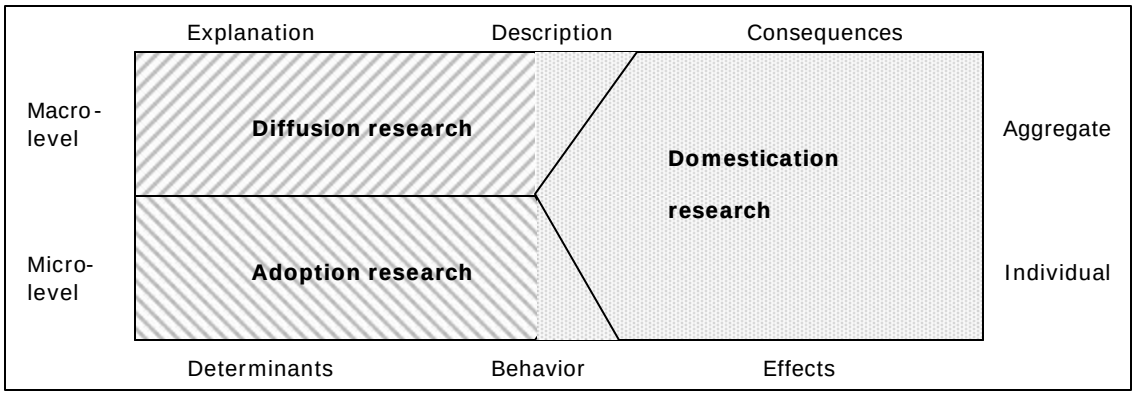

Figure 1. A typology of perspectives in end-user service adoption studies

Even though the domestication perspective dominates in studies of mobile end-user service adoption and use (see Ling, 2001c), relevant studies are now also found in diffusion and adoption research. *Diffusion studies* of mobile end-user services focus on describing adoption processes at the aggregate level. Typically, these studies classify adopters as belonging to different categories (segments), such as early adopters, early majority, late majority, laggards and non-adopters. For example, Tjøstheim and Boge (2001) studied the demographic characteristics of early adopters of mobile commerce when compared to non-adopters, while Mante-Meijer and Haddon (2001) did the same for general mobile services like voice and messaging. Both of these studies also did comparative analysis of the diffusion of Internet and mobile services, illustrating the opportunities for and limitations in generalizing diffusion research on one kind of technology to another. Diffusion research also explains the aggregate adoption process by the characteristics of the technology or by the characteristics of the channels used to communicate information about the technology. For example, Mahler and Rogers (2000) suggest that the difference in the adoption processes of mobile and fixed telephony may be explained by differences in network effects (externalities) between the two technologies. Both these types of comparative and explanatory diffusion research may also be highly relevant when trying to generalize diffusion models from simple mobile end-user services to 3G services.

Adoption studies of mobile end-user services focus on describing and explaining adoption processes at the individual adopter level. Some descriptive studies focus on the decision

to adopt mobile services only (see Green et al., 2001), while other studies also investigate the attitudes towards using mobile services as use is habituated (see Palen et al., 2001). Explanatory studies apply individual level adoption models. While a large number of explanatory studies may be found on traditional ICT-adoption, we have only been able to identify a few explanatory mobile end-user services adoption studies. One example is an adoption study of mobile telephony applying Davis' (1989) TAM-model (Kwon and Chidambaram, 2000) and some studies applying the TAM-model to study the adoption of telemedicine (e.g. Hu, et al., 1999). Even though these studies suggest extensions of the TAM-model are necessary to explain the adoption of mobile ICT, the simple TAM-model also proved promising. For example, the Hu et al. (1999) study showed that the TAM-model explained 44 percent of the variance in intention to use a telemedicine application among physicians. In a study of early adopters, a modified version of the decomposed theory of planned behavior explained 49 percent of the early adopters' intention to use mobile commerce services (Pedersen, 2001b). In a situation of 3G services with increasing complexity and similarity to other ICT-applications adopted for functional reasons, these studies indicate a potential for adoption research when studying mobile end-user services.

