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What Users Expect from Future Terminal Devices: Empirical Results from an Expert Survey

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Abstract

For the acceptance of future network-based media services the technical advancement of the man-machine interface is of great importance. The Fraunhofer Institute for Systems and Innovation Research (ISI) in Karlsruhe has conducted an expert survey on different acceptance factors, on the future development of media usage behavior, on network infrastructure and terminal devices as well as on the expected market development. Drawing on the results we point out perspectives in the light of today's user needs and the technical possibilities.

Over the last two decades progress in software engineering and hardware miniaturization have turned the computer from a large device that could only be operated by specialists into a common consumer good that can be found in almost all areas of private and business life. The IBM Personal Computer (1981) and the Apple Macintosh (1984) were important early milestones on the way to the computer as a useful product for everyone. Today it is much more than a simple calculating machine or tool. With the establishment and commercialization of computer networks since the early 1990's the computer became a new medium fulfilling information and communication needs [Friedewald 1999].

According to expert opinion online media services will lead to a substantial expansion of financial and time expenditure of private households for the use of media. Network-bound media offerings like Internet or online services enable easy access to conventional media contents, for example newspaper articles, music titles, and video sequences at each time of day. The most important progress however is the possible integration of different types of media as well as their linkage to additional services. This includes communication with other users, the handling of transactions, e.g. electronic shopping, and even interactive television.

Supported by the German Federal Ministry for Education, Science, Research and Technology and in co-operation with a research association focussing on media education (Medienpädagogischer Forschungsverbund Südwest) the Fraunhofer Institute for Systems and Innovation Research (ISI) in Karlsruhe has conducted a survey on the expected future development of media usage behavior, on network technology and terminal devices, as well as on market development in Germany.

The survey is part of the research project “Development of Media Services“ (DeMeS) about the future media use in the private sector [Harnischfeger et al. 1999]. 281 experts have participated, 40 % of whom belonged to the German industrial sector (media industries, information and communication technology). In addition, experts were chosen from German Institutions, who either have a scientific interest in media or who are concerned with the shaping of the media sector and its social, political and economic conditions (politics, churches and unions, as well as professional organizations). The survey was conducted by mailing questionnaires. Most of the questions were closed, showing a variety of possible answers to be ticked. The experts were not asked to justify their estimates. However several questions focusing on related topics allowed a check for consistency. Furthermore comparison of estimates by experts from different professional backgrounds showed no significant difference concerning the results discussed below. In combination with the 1998 Delphi study questioning more than 2,000 experts on the global development of science and technology [Cuhls et al. 1998], this data allows a thorough view on what users require from future terminal equipment, and what technical developments can be expected.

1 Diffusion of Terminal Devices

While in the middle of the 1970 there were no more than 165,000 computers world-wide, this number grew up to 200 million devices in 1997 [Phister et al. 1983, Kelly 1997]. Today a personal computer is available in more than 40 % of the US-American and in approximately 30 % of the Western European households. It is expected that in Europe this number will increase by further 10 % up to the year 2001 [Zerdick et al. 1999, EITO 1999].

Until recently stationary PCs were the only devices for using online services. In the future a multiplicity of new devices will appear: e. g. Network PCs that receive their software via network connection, television sets with computer functions or enhanced mobile phones. Because of particular features, such as the small display of mobile phones, the mode of interaction has to be adjusted for a number of new terminal devices [Oliphant 1999]. Media services based on the Internet Protocol Suite offer new application perspectives even for those users, who in the past did not see a reason for buying a PC with its stand-alone applications. Altogether the experts expect that the share of households with terminal devices for the use of online services will rise from 9 % today to more than 40 % in 2015. The growth will be even faster with mobile devices, which at present constitute a share of less than 1 %. It is expected that in 2015 almost 17 % of the households will be using mobile equipment (Fig. 1) [Harnischfeger et al. 1999].

The crucial point for this development is the users acceptance. Before discussing the technical factors with respect to acceptance it is worth mentioning that the social environment and the user competence are central as well. More than 80 % of the experts regard vocational practice with multimedia technologies, the integration of multimedia into the educational context, a high-quality and reasonable priced customer service as well as personal non-commercial help in case of problems as important or very important for the acceptance. These findings illustrate that the formation of user competence by self-instruction or “trial and error” that is still often practiced today will not be sufficient for a broad acceptance and future diffusion in the view of the experts.

