Chapter 17

Domestic Systems

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Introduction

We now live in a world where most of us have several computer-based systems at home. Home systems are different in many ways from organisational systems - they may be consumer products, it is important that they fit into the fabric of the home and they have to be installed and supported by the users themselves. For older or disabled people, specialised home systems may be 'assistive technology', which supports them in some aspects of their daily lives. Our work, developed as part of the DIRC project has mostly focused on these assistive technologies in the home so that is the theme of this chapter.

The home has different meanings and imbues different feelings to people who live in them. The home provides shelter as well as a sense of identity. Within the home, the domestic space, the way in which participants or occupants interact is very different. The ways in which people use their domestic space is a personal decision, which could be mediated by cultural fashions and other facets of society. For a designer of systems to support people within their domestic space it is important to understand the richness and individuality of the domestic spaces and the meanings that they have to the occupants.

Network connectivity in the home is, in Western societies, becoming universally available. A home network can allow isolated individuals to retain contact with the world around them as well as allow for external monitoring of people who require this service. Social networks, email, newsgroups etc. all allow people to be informed and connected with friends and colleagues. This has important benefits for older and disabled people who may suffer from mobility

and other problems that makes it harder for them to meet people face to face.

Dependable assistive technology

Assistive technology is the name given to any device or system that supports everyday living. Generally, they are used by people who have some kind of functional or cognitive impairment - they may be hard of hearing, forgetful, have mobility problems, etc. We are interested in assistive technologies that are computer-based and networked, rather than, e.g. mobility support devices or hearing aids.

Because such devices may be essential to support normal living, it is important that they are dependable, as failure or unavailability can cause harm to their users. In the home of a disabled person, the failure of assistive technology devices could be critical to the occupants. If a piece of telecare, such as a fall detector, fails the person could be lying on the floor for a long time until they are discovered by which time the possibility of hyperthermia and the likelihood of successfully repairing any damaged limbs are

But dependability in this context has to be considered in a rather different way from the dependability of organisational systems. We have a body of knowledge on dependability that can be applied in designing organisational systems but this needs to be extended for domestic systems. Key differences that have to be taken into account include:

1. Activities and processes are standardised in organisational systems but not in home systems. The most significant difference between the organisational system and the home system is that processes and timing functions are different. Home routines are often unplanned and unpredictable.

2. Within the home there are fewer external legislative and advisory bodies imposing their regulations, opinions or choices upon the occupiers.

3. When a device fails in an organisational system it can be very costly as the organisation could consequently lose a considerable level of productivity. In the home, by contrast, if a device fails there is usually a work around.

4. Traditional hazard analysis for organisational systems considers safety and risk from concrete positions where organisations could fall foul of legal problems by not following standards. Risk tends to be minimised at all levels and personnel are prohibited from undertaking various tasks on the grounds of health and safety. Safety and risk are considered part of the organisational framework and their minimisation is central to effective

management. In the home, users may be willing to trade off risk against convenience.

In the home, there are trade-offs between privacy and safety that exist so that users can maintain an acceptable quality of life. Although most people might not wish to be 'spied upon', when their health or even life is in danger, being spied upon might be preferable to being left completely alone with no assistance available. The most appropriate system should always balance privacy with safety.

Finally, system dependability as well as system reliability and system availability are characterised differently from more formal organisational systems such as offices and other businesses. The notion of failure may be less clearly defined and, as systems are assistive, users may be able to cope with unavailability.

Analysis

The home presents a range of potential exploratory areas, which can be themed together to produce activity centres, which result from chains of actions. Activity centres and the chains of actions can be used to articulate the organisation of coordination, how routines and practices are interpreted by individuals within their living spaces. The patterns of activity within a domestic environment are constantly changing as needs and wishes of individuals change. These patterns and rhythms of daily activity are central to design, particularly for designs for disabled people.

The variation of users and personalisation of activities within the home mean that, for assistive technologies, analysis of each setting is important before technologies are chosen, designed and installed. Conventional analysis for organisational systems, based on a technology or process perspective is inappropriate and it is essential that a socio-technical approach to analysis is adopted.

However, socio-technical analysis designed for organisational systems such as workplace ethnographies often require considerable on-site working by an observer and this may be impractical in the home. Furthermore, interviews with participants which reply on their memories are likely to be unreliable, with essential details forgotten or considered by the users to be unimportant.

For this reason, we adapted the notion of cultural probes, first developed to facilitate the design of systems for elderly people, to support the analysis of domestic system requirements for elderly people. We provided users with a kit of different ways to record their everyday actions - a camera, a notebook, a diary, a sound recorder and asked them to use these over a period of time. We then conducted interviews with the users which were focused on the records

that they had made. This meant that we had information about their everyday lives without the need for intrusive analysis.

