

The Discovery Phase of User Centred Design: Putting Users First in the Design of Smart Internet Technologies

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Abstract

The Smart Internet Cooperative Research Centre aims to produce Internet technologies that are scaleable, intelligent and user friendly. Alongside four technology programs, a key research innovation of the SITCRC is the User Environment program aimed at ensuring technology outputs are user-centred and market focused. A challenge for researchers in this program is to ensure a user focus in the discovery phase of technical research where technologies and their functionalities are as yet poorly defined. This paper reports on the development of a methodological approach called Discovery UCD that is useful for researchers attempting UCD outside purely product focused corporate environments. Abstract paragraph

Keywords

User-centred design, academic context, corporate context, discovery phase, product phase, user studies

INTRODUCTION: THE SITCRC CONTEXT OF USER-CENTRE DESIGN

Australia's Smart Internet Technology Cooperative Research Centre (SITCRC) is a collaborative research enterprise involving 11 universities and five major industry partners (www.smartinternet.com.au). It comprises four technology research programs on Natural Adaptive User Interfaces (NAUI), Smart Personal Assistants (SPA), Intelligent Environments (IE), and Smart Networks (SN) and one User Environment (UE) research program. The UE program is a key innovation of the SITCRC and is intended to ensure that the activities and outputs of the technology programs are user-centred and ultimately, market-focused.

Within the UE program a geographically dispersed, multi-disciplinary group of 11 researchers from three universities were charged with supporting continuing interaction between the development of the technology research programs and research understandings of the user environment. For this research team the key challenge was how to ensure a user focus in the discovery phase of the technical research being conducted by the other programs. This was particularly difficult because at the inception of the technology programs the technologies to be developed and their functionalities remained ill-defined.

In responding to this challenge the team quickly recognized that while the philosophy of user-centred design was a useful starting point there were numerous differences between it and the user research problems being faced. This highlighted that no 'off-the-shelf' approach could be adopted. In contrast to the corporate context of UCD, we were working within a university culture with corporate partnerships. In structuring valid and assessable 'design concepts' the team would be part of an evolving methodology that itself required reflection and refinement throughout the engagement.

To structure the team's approach, research activity in the first 18 months was focused on four interrelated issues: methodology; user research; linking with the technology programs; and cross-cutting issues. The primary focus of this paper is on the first three of these issues and how they contributed to the development of the discovery user-centred design (UCD) approach.

METHODOLOGY: USER CENTRED DESIGN AND THE SITCRC CHALLENGE

The challenge for researchers in the User Environment Program of the SITCRC was to establish a user-focus in the discovery and development phases of the design of technological innovations. This meant that the developing methodology was aligned to the philosophy and principles of user-centred design. There were however three notable differences between conventional UCD and the type of approach required by the SITCRC user researchers.

Firstly, the techniques of UCD have largely been developed in the corporate context where there is some initial definition of the product. This was not the case in the SITCRC technology programs where products, markets, technologies and system functionalities had yet to be defined. The discovery phase is then an earlier phase of design, lying before the integrated product development phase where more conventional UCD may be most appropriate. Secondly, a core element of the CRC challenge involved the establishment of a “meeting place” where user researchers, technology researchers and industry partners could engage about the design and directions of CRC projects and programs. This meeting place is supported by research on user groups and cross cutting issues such as trust and identity. Finally, the university research environment presents a different culture to that of the corporation. In the corporate environment, the sharing of knowledge is bounded, and the emphasis is on protecting the intellectual property in the product and processes. In the university context performance criteria are based on the discovery of knowledge as evaluated by peers and the focus is on sharing and claiming knowledge through the peer review process.