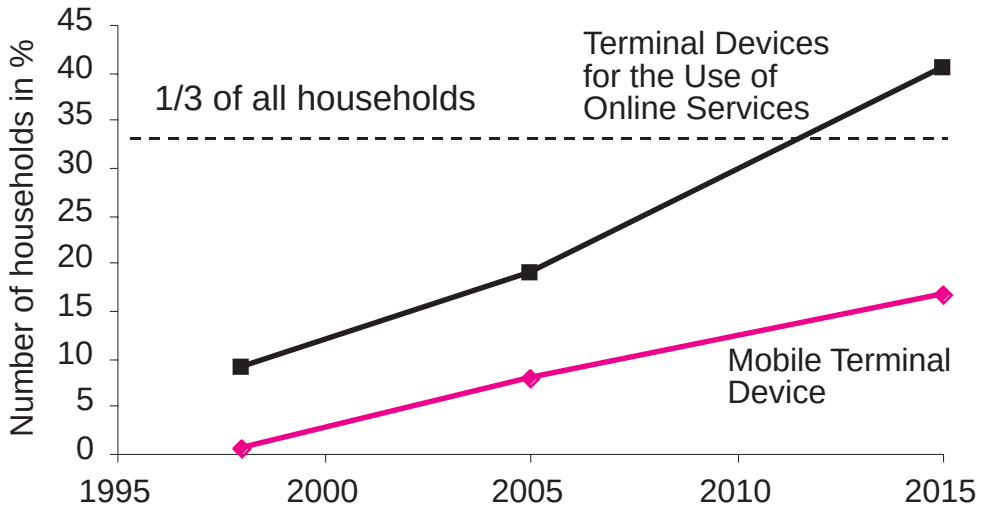

Figure 1: Expert estimate for the diffusion of terminal devices [Harnischfeger et al. 1999]

In this respect also the technical development is challenged to achieve a new quality of user friendliness.

Furthermore, the usefulness of new media services will be compared with conventional alternatives. In comparison with newspapers or television, more than 80 % of the experts named the timeliness of information, the greater flexibility in time as well as the reliability as central criteria. Attractive contents are a basic precondition, while evaluated differently depending on the user segment.

2 Technical Features and User Acceptance

Regarding the importance of hardware and software design the following picture can be drawn. Some of those aspects also concern the network infrastructure, as shown in figure 2.

Better user support is regarded as the one central requirement for the improvement of present media services. At the top of the list is the demand to reduce existing response time (99 %). With glass fiber technology and efficient transmission methods such as ATM (Asynchronous Transfer Mode) or ADSL (Asymmetric Digital Subscriber Line) this is no longer a problem. However, the connection of every household to such a high-speed network will take time, mainly due to the high supply costs for the private user.

The second most important aspect and a challenging task for software developers and designers are self-explanatory functions that reduce the time users require for training (98 %). An equally important aspect is the quick and easy software installation (98 %). This comprises sale and update of software over the Internet and the adjustment of software to individual needs.

Much importance is attributed to the application of intelligent, adaptive software (87 %) and so-called “software agents” (84 %), in order to achieve a better fit of media offerings to individual needs. The importance of large and flat displays (83 %) as well as of new generations of portable

