HOUSING AND TECHNOLOGIES IN THE EU FOR PROMOTING QUALITY OF LIFE: CURRENT TRENDS IN THE UK AND ITALY.

Luigi Biocca, MSc BArch Ph.D.,
Guy Dewsbury, BA Hons, PGCEM [1]

Abstract
The use of electronic assistive technologies to enhance the quality of home life is a common endeavour in many EU countries, although the approach and experience of delivering these services can vary considerably, due to different demands and developments. This paper analyses research from the UK and Italy in order to compare the future opportunities and developments in each country. In particular, a strand of the British experience which is centred around the notion of dependability which is adapted from the traditional HCI definition and redefined for home environments, and on the other side, the Italian context still gives a prominent role to designing in accordance with some performance requirements.

Each experience is contextually different, however, the two trends both share a special attention to a user-centred technology system and this is the key rationale for analyzing and comparing their outcomes and methods.

The authors illustrate the backgrounds of the UK and Italian work, and the different strands through a review of built examples, which have technologies or tools installed. This leads the authors to suggest that there are parts of each experience that can be assimilated into future EU developments.

User-centred technology and design performances for the building and housing sectors can give benefit to the construction industry in order to provide more comfortable and innovative living environments, in accordance with the changing needs and expectations of the population as well as the boost of upgrading the built environment to the current up-to-date technology level of other sectors when applicable.

Introduction

Technology design in Italy and the UK can be summed up in terms of Buxton (2002) of the 'quick sketch of a computer'. William Buxton asked 3000 people to perform a quick sketch of a computer and found that almost all people drew the boxes, keyboards and screens of computers but as he notes "*nobody draws the computer*" (2002, 171). The participants in this exercise, focused they attention onto their conception of a computer, their visual acumen and not on what the computer actually is. As Buxton explains "*the exercise highlights the power of what users see and touch (the I/O devices or "terminals") to shape their mental model of the system*". Drawings of a video or a memory card also do not constitute a computer, as the computer itself is all the various parts required to undertake the task.

Designing socio-technical systems for disabled or older people, has tended to follow a similar pattern, considering wide implications and hasty judgements about people as organisational groups rather than heterogeneous entities with personalised thoughts, feelings and activity patterns (Heywood, 2001). This paper contrasts two forms of design, one from the UK and one from Italy, and demonstrates that designing telecare systems for people must be a co-operative and iterative process in which users are the primary component of the design.

THE UK EXPERIENCE

Defining the socio-technical system

The term socio-technical system traditionally refers to the interaction of subsystems (both social and technical) within and organisation. This working definition lacks a focus for the occupants of the domestic space. Clearly, the home is significantly different from an organisation (for more information on these differences Dewsbury et al, 2003) and as such the socio-technical system exists in the interaction of the occupant with the domestic space and technology within the local environment.

1 - Authors' note

L.Biocca is researcher, Construction Technologies Institute Unit of Rome, National Research Council, Rome (Italy);
G.Dewsbury is associate researcher, Computing Department, Faculty of Applied Sciences, Lancaster University, Lancaster (UK).

The work undertaken in the UK by Lancaster University has centred on the classical notion of dependability (Dewsbury et al, 2002). The DIRC (Interdisciplinary Research Collaboration in Dependability of Computer-Based Systems) project has adapted traditional Human computer Interaction definitions of dependability attributes as advocated by Laprie (Laprie 1995, Avizienis 2001 and Kaâniche et al 2002) into a more applicable socially situated home context (Dewsbury et al, 2003). This socio-technical version of dependability is user-centred and focuses on what the user expects the system to do and whether the system lives up to these expectations and everyday mundane activity patterns. In developing a reworked dependability model four main areas of qualitative dependability were derived from our fieldwork namely

> *Trustworthiness*: In order for a system to be dependable, the user must trust that the system will behave as they expect. We define this attribute to be the equivalent of 'dependability' in Laprie's (1995) model. That is, it includes the traditional dependability attributes of availability, reliability, etc. However, we will argue that these need to be re-interpreted to some extent to take into account the characteristics of domestic systems.
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> *Acceptability*: We have argued above that a system that is not acceptable to users will simply not be used. Therefore, it is essential that system characteristics that affect its acceptability such as the system learnability and aesthetics be considered in the design process.
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> *Fitness for purpose*: Fitness for purpose is taken for granted in most of the dependability literature but, socio-technical system failures regularly arise because a computer-based system is not fit for the purpose for which it was designed and users of the system have had to adapt their operational processes to accommodate the system's inadequacies. When the purpose of a system is to cope with disability, users may simply not have this option and the system may simply be unused.
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> *Adaptability*: Within the home both the environment and the user's of the systems change. This is particularly true for elderly disabled people whose capabilities tend to decline as they age. Therefore, if system dependability is not to degrade, then it must be able to evolve over time, generally without interventions from the system's designers.