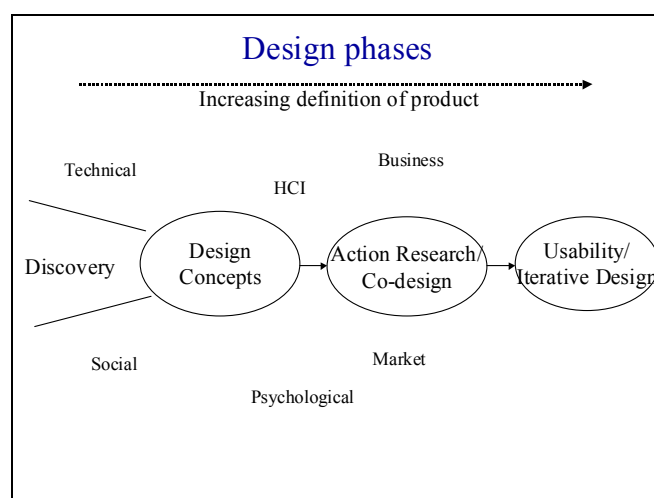
Philosophy and principles of UCD

User-centred design has been conceived as universal design, usability, interaction design, computer-human interaction and human-computer interaction. It is linked to broader perspectives of universal design and participatory design (Astrink and Beekhuyzen 2003 and Beekhuyzen et al 2003). The UCD approaches sometimes refer to a process of design and sometimes to the users’ experience of the product or service.¹ The best known texts of these UCD approaches are Jakob Nielsen, Donald Norman, John Seely Brown, Dertouzos and Vredenburg (Brown and Duguid 2000, Dertouzos 2001, Nielsen, 2000, Norman, 1990 and Vredenburg et al. 2002).

An important reference for the corporate context of UCD is User-Centered Design: An Integrated Approach (Vredenburg et al. 2002). This text outlines the approach to be taken in the UCD of products that are taken to market. Vredenburg et al stress four phases of UCD: planning, concept, detailed design and development and life-cycle management. Though UCD is iterative there is “a definite progression towards a final goal.” (p. 107). In Discovery UCD, there is an initial phase before planning and detailed design can start. This is to discover the kinds of technologies that are to be designed which will be useful for people for activities within their social and cultural context.

A different phase of design

Reference to this core UCD literature made us conscious that we were at an earlier design phase. In articulating the difference, we learnt that UCD at the discovery phase is different from the conventional UCD that comes as products and services are being designed. We depict this in figure 1.



¹ Personal communication, Jakob Nielsen, 21 June 2002, Sydney Singh, Burke, Turner, Castro

Addressing the value of UCD

There are measurable benefits of UCD in the corporate context, which we expect will be reflected in the Discovery phase. These benefits include increased sales, reduced development time, time saved on redesign, reducing the costs of help desks, and user productivity and satisfaction. A usability expert who has worked with 40-50 companies on designing software has never seen a software project that has used the usability approach, fail.² The benefits are particularly great at the early processes of design, where users are studied within their social and cultural environments. As Mayhew (2001) says, "Finding out prior to design what the unique requirements are, and designing to support them, is much more cost-effective in the long run than finding out after launch that your design does not meet requirements."

We presented the quantifiable benefits of UCD from the literature:

- Software industry studies suggest that an investment in usability engineering can produce a return on investment in the range of 3:1 to 100:1 (Karat 1990).
- Experience of ten years of usability projects shows that a ten per cent investment in usability increases user benefits from 100 to 180 per cent (Nielsen 2002).
- Usability engineering has demonstrated reductions in the product-development cycle by over 33-50 per cent. Sixty three per cent of all software projects over run their budgetary estimates, with the top four reasons all related to unforeseen usability problems (Rhodes 2001).
- Design changes due to usability work at IBM resulted in an average reduction of 9.6 minutes per task, with projected internal savings at IBM of \$6.8 Million in 1991 alone (Karat 1990).
- It costs 100 times more to change products that are already in the market than change products and services before code is written (Nielsen 2002).
- Help desk calls are estimated to cost between \$US30-\$US100 a call, depending on the complexity of the software. More than half the calls are due to poor usability (Nielsen 2000).
- Eighty per cent of maintenance is due to unmet or unforeseen user requirements; only 20 per cent is due to bugs or reliability problems (Rhodes 2001).