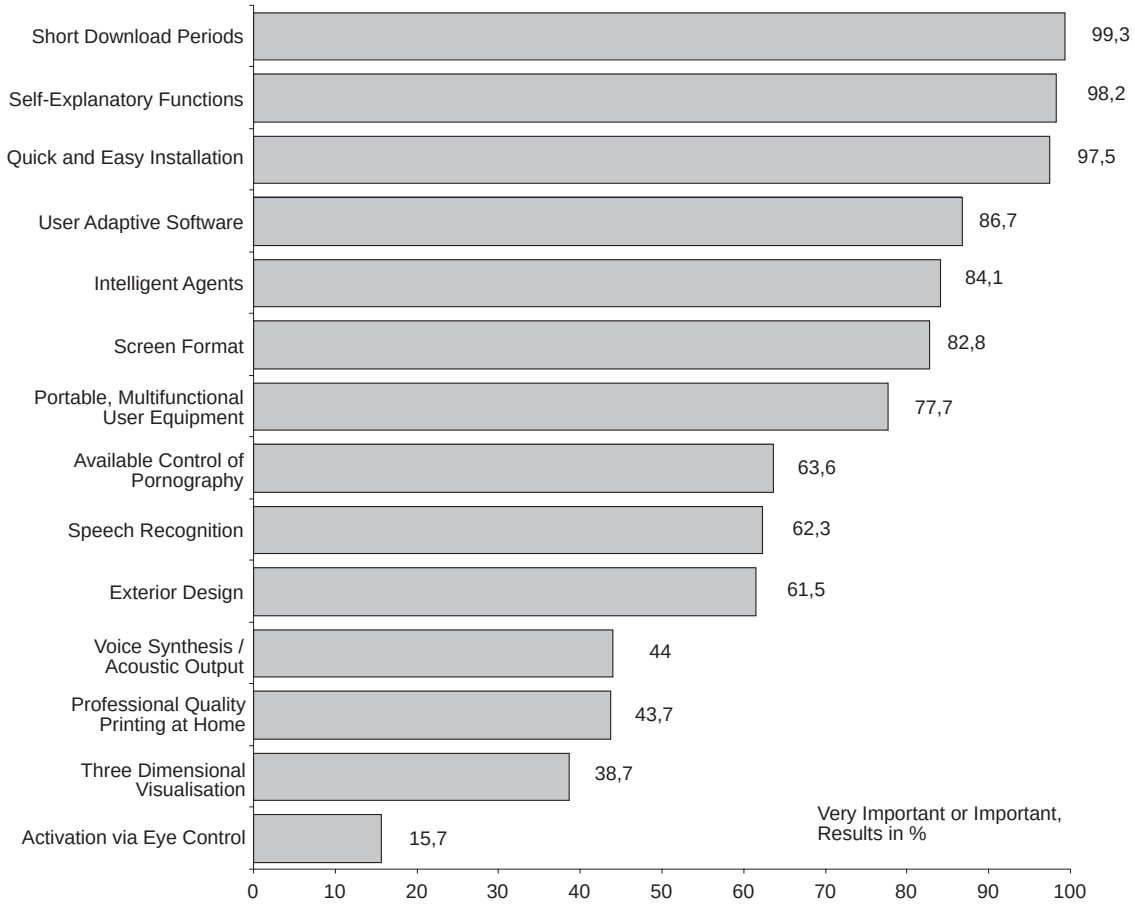

Figure 2: Importance of hardware and software design for the acceptance [Harnischfeger et al. 1999]

multi-functional devices (78 %) is also underlined by the experts. The majority of them states that acoustic output in an individually selectable language (44 %), three-dimensional visualization (39 %) or the activation and control of the PC by eye movement (16 %) are of fewer importance for the users acceptance.

It cannot be denied that the requirements for the properties of information technology will grow and become more sophisticated on the way to a knowledge society. Limitations in quantity and availability of information have been replaced by limited resources of its reception and evaluation. In addition to this quantitative aspect there is the problem of highly heterogeneous information, requiring systems that support the user in structuring information adequately. The growing requirements implies a technology that can adapt to various situations and take over tasks independently. It is not possible to meet these requirements simply by increased switching rates or further miniaturization of the computer hardware. Moreover new qualities in information processing technology is needed [Kolo et al. 1999].

3 Innovative Terminal Devices – Estimated Realization Time

For designing future terminal devices that are adaptive to individual needs, it is necessary to model the cognition of meaning and context of information at least to some extent according to human capabilities. This goal is aimed at since long by AI research with slow progress and frequent throwback. Nowadays researchers seek to complement the purely syntactical level by the semantic and the pragmatic dimension of cognitive processes, i.e. knowledge of implicit relationships and pragmatic knowledge. These aspects of human reasoning however are still poorly understood even by cognitive scientists [Winograd and Flores 1986]. This explains why experts expect breakthroughs only in the distant future (see fig. 3).[1]