Domestication studies of mobile end-user service adoption focus on studying service use and the consequences of use. However, domestication studies are not limited to studies of individuals or aggregates, but are found describing both the adoption and usage patterns of groups in society (e.g. Townsend, 2000) as well as individual end-users (e.g. Ling, 1997). As indicated above, domestication research also investigates the societal consequences of adoption and use, both at the aggregate and individual level. For example, Townsend (2000) analyze the consequences of mobile telephony on the planning of cities, while Fortunati (1998) analyze the consequences for the family as an institutions and for individuals using the mobile telephone as a way of expressing their individuality. All these are examples of findings that are likely also to be important for understanding the consequences of new mobile end-user services, such as network mediating services contributing further to the mobile terminal as an instrument in increasing accessibility, flexibility and individuality. Studying consequences is also

relevant because they can be reinterpreted as reasons for adopting mobile services. For example, increasing individuality is both a determinant and a consequence of using mobile end-user services for social network management (Palen et al., 2001).

The typology presented in figure 1 may be used to classify and characterize most of the studies we have identified of mobile end-user service adoption, but different studies within the same category also give different explanations of the adoption behavior, focus on different issues of user behavior, and predict consequences of service adoption in ways that are not easily categorized by perspective, level of analysis and purpose of study only. Thus, finer grained categorization of research may be useful, for example to identify different and competing explanations of micro level adoption behavior.

4. Contexts

One way to provide a finer grained categorization of research on mobile end-user service adoption is to investigate the end-user contexts introduced when applying a specific perspective, theory or approach. When trying to categorize these end-user contexts, we observed a particular interest among researchers in contrasting different contexts. We term such contrasts "context distinctions". Context distinctions may de designed on an ad hoc basis, such as in the distinction between using a service indoors versus outdoors, or while being mobile or stationary (e.g. Kim, 2001). Alternatively, the context distinction may be more conceptual. Typically, conceptual context distinctions are the results of a long tradition of research in a particular research area. They are often applied to new phenomena, such as the adoption of mobile end-user services, using existing models and theories. We have identified five conceptual context distinctions in mobile end-user service adoption studies. The first distinction is between different *modalities of mobility* representing different contexts. The second distinction is the traditional distinction between *work and leisure* contexts. The third distinction becomes apparent when demographic variables are used as proxies for context variables to identify a contextual contrast between end-users belonging and not belonging to a specific *demographic group*. The fourth context distinction is the distinction between the *private and the public*. The final distinction is *dynamic* and based on the recent observation that end-

users seem to participate in different contexts maintaining different roles and identities. In this perspective it is the *dynamics* of context, role and identity management that is of interest.

One way to categorize modalities of mobility has been identified by researchers in mobile informatics (e.g. Dahlbom and Ljunggren, 1999). They categorize mobile contexts by three modalities; traveling, visiting and wandering, and have used these modalities as bases for designing applications for mobile work (e.g. Kristoffersen and Ljungberg, 1999). Haddon (2000) has also suggested modalities of mobility as a useful way to categorize contexts of mobile end-user service use. He suggests five different contexts termed preparing mobility, potential mobility, immobility, actual mobility and hypermobility.

A much more widely applied conceptual context categorization is the distinction between work and leisure contexts. Much of the research studying the work/leisure distinction focuses on *functional* issues of mobile end-user service adoption. In a way, the functional consequences of bringing mobile end-user services from the workspace into the leisure context are frequently in focus. In the work context, research on telework is often distinguished from mobile work (see Kurland and Bailey, 1999). Research in mobile work can be categorized in several different ways, for example based on the type of mobile workers being studied. While much previous research in this area has been conducted on the adoption of services among knowledge workers (e.g. O'Hara et al., 2001), recent work has also focused "blue collar" workers (e.g. Brodie and Perrie, 2001). Even though much of this research is interesting because it focuses on functional reasons for adoption, little of it is directed specifically at the adoption decision of end-users. Instead, most of the research on mobile work is usability studies applied to design user interfaces and to develop work-related support applications. This sharply contrasts research on technology acceptance in adoption research which focuses specifically on modeling the adoption decision of end-users in work-related contexts.