The benefits of the user-centred approach are so demonstrable that corporations such as IBM, Apple and Oracle have adopted UCD as an integral part of product design. At Oracle, 60 per cent of the user-centred work is done at the very initial stages of the project (Rosenberg and Kowalski 2002).

USER RESEARCH

User studies focus on users, their activities and their social and cultural context. Most often the studies use a combination of qualitative and quantitative approaches. These user studies may be found in sociological studies of technology and the diffusion of innovations. More limited versions of user studies are also found in corporate UCD, using the ethnographic approach of observing users' environments. Focus groups and lab observation are also important. More detailed field research is considered important, but UCD professionals seldom have the time or resources to undertake this research within the corporate context (Mao et al. 2001). However, in UCD Discovery, our strength lay in detailed user research that the researchers brought with them.

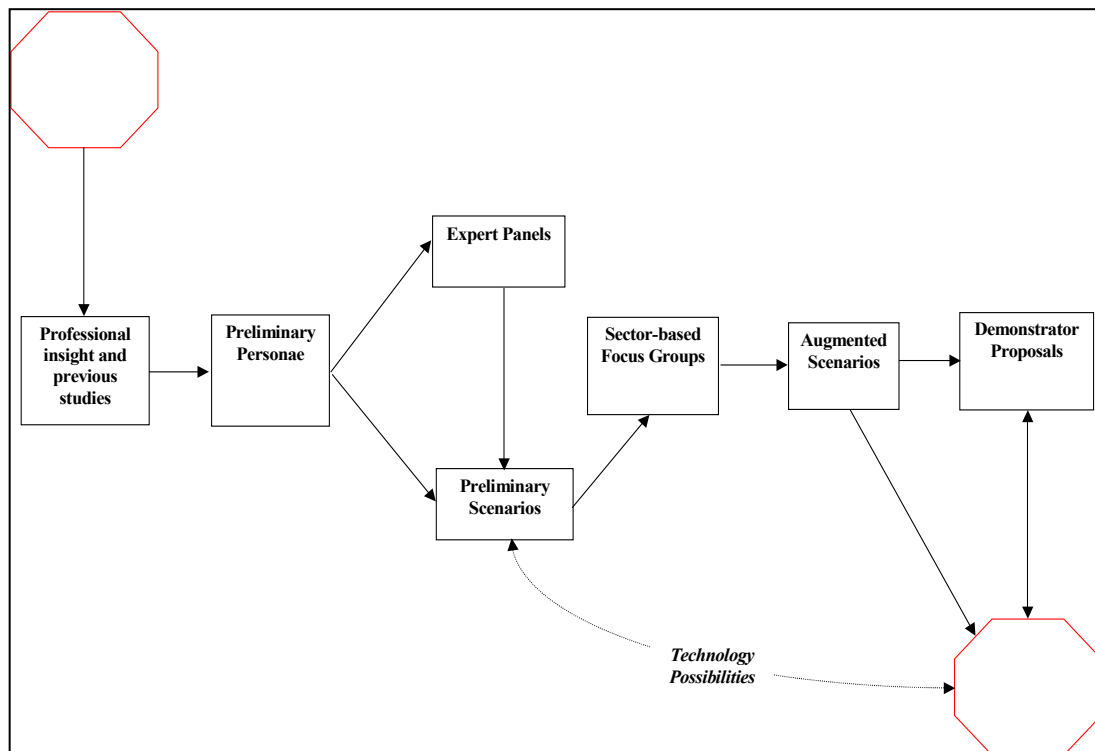
Within the User Environment projects, research with a focus on specific user segments was identified as an appropriate method for generating insights to feed into the Smart Internet Technology development process. In examining users' activities within specific segments the aim was to generate insights into user needs and translate these to design. This involves a focus on how users currently match characteristics of communication channels to engage in activities that fulfil their needs. We then translated this understanding into insights for desirable attributes of Smart Internet Technologies that will enhance/support the conduct of existing and new activities.