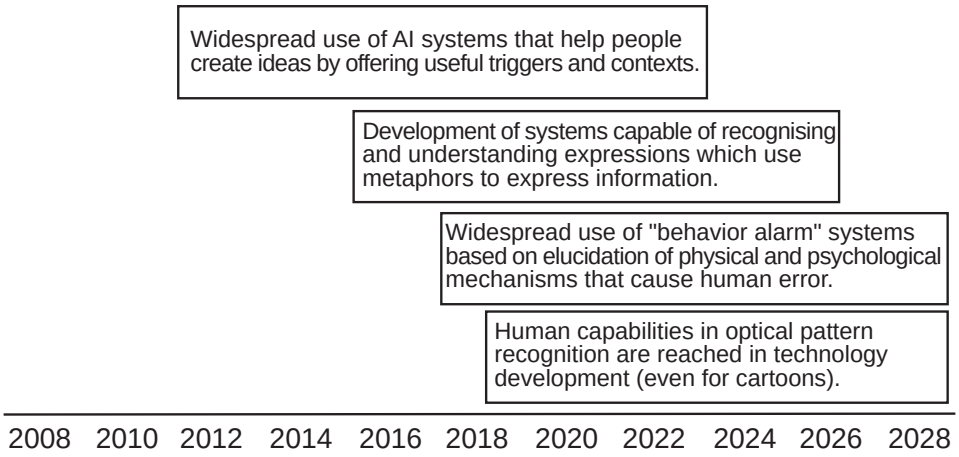

Figure 3: Expected realization timesfor intelligent applications modeling human cognitive processes [Cuhls et al. 1998]

On the other hand the expert survey underlines, that intelligent devices are of particular importance for the acceptance of online media services. Here a discrepancy between the requested features of terminal devices and reality prevails. But nevertheless terminal devices, for surfing on the net, will change on the way to the far and perhaps never reachable goal of modeling human cognitive processes. Technical innovations expected by the experts in the years ahead can be divided in three domains: I/O technology, new functionalities and the decreasing dependence on a fixed location.

3.1 Input/Output Technology

According to expert opinion I/O technology is the most advanced among these domains. Despite the long research tradition in I/O technology, so far mainly the development of two-dimensional graphic I/O was advanced. Today engineers increasingly concentrate on multi-modal man-machine interfaces enhanced through I/O procedures in natural language as well as on tackling the third dimension (fig. 4) [Myers 1998, Glinert et al. 1996].

[1] The time frames given in this and the following figures correspond to the first and the last quartile. 50 % of all expert judgements lie in this time interval.

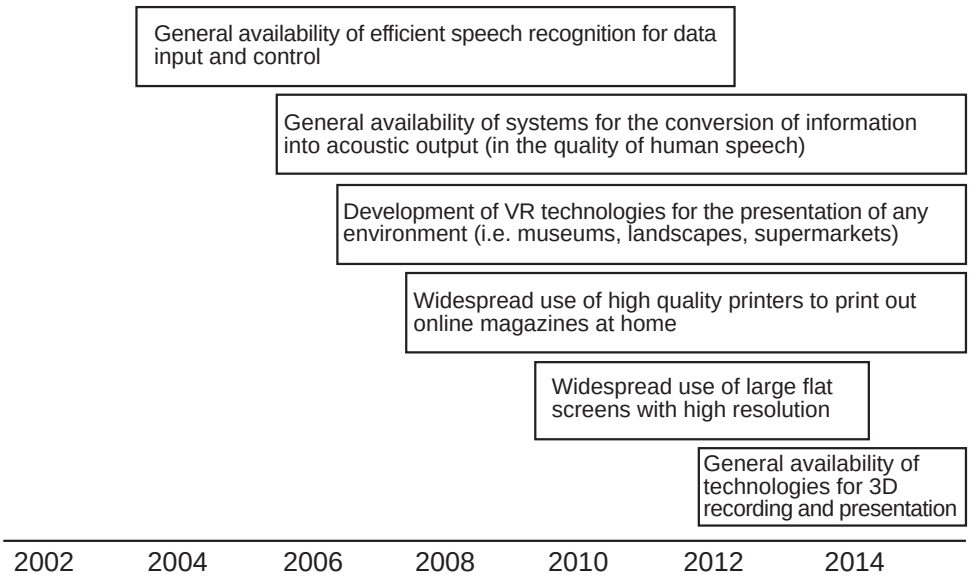

Figure 4: Expected realization time for innovative I/O technologies at the man-machine interface [Harnischfeger et al. 1999]

According to the experts powerful devices for speech recognition and speech synthesis could be widespread already in the next five to ten years. In the same period the development of VR technologies for the presentation of any environment is considered probable. General availability of technologies for 3D recording and presentation however is not expected before 2012.

3.2 New Functionalities

Even more important than I/O technologies with respect to the user acceptance are new functionalities for terminal devices that are not necessarily resident in the terminal device but could also be provided via network connection. This comprises simple installation and control as well as adaptivity to the users needs. These properties are tried at with software agents for some years now. Software agents are even considered the key technology for online services (i.e. World Wide Web) [Klusch 1999]. Software agents are a class of intelligent programs that access autonomously heterogeneous, geographically dispersed data and support the user in selecting relevant information. Such programs protocol and evaluate user activities. New or shifted interests are automatically recognized and taken into account for subsequent searches [Maes 1995]. Ideally, software agents release users from routine activities leaving more time for productive and creative work. Already 30 years ago software pioneer Douglas Engelbart had the vision that such applications could selectively augment human intellect leading to a symbiotic relationship of man and computer [Engelbart 1995].