A dependability model for domestic systems

The potential criticality of home systems for disabled people is of great concern. Any design, which has a person or people relying on the system for support and quality of life becomes a critical system. Therefore, the design and use of assistive technology in the home should be viewed from the perspective of the assistive technology as a critical intervention. To help guide the design process and to bring dependability issues to the forefront of the designer's mind, we developed a dependability model for domestic systems as shown in Figure 1.
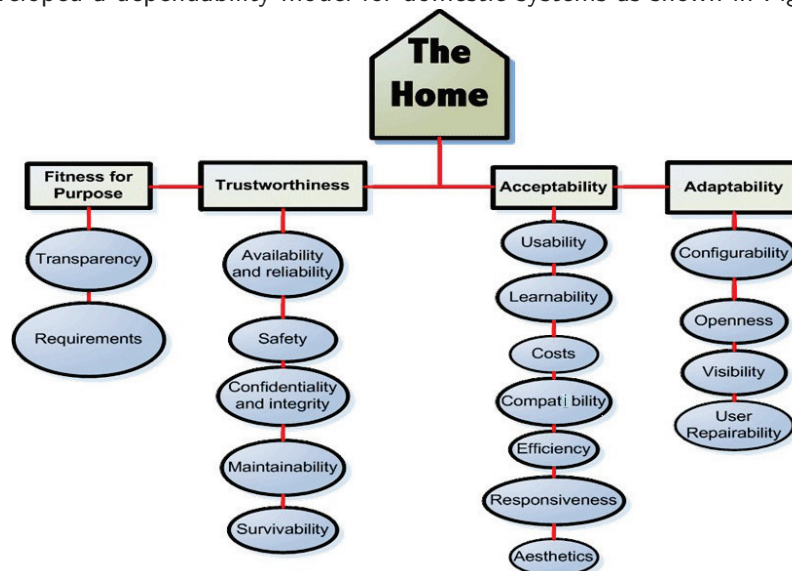

Figure 1. A dependability model for domestic systems

The Dependability Model of Domestic System (DMDS) was developed to illustrate the key areas of importance in the design of assistive technology systems. This in turn led to the development of MDDS (Method of Dependable Domestic Systems) which features a set of tools to facilitate system dependability for assistive technology systems. MDDS became simplified further to produce DTA (The Dependability Telecare Assessment Tool) which was developed to facilitate dependability in telecare systems.

The attributes in the domestic dependability model reflect system attributes that may be important in a domestic setting. They are grouped under 4 headings:

1. **Fitness for purpose**. The system must meet the needs of the user, which is not the same, of course, as meeting the requirements for the system as defined to the designer. A device chosen may be the wrong device for that user, even although it performs according to its specification.

2. **Trustworthiness**. The system must be trusted by its users otherwise they will simply turn it off - something that organisational users of systems may not be able to do.

3. **Acceptability**. The system has to fit in with the ways in which users live their lives and what is important to them. It is not just a question of 'does the device work' but also whether or not users are willing to change their homes and the way they live to accommodate the device.

4. **Adaptability**. The system has to be able to evolve to reflect the changing needs to users. For older and disabled users, their capabilities change over time and the device has to be able to evolve to reflect this.

We have covered these issues in depth on our paper on a dependability model for domestic systems (link here to paper) and space does not allow us to describe all of them in detail here. However, to help explain why dependability for home systems is different, consider two of what we consider to be the most important attributes - user repairability and aesthetics.

User repairability is an essential quality of devices in the home, whereas organisational users call on technicians to repair their systems. Repairability is distinct from maintainability, which reflects the ability of the system to evolve to reflect changing user needs. Domestic consumer devices are usually built to be available for a relatively low price and this inevitably means that the components of these devices have to be low cost. Breakdowns are therefore likely to be more common than in more expensive organisational systems. To maintain dependability (and to ensure that users do not incur unacceptable maintenance costs), users should be able to repair devices themselves - at least to some extent. This requirement leads to design considerations such as:

1. All devices should have their self-diagnostic functions built into them.

2. To recover from user errors, all devices should include a simple mechanism to reset and restart the system.

3. Devices should be accessible - it should be possible to electrically isolate devices, safely remove covers and access components without specialist tools.

You may think that aesthetics is an unusual and unnecessary system dependability attribute. But, for many people, the way their home looks and the way

that assistive technology devices fit into their home is important. Devices are usually purchased to complement the domestic physical environment, and the self-image of the user. If aesthetically unpleasing devices are proposed or installed, the user may simply refuse to accept or to use them. They are therefore unavailable and so the overall dependability of the system is compromised.

More information on domestic system dependability is available from this blog: http://thetelecareblog.blogspot.com/