The user segments initially selected were small and medium enterprises (SMEs) including professionals and e-lancers; young people (YP); and people with disabilities and other special needs (PWD). This user segment selection was based on their commercial relevance, the likely applicability of Smart Internet Technologies (SIT), and the particular design issues they raise. These user segments also represented large groups of users. SMEs, for instance, constitute 95 per cent of all businesses and 50 per cent of private sector employment. Young People, that is people under 24 years, are strong users of new technologies. An emphasis on people with disability ensured sensitivity to issues of accessibility and universal design that have frequently led to

² Personal communication, Bruce Tognazzini, 21 June 2002, Sydney
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innovations applicable to mainstream users. It was also considered advantageous to leverage the existing research experience with these segments amongst the user needs researchers.

Figure 2: Implementing Discovery UCD with SMEs



Taking the SMEs as an example, figure 2 illustrates how we conducted user research within the Discovery UCD framework. Figure 2 illustrates the first step which involves leveraging insights from the literature and UCD researchers' experience with the needs for designing for this user segment. This process led to the generation of six preliminary personas representing SME users described in terms of their attributes, activities and technology requirements. These personas were starting points for consideration of the expert panels and the process of developing preliminary scenarios. The expert panels were utilised to obtain detailed information on SMEs for the development of meaningful scenarios that had been validated with users and that could be used to engage with the technology programs (Greenbaum 1993, Rubin 1994, Von Hippel 1988). The expert panels involved both collective discussion on SMEs and SITs followed by individual discussions with expert panel participants. These processes led to a detailed consideration of SME needs and the development of the scenarios to be used as preliminary vehicles for communication/negotiation with the technology programs in them

LINKING THE PERSPECTIVES OF USERS AND TECHNOLOGISTS

The UCD approach in this discovery phase of design emphasises a shift in thinking from a technical to a users' perspective. Connecting with the users' perspective means the acceptance of a multi-disciplinary perspective and a different process of research and design. It also means being able to work with a plurality of stories, while moving from data to theory. Fundamentally, it requires effective engagement between technical and user researchers.

In figure 3, we depict the different elements involved in the connection of perspectives. It also illustrates how this connection leads to a meeting place and product development. This process of Discovery is not linear but highly iterative, requiring interaction between users, researchers, and industry partners to formulate research problems and directions.