3.3 Mobile Terminal Devices

Innovations from different fields of research will lead to an increasing diffusion of mobile terminal devices for online media services during the next 15 years (Fig. 6). The development

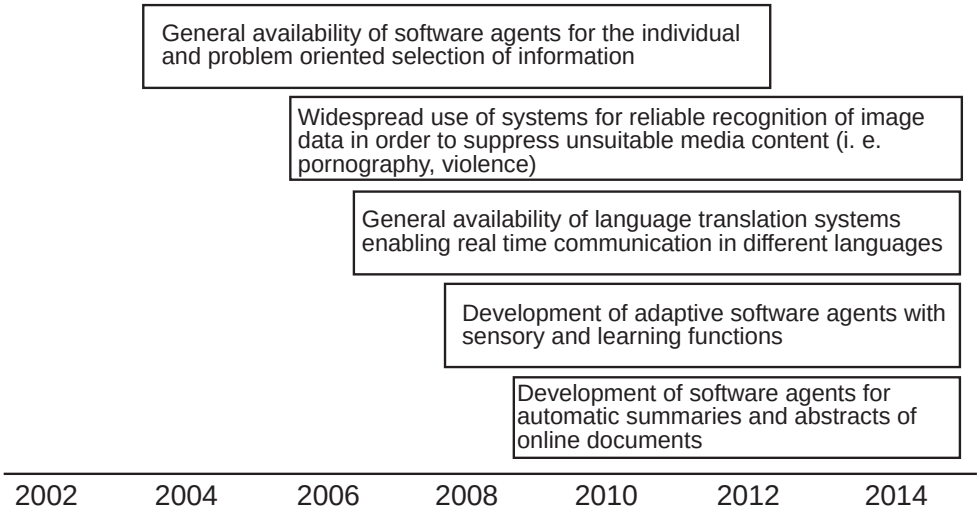

Figure 5: Expected realization time for innovative functionalities [Harnischfeger et al. 1999]

of electronic components with low power consumption and light, powerful batteries are considered important. Their use, however, will be widespread comparatively late, according to the experts. The currently developed UMTS (Universal Mobile Telecommunication-System) standard with a transmission rate of 2 Mbit/s already addresses the increasing importance of broadband wireless data communication and even higher data rates are already technically feasable [Johnston 1998, IEEE Spectrum 1999]. But mobile terminal devices with rates higher than 10 Mbit/s will not be widespread among private users before 2006.

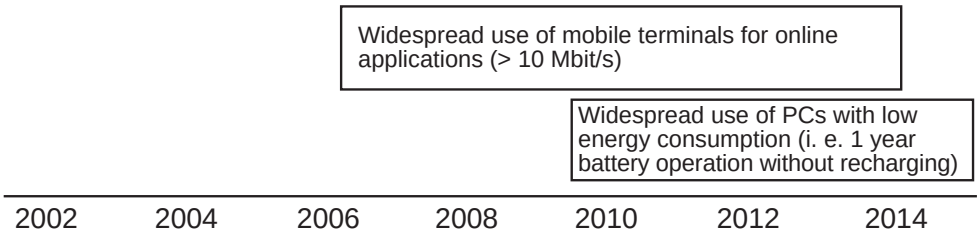

Figure 6: Expected realization time for innovations leading to enhanced mobile terminal devices [Harnischfeger et al. 1999]

4 Conclusion

In spite of the tremendous growth in the use of online services, the necessary terminal devices will change less dramatically in the coming 15 years as forecasted by some technology evangelists. The most requested features of innovative technology, in particular user adaptive devices and software agents to selectively augment human intellect will only partly be developed. Instead of new revolutionary qualities, a number of incremental improvements in transmission rates, computing power and software functions are ahead. Although these innovations will make the use of online media services more comfortable or simply more exciting, users will still have

to accept the numerous minor and major annoyances whilst working with their terminal devices. The still increasing number of online users, however, shows that many are willing to accept these circumstances. Hence, the increase is less due to more user friendly devices but rather to new or improved aspects of utility compared to traditional alternatives. Such aspects are in particular the greater flexibility in time and the timeliness of information content. A crucial factor for the broad diffusion of online media services remains the strengthening of user competencies through education and training as well as personal, non-commercial help in case of problems.

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