Research focusing the leisure context has either focused directly on the functional use of mobile services in leisure and everyday contexts, or focused on how the boundary between work and leisure contexts is blurred by the use of such services. An example of the kind of research conducted on functional issues of mobile end-user services when applied in leisure and everyday contexts is the study by Palen et al. (2001) on the change in communication behavior of 19 new users after their acquisition of a mobile phone. The interesting thing with this article is that Palen et al have found that the domestication process goes quickly. That is, the new users seem to adopt the ideology of being a user rather quickly. They change their attitude toward the disturbing influence of the device and they are quick to find ways that the device fits into their daily lives. Examples of research on the blurring of boundaries between work and leisure life caused by adoption of mobile end-user services are studies of homework (e.g. Yttri, 1999) and studies of quality of life issues (e.g. Akselsen, 2001). These look at the integration of technology into the family. Among other things, this work examines how some members of the family enjoy increased quality of life while others experience the opposite. Both in work and leisure contexts, the adoption of mobile services is affected by and affects the social networks of the adopters. This is especially true of services adopted for functional reasons that are also expected to affect the social interactions of adopters across work related and leisure-related social networks.

The third context categorization is based upon using *demographic variables* as proxies for identifying a distinction between end-user contexts. Of these variables, gender and age have been most widely applied. While *gender* as such is not necessarily relevant as a variable explaining differences in service use, the context differences attributed to gender differences are of relevance. For example, social networks of men and women, their roles in social networks and the boundary between work and family life may all be different. When contrasting the contexts of diverse demographic groups, the "*introduction of mobile phones into existing situations illuminates various aspects of the context*" (Ling, 2001a, p. 134). Several studies focus on gender differences in mobile end-user service adoption. An early study of in this tradition was conducted by Rakow and Navarro (1993). Their work described interesting communication patterns, such as e.g. "remote

mothering" among women. Rakow and Navarow asserted that, at an early point in the diffusion of the device, the mobile telephone was a device that replicated preexisting gender patterns, i.e. the role of the woman as an accessible nurturer and a person in need of male protection. Later, several studies have elaborated on gender differences in the adoption of both voice and other mobile end-user services (e.g. Ling, 2001a, Ling, 2001d). The focus here is on the way in which the mobile telephone was earlier seen as a technical gizmo and thus a part of the male domain. As the adoption process has continued, and indeed teen girls adopt mobile telephones in significantly higher numbers than their same-aged male counterparts, the device has been redefined as a social network device and thus within the domain of women.

Age has been the most widely applied demographic variable characterizing differences in adoption of mobile end-user services. Of these studies, the differences in adoption patterns between *young people* (teens, adolescents) and other users have been the most common focus. While some studies have been preoccupied with *describing* differences in adoption behaviors (e.g. Heinzmann et al., 1998, Karlsen et al., 2001, Eldridge and Ginter, 2001), others have suggested theoretical *explanations* of the observed differences in adoption behaviors.

The most important findings of the descriptive studies are that from age 20, adoption is a linearly decreasing function of age consistently all over Europe (Mante-Meijer and Haddon, 2001). However, when compared to Internet adoption, the older people have a much higher adoption rate of mobile phones than of Internet. Still, their use of services is very simple, focusing almost exclusively on voice. The teenage segment has been described in several studies, both qualitative and quantitative. Among the most penetrating studies are a set of qualitative studies done by Rautiainen and Oksman on Finnish adolescents (e.g. Oksman and Rautiainen, 2001), by Weilenmann on Swedish teenagers (e.g. Weilenmann and Larsson, 2000) and by Ling and others on Norwegian teenagers (e.g. Ling, 2001d, Ling and Yttri, 2001, Johnsen, 2000). A main conclusion that can be drawn from these studies is that service adoption and usage varies in segments of teenagers in a way that treating the teenager group as a homogeneous segment is not

advisable. A summary of qualitative observations is found in Plant (2001). In quantitative studies, mobile phones are shown to have an adoption rate of close to 100 percent in teenage segments. Service usage is concentrated on text and voice usage, with a slightly higher text service usage among female that male users (Ling, 2001c). Thus, the use of mobile services is very well integrated in the daily lives of teenagers. However, the impression that services are adopted for non-functional and social status reasons only (e.g. Skog, 2000), is contradicted by many of the descriptive studies. For example, Karlsen et al. (2001) found a remarkable orientation towards usability and costs in their study of the potential adoption of new end-user services among Norwegian teenagers.