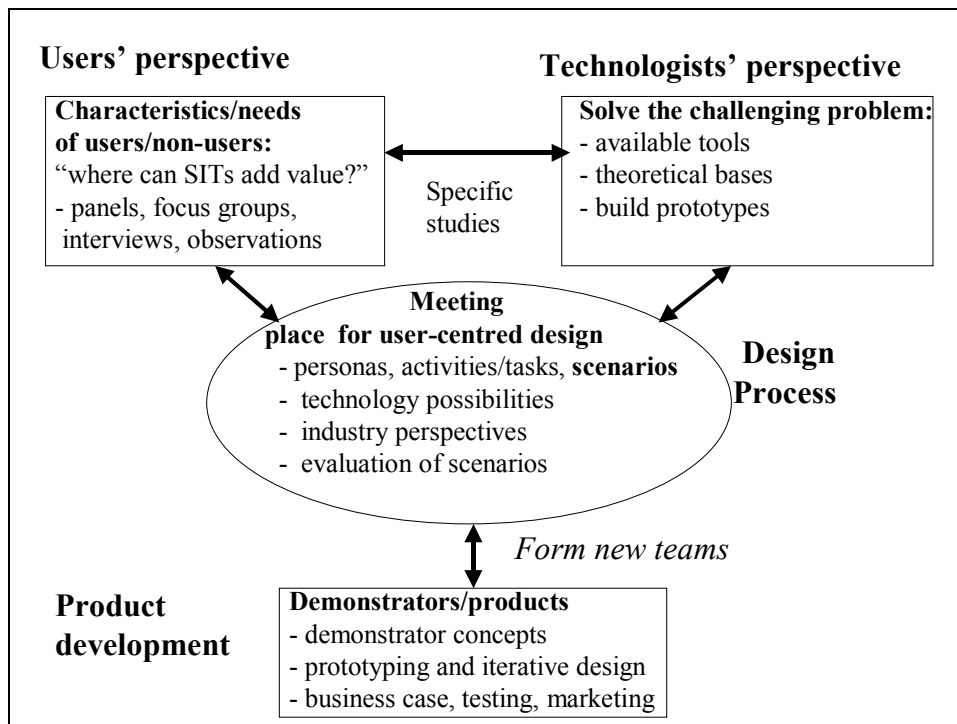


Figure 3: Connecting perspectives in the discovery phase of UCD

The users' perspective

User-centred design places users and their activities at the centre, at all stages of the design process. Users' activities are examined within their social and cultural context to see how new technologies can fit with accepted ways of doing things. In the process new technologies can also change the way the activity is conducted (Singh 2001).

The question then is one of how the new technology may fit in with the mix of other technologies already in use and familiar ways of doing things (Singh 2001). Examples of user studies are Silverstone and Haddon's studies of the use of information and communication technologies (ICTs) in homes in the United Kingdom (Silverstone and Haddon 1996) and Australian studies of the use of ICTs in the home, small business, governments and corporate environments (Singh 1999, 2001; Singh and Ryan 2000, Singh and Slegers 1998).

Such studies are particularly important when the new technology has to fit with other new and old technologies. A failure to keep the environment in mind has led to design disasters like the home theatre (Norman 2002), where one new technology does not fit easily with another part of the system. The users' context is particularly important to prevent over-estimating the importance of technology. Bruce Schneier's 2000 book is a mea culpa that in highlighting the role of cryptography in security, he overlooked the context of the user. Assuming that mathematics would provide the answer, he failed to understand in his earlier work that "the fundamental problems in security are no longer about technology; they're about how to use the technology" (Schneier 2000: 398).

The goal of user-centred design is to increase user productivity and satisfaction. Studies of the adoption and use of technologies have shown that for technologies to be successful they need to have the following criteria:

- They need to be easy to use;
- They should provide relative value – in terms of cost, convenience, mix of channels or better ways of conducting the activity;
- A person can try the technology or observe it before committing to it;
- Technologies have acceptable social and cultural meanings;
- People trust the technologies (See Newstead 2000, Rogers 1995).

The technologists' perspective

The technologists approach the design of new technologies with the technology at the centre. The novelty of the technology is valued by their peers, rather than ease of use. One of the main differences between the

technologists' approach to use and the UCD approach lies in the sequence of the design process. As Scott Berkun from Microsoft says (2000), "There is a fundamental difference in how technologists and true designers approach products. Technical people tend to start with technologies. We take teams of developers, build a technology, and then shoehorn a user interface and a user experience onto the framework dictated by technology. This guarantees that the user experience will be a poor compromise" (Berkun 2000).

Traditionally computer scientists see problems of use as problems of interface and user-testing. Hence they consider the dimension of "use" after they have a device that "works". After a prototype is developed, it may go through some usability processes at the later stages of design. There is an absence of overt attention to users. Hence the implicit user can often be in the image of the academic computer scientist - male, in their 30s or 40s, expert computer user with access to an office. This self construct of the user is recognised as a common feature in technological design (Vredenburg et al. 2002).

Establishing the meeting place

The UCD process depends on establishing a comfortable meeting place for effective, sustained communication during all phases of the design process, between UCD researchers and the computer scientists and engineers in the project team. The meeting place is where the products of social research and the technology programs and partners are brought together. From the meeting place emerge new concepts, new multi-disciplinary teams and existing research.

This place is formed through a two-way information flow between the User Environment program and the technical programs. The UCD researchers present user group research in the form of scenarios and through links to the technology programs. The technical programs bring their scenarios, knowledge, skills and interests. The meeting place enhances the value of existing concepts by ensuring they address genuine human needs. It also produces concepts of value in collaboration with the technology programs.