These dimensions have been derived through fieldwork that was undertaken throughout the UK and used a tool called 'cultural probes' (Gaver et al, 1999). We use 'cultural probes' (cameras, diaries, maps, Dictaphones, photo-albums, postcards etc) as a way of uncovering information from a group that is difficult to research by other means and as a way of prompting responses to users emotional, aesthetic, and social values and habits (Cheverst et al, 2003, Kember et al, 2003). The probes furthermore provide an engaging and effective way to open an interesting dialogue with users. Sensitivity to the feelings of the participants who agreed to be involved in our study involved this choice of a range of 'sympathetic' data gathering techniques. The probes have allowed us to consider design aspects from temporal/spatial/activity pattern perspectives, allowing the team to design technology that fits into with the standard activities and lifestyles of person.

The use of the cultural probes allows the system to be more than the externalities. The constituent components therefore are as important as the packaging. Similarly, the appropriate and dependable use of assistive and domotic technology requires the designer to fully understand the user's requirements (user being all people who will use the space and the technology) (Dewsbury et al, 2001) no matter how mundane.

The Design Protocols

Adults with Autistic Spectrum Disorders (ASD) and unpredictable behaviour require sensitive design that is responsive to their individual needs. The designs we have undertaken in Scotland have been for adults who are returning to the community from hospitalisation predominantly. These adults have in many cases had little experience of living in the community.

Due to the profound nature of their disabilities, all of the adults have full time support workers who will provide assistance throughout the day. At night support workers are fewer, but still present. The adults are provided with individual accommodation within a grouped accommodation space.

The design requirements for adults with ASD and unpredictable behaviour entail high ceilings, thick walls and windows. The internal spaces are required to be sound proofed as well as possessing tensile strength allowing the residents to use the home in whatever manner they see fit (see Figure 1). The designs also required technological interventions that would facilitate the support process as well as ensuring the safety of the residents and support workers.

The six elements of the final system were based on a number of prerequisites that had been laid down by project managers. Firstly, all information is required to be kept within the group domestic location and cannot be transferred to bodies externally, although information is passed throughout the buildings within the site. Secondly, the system must be robust and unobtrusive, whilst supporting residents and support workers. Thirdly, the residence should not become institutionalised by technology use. Fourthly, the technology should enhance the quality of life for residents and support workers whilst not being restrictive for the residents. This signifies that the system should not stop residents attempting to abscond or prevent any non, life-threatening action, but should bolster the support staff in allowing residents to maintain privacy and independence whenever possible.

FIGURE 1.

An artistic impression of the final design

The system

The system contains six main elements:

1) A simple alert system to detect activity patterns of residents when they are alone in the flat.

2) An extensive fire system to pre-warn support staff in the event of a fire and not cause panic in the residents which automatically turns off electricity to cooker and plugs in the kitchen and front doors of flats would unlock, allowing staff easier access.

3) A 'staff attack' system to allow support worker three levels of call for assistance in the event of requiring assistance in daily tasks through to an attack situation.

4) A simple security system to detect when doors are opened which allowed staff to determine which doors to monitor.

5) Isolation of hot and cold water by support staff to prevent residents from compulsively drinking.

6) Automatic locks on external doors and flat front doors which allow monitoring of people in and out of the building as well as in and out of individual's flats.

The systems were integrated and connected to a series of displays placed in support worker accommodation. A dedicated central computer, situated in the staff office space allows for all the data to be recorded and staff monitoring alerts remotely within the building. This also allows staff to determine and plan future care initiatives with residents as the person's activities can be called up for a required period. As a socio-technical system, it was also important to make the system as easy to use by staff and as robust as possible such that residents are unlikely to feel that they are being monitored or that there are odd looking ‘devices’ in their domestic spaces.

The systems were predominantly hard wired as this made things easier to integrate into a computer programme although the staff attack system uses infrared modules that are clipped on the support workers belts and these alerts are recorded on the computer system as well as being able to be transferred by radio frequency to pagers given to designated support workers. Wherever possible, ‘off the shelf’ systems were utilised throughout the projects so that non-specialised electrical workers could undertake maintenance of the system.

The significance of this system is that it meets user needs whilst using conventional technology and thereby avoiding many of the hazards that have beset other telecare projects, such as security of data, safety of residents etc (these issues are discussed in greater detail in Barlow et al 2003, Brownsell and Bradley 2