Among the explanatory studies of the adoption and use of mobile services among teenagers, a variety of explanations is found. Among these explanations are the suggestion that the adoption behavior can be illuminated by a "theory of fashion" (e.g. Ling, 2001b) wherein the popular characterization of the device seems to have changed with time, by the use of services as "ritual gift giving" (e.g. Taylor and Harper, 2001a, Johnsen, 2000), by treating the mobile phone as "symbolic capital" (e.g. Skog, 2000) or as an instrument in "family differentiation and symbol of individuality" (e.g. Taylor and Harper, 2001b), and the use of services as a "group marker or social identifier" (e.g. Weilenmann and Larsson, 2000, Larsson, 2000) or as a "self identifier" (e.g. Alexander, 2000, Hume and Peters, 2001). Currently, these explanations should all be treated as tentative because none of then has undergone formal hypothesis development and confirmatory testing. Instead, they are typically supported using ethnographic studies and documented using "citation techniques" from observation logs, diaries and qualitative interviews. Still, they suggest important explanations that eventually will have to be integrated as parts of a more formal theory of adoption. For example, the importance of interpersonal and media influence inspired by a "theory of fashion" should be a part of such a theory. Similarly, the relationship between social reasons for use and social reasons for adoption should somehow be integrated. For example, late adopters may be affected in their adoption process by the observations they make of use among adopters who has "objectificated" the device (Taylor and Harper, 2001a, Ling, 2001c) or of those who have reached the stage of conversion, making the device and their service usage

parts of their own identity (Ling, 2001c). These mechanisms will have to be integrated into a theory of adoption applied to 3G service adoption, but it is also necessary that this theory includes mechanisms in which services are adopted for functional reasons as well.

The fourth categorization of contexts focuses on the consequences of mobile end-user service adoption rather than trying to explain it. The distinction between *private and public contexts* is investigated applying two perspectives. For some time researchers have studied - and expressed opinions on - how society is affected by bringing the public into the private sphere. This question was first raised by researchers studying the domestication of fixed telephony (see Fisher, 1988). However, researchers studying the adoption of mobile end-user services now investigate the opposite perspective. The question is how society is affected by the fact that an instrument for managing personal relations and networks - the mobile phone - can be used ubiquitously. Answers to this question may be given both at the micro level by studying individuals' use of mobile services in public places such as restaurants (e.g. Ling, 1997), or at the macro level by studying more fundamental changes in society. For example, Fortunati (1998, 2001) has investigated how the use of the mobile phone increases individuality, reduces the importance of the family institution, and has "*stolen communicative space from the public sphere and attributed it to the private*" (Fortunati, 1998, p.2). As mentioned above, Townsend (2000) has studied how mobile phones emphasize real time planning and "microcoordination" (see Ling and Yttri, 2001, Ling and Haddon 2001). These, in turn may change city planning and the everyday life in cities. All these studies focus the blurring of the boundaries between private and public spaces. Even though these studies are important to understand the consequences of widespread adoption of mobile services, their contribution to an understanding of the adoption decisions made by individual users is somewhat limited.

The observed blurring of the private and the public, and of work and leisure contexts, indicate that mobile telephone use together with other recent advances in information and communication technologies (ICT) changes society from a "door-to-door", via a "person-to-person", to a "role-to-role" society (see Wellman, 1999, 2001). The most recent trend

in research on mobile end-user service adoption treats *contexts as dynamic* and end-users as *"negotiating and managing their numerous identities and relationships"* using such services (Green et al., 2001). This means that end-users manage different roles in different contexts and social networks, and that network members, and their identities and roles, may differ across contexts. Managing these identities, roles and network memberships may require mediating communication services, such as mobile end-user services. Consequently, to understand the adoption behavior of end-users, a multitude of end-user contexts should be studied applying context-dependent models. Next, the results of these studies should be integrated in some form of triangulation framework (e.g. Pedersen et al., 2001).