Communication is often the most important challenge in a multi-disciplinary project. "Seeing differently" and being comfortable with a plurality of stories and languages requires sustained work (Brown 1997). A failure to nurture cross-disciplinary perspectives is often the reason why UCD processes falter in the technology programs. This ability to see differently is particularly important because UCD aims to change the traditional approach focused on technology and components.

Establishing channels of communication

There were a few face-to-face meetings amongst the researchers in the SITCRC. However, e-mail, discussion groups and teleconferences were the main channels of communication. To buttress this group-wide communication, linkages were established with the technology programs. The linkages have all had different characteristics, but have been successful in beginning to foster greater collaboration between the projects and UCD researchers.

Natural Adaptive User Interface (NAUI)

Links were made with the NAUI Program by reviewing the research activities and approaches being taken by the UCD project and NAUI Program and then communicating these to both stakeholder groups through a working paper, and via telephone and e-mail interactions with the NAUI Program leader. UCD researchers were consequently oriented to issues of natural user interfaces in the course of their empirical research. And, working back the other way, the NAUI Program will be building understandings of the needs of user groups (young people, SMEs and people with disabilities in the first instance) into their natural interfaces.

Smart Personal Assistants (SPA)

A member of the UCD group was allocated to the SPA program. She participated in the project development that took place in the first round, and took part in follow-up workshops and tele-conferences. This participation resulted in a qualitative project investigating the user constructs in the minds of academic computer scientists who are designing SPAs. The project led to personal links. The computer scientists were also more likely to reflect on their own use of technology.

Intelligent Environment (IE)

A member of the UCD project was seconded part-time to an Intelligent Environment project. Direct involvement in their development process has been used to ensure that the critical cross-cutting issues of security and privacy are at the forefront of the group's thinking. The work within the group exposed location as a major cross-cutting issue which was followed up within the UCD project.

EXTENDING THE LINKAGES THROUGH WORKSHOPS

This initial linkage developed relationships and set the basis for trust. We however needed to go further to have an input into the conceptualization of further projects and ideas. To this end linkage workshops were held in November 2002 between UCD researchers and program leaders/key researchers of the technology programs. The two-way interaction was important in working out what we had not previously understood about the key goals and passions driving the research. It was also important to have champions of UCD research in the technology programs. This was like the need for corporate champions as Vredenburg et al (2002) have stressed.

Personas and scenarios as vehicles for communication

A shift from the technical to the users' perspective is difficult to achieve. This is particularly true at the beginning of a project when the issues are complex and ambiguous. We used personas and scenarios as communication tools. In effect they represented the characters and plots of the stories. Stories are able to express this complexity and are good communication tools. They give an occasion for reflection at the beginning and intermediate phases of design. They keep the design focused on the user, his or her goals, activities and social setting. The stories keep the design fluid and flexible and yet present something concrete. And most importantly, stories use language users can understand (Carroll 1995).

The stories we told changed in complexity as the technologists and UCD researchers together developed them to answer the questions that arose. It was important for the validity of our input into the design process, that the personas and scenarios were backed by demonstrable user research. We further substantiated them with user panels and focus groups.

The scenarios provided a stable foundation for action-oriented reflection in design teams. "By being both concrete and rough, they make explicit the design goal of specifying tasks and functions in greater detail" (Carroll 2000: 50). Scenarios encouraged people to think about how one might navigate successfully through the developmental processes that lead to the production and marketing of new user-focused Internet technology products (Institute for Alternative Futures 2001). From a user needs perspective the preliminary scenarios emphasize users' understandings and inputs into the design process because they are orientated towards the activities that users wish to engage in rather than on the specific merits of a particular technology (Nielsen 1993). A key next step will involve in-depth engagement with these scenarios by the technology programs and CRC industry partners. To aid in this process the user needs group provided both scenario summaries and complete scenario descriptions.

Joint discussion of the scenarios have led to a joint demonstrator project - AMIVOX. It consists of a wireless headset and a very small laptop with many communications interfaces. This would allow us to reduce the device count, to allow a natural speech interface to build a "killer app" for a niche group (blind people) that has the potential to cross over to the mass market (Astbrink and Kadous 2003). We are also engaged in a project with strong corporate interests entitled Nymity, that is looking at issues of identity, trust and authentication that cut across all the technology programs in the SITCRC. In the development stage are projects on virtual communication and Smart Networks.

DISCOVERY IN THE ACADEMIC CONTEXT

We were conscious we were working in an academic context with corporate partners. A key challenge was to produce value in both the academic and corporate environments. UCD researchers linked with corporate partners and SMEs through the SME alliance. The form of the linkage varied significantly depending on the willingness of the partners to commit resources and the form of the outcome sought by the partner.

The tension between the two cultures was a tension between different processes of research and validation. Academics need to present the work as it is happening – at different phases of the research – rather than wait for the final product to emerge. Academic researchers get confirmation of the value of their research and their contribution to their fields through peer review publications. This process conflicts with the corporates' understandable attitude to keep confidential issues that would lead to competitive Intellectual Property. We are not yet at the stage in UCD when we have had to deal with the issues as they impact on the market value of the technology innovation. However these different perspectives influence the breadth and detail of the interaction and the resulting products.

It needs to be recognised that the different cultures leads to frustration on both sides, unless it can be seen to be contributing to a common goal. From the academic researchers' perspective, there is a view that the process of interaction is more from academia to corporates rather than the other way around. From the corporate perspective, it became clear that they would like more emphasis on the dollar value of the project, rather than contributions to knowledge. But as relationships develop through academic and corporate led projects, there is

an increasing recognition, that UCD can help with multidisciplinary discovery and can add value to corporate projects.

NEXT STEPS AND PRELIMINARY CONCLUSIONS

In this paper we have described a methodology we call Discovery UCD. This methodology was developed in the first 18 months of UCD work in the SITCRC. It addresses the issues that arise when the technologies are still being discovered. There is as yet no prototype to be tested for usability and to take to market. The involvement of UCD researchers at these very early stages of discovery, ensure that UCD principles and perspectives are part of the thinking about the technology that is being designed. It marks a desirable shift in direction for technology projects, as both the user and the technology are considered at the earliest phases of conceptualisation.

In describing Discovery UCD, we use the principles of UCD as a base. However we have begun labelling the general UCD methodology as Product UCD. UCD processes have generally been honed in a corporate context for the design of products that are being developed for the market. In the SITCRC we also aim to engage in Product UCD. But Discovery UCD differs from Product UCD in three ways. First it represents a design phase prior to the planning of Product UCD. Second, it means that the focus is on establishing a meeting place between UCD and technology researchers. Two-way relationships of trust and understanding are forged so that UCD researchers are part of the process of deciding on the functionality and usefulness of the technology to be designed. And thirdly with Discovery UCD we are working in a mixed academic and corporate context, where there is possible tension between the research and validation processes.

Discovery UCD has led us to one demonstrator project – AMIVOX – where a UCD researcher and a NAUI researcher lead the project together. We are also engaged in a project that is looking at issues of identity, trust and authentication that cut across all the technology programs in the SITCRC. We are also developing areas of joint interest in virtual communication and Smart Networks.

The next phase of research in the SITCRC presents different challenges for UCD researchers. We will be working on the linked technology/UCD projects while continuing to develop further points of linkage. For this two faceted engagement, we will need to have a focused engagement with the technology programs, while ensuring that we remain up to date and relevant in our knowledge of UCD. These are issues that are also faced by Product UCD In addition we will need to remain relevant in our contributing disciplines through a continuing development of expertise in User Research. This will mean both deepening and expanding our knowledge of user segments in a way that creates new knowledge that can be translated to the design of Smart Internet Technologies.

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