5. Methodologies

Because researchers from many different traditions and areas of research have been involved in behavioral end-user adoption studies, a multitude of methodologies have been applied in these studies. Studies in mobile informatics and anthropological studies of user behavior both apply *ethnographic* methodologies, but with very different foci. While mobile informatics studies apply the methodology for prototype development and initial usability studies (e.g. Dahlbom and Ljungberg, 1999), anthropological studies have focused on societal consequences of adoption (e.g. Blinkhoff and Blinkhoff, 2000). Both qualitative and quantitative social science methodologies have been applied, but a far greater number of studies applying qualitative methodologies are found. For example, *scenario analysis* has been applied to identify opportunities for development and study future consequences of adoption (e.g. Dörsch and Fiebig, 2001). *Focus group interviews* have been used to investigate and refine initial propositions on adoption behavior and its consequences (e.g. Ling, 2001b). Recently, *diary and log-based methodologies* have also been applied in adoption studies, often combined with different interviews techniques (e.g. Palen and Salzman, 2001). Finally, traditional *observational methods* have also been applied and combined with other methodologies (e.g. Larsson, 2000). Quantitative methodologies have also been applied, for example using traditional *survey methodology* (e.g. Marcussen, 2001), but the number of studies applying this methodology to study the adoption of complex end-user services is limited by the slow introduction and adoption of

these services. For the same reason, few studies applying systematic *experimental or quasiexperimental methodologies* are found. However, with a more confirmatory approach to research and more widespread adoption of services, the number of studies applying experimental designs is likely to increase in the near future (see e.g. Cattell, 2001).

6. Conclusions

We have suggested different ways of categorizing research on mobile end-user service adoption. In each category, we have presented examples of research we find relevant for understanding the behavioral adoption requirements of 3G services. Even though many relevant studies have been identified, the categorizations also illustrate how numerous studies are found within one category, while lacking in another. An overrepresentation of certain perspectives, context distinctions and methodologies has been identified. One example is the numerous studies of mobile phones and simple services as objects, but very few studies of the kind of complex end-user services likely to be introduced in 3G networks. Another example is the numerous descriptive studies on adoption behavior and studies of consequences, but few studies focusing directly on the explanations of adoption behavior. A third example is the numerous studies of the adoption behavior of somewhat marginal demographic groups, but few studies of the adoption behavior of larger, less sophisticated user groups. A fourth example is the numerous studies applying exploratory methodologies, but few studies using a confirmatory approach and methodology.

The focus on simple services may be logical because, aside from some quasi-advanced services such as iMode, SMS and, in some cases PIM functions, there is actually very little use of mobile services beyond standard voice telephony. This awaits the development of various types of interactivity and context sensitivity and perhaps devices such as mobile web pads. In the mean time, empirical research perhaps necessarily focuses on the types of services that have certain dispersion in society. Two considerations may be taken into account when trying to understand the overrepresentation of descriptive studies. First, the technology is still quite immature and

thus the broad social consequences are only starting to emerge. Some issues such as the facilitation of coordination, impact on the emancipation process, new forms of safety and security and finally the disturbing influence of the device, are all potential issues. However, one feels that they are in the midst of the torrent at the moment and there is little chance in order to gain a perspective on the phenomena. This said, there is also little time to be lost. In some countries the adoption and embedding of the technology is taking place right before our eyes. Thus, it may not now be the time just to derive and explore theories but to be in the midst of the action. The overrepresentation of exploratory methodologies may also be logical. Survey analyses increase the generalizability of results, but their potential for prediction may be limited to analyses based on regression and correlation. Panel studies, such as the IST e-Living project, address some of the issues of "single shot" studies but do not fulfill the full requirements of an experimental method, i.e. random sample of a general population, random assignment to experimental and control groups, pre and post testing and the use of experimental stimuli. When looking at mobile services in this context, experimental methodology requires careful framing of the research questions, and these studies tend to be expensive and require time to carry out. Neither of these latter requirements are common resources in the mobile services industry of today.

Even though the overrepresentation of some kinds of studies identified in this review may be logical, it is still somewhat worrying. From the perspective of researchers and industry players trying to use present studies of mobile end-user service adoption to understand and predict the adoption behavior of large consumer groups when introduced to the complex end-user services of 3G networks, the lack of explanatory consensus and the bias in perspectives and categories of research may be somewhat worrying. For example, the lack of explanatory consensus makes it difficult for applied researchers and industry players to get a general understanding of end-users' adoption behavior when introducing new mobile services. In addition, the bias in perspectives and categories of research also makes it difficult to generalize conclusions from studies of simple services, and in particular studies of mobile phones as objects of expression, to the adoption of complex end-user services that are likely to be adopted for functional reasons. It is also difficult

for industry players to use these results to design the content and interface of end-user services, and to assist in choosing the right business models for the distribution and marketing of these services. For example, Taylor and Harper (2001b) have suggested many design implications based upon the study of young people's adoption behavior that certainly will not generalize to all end-users. It is also somewhat surprising that many of the traditional models applied to understand the adoption of traditional ICT have not been applied in adoption studies of mobile end-user services. As mentioned above, we were able to find only one study of the adoption of mobile phones using one of the most widely applied models in studies of traditional ICT adoption - Davis' (1989) TAM-model (Kwon and Chidambaram, 2000). This said, the tradition of "domestication" outlined by Silverstone and the group around him has been relatively widely adopted (Silverstone 1996; Silverstone and Haddon 1996), indicating a difference in "schools of thought" between mobile and traditional ICT adoption studies.

For researchers and industry players trying to understand the potential adoption of mobile commerce services, the bias in studied contexts is also somewhat worrying. For example, almost no publicly available studies are available in which one applies a consumer behavior perspective to study the end-user, or to study the end-user in a consumer context (for an exception, see Gerpott et al., 2001). This type of study is most considered proprietary for industry actors. We fully accept the fact that many of these end-user services are new and that exploratory research is required. We also fully accept that marginal phenomena often represent important research challenges, but we suggest these interesting research opportunities should not be misinterpreted as interesting financial opportunities of the mobile end-user service industry. Our opinion is that the widespread adoption of simple services now makes it more relevant to apply confirmatory research to understand and explain the adoption process of end-users, and not only study its potential consequences in marginal demographic end-user groups. With such a change in perspective follows the need for more formal theory development, more exact formulation of propositions and hypotheses, and more experimental and quasi-experimental methodologies.

There are some signs of a reorientation in more recent research on mobile end-user service adoption. For example, we now find examples of broader analyses of mobile services among general populations (e.g. Mante-Meier and Haddon, 2001). In this analysis a broad sample of users and non-users across Europe is studied. One motivation behind the study is to look into the effects of mobility, social networking and time stress on the adoption and use of mobile telephony and Internet use. A general finding is that the degree to which one participates in social networks is predictive of mobile service adoption. This, of course varies according to demographic groups. A second example of a reorientation is in the suggestion that contexts should be treated as more dynamic (e.g. Green et al, 2001), and in the reintroduction of functional issues in service adoption studies (e.g. Palen et al., 2001, Karlsen et al., 2001). Still, we would like to see more studies of end-users managing multiple roles and identities across contexts using mobile services (see e.g. Ling and Haddon, 2001). We would also like to see context-specific models applied to understand the diversity of contexts in such studies, and that these models are applied to formulate explanations of behavior, not just descriptions of such. Finally, based upon our experience from this categorization study, we suggest that researchers studying mobile ICT adoption and researchers studying Internet-based ICT adoption combine their intellectual resources in a refinement of explanatory theories and models. This may give a better understanding of the importance of mobility and social issues of adoption to the traditional ICT-adoption research community as well as increase the interest among domestication researchers in formulating explanatory propositions and applying experimental methodologies. That said, this review has also shown that present research on the adoption and use of current mobile end-user services may be used to improve our understanding of the behavioral adoption requirements of end-users awaiting the introduction of 3G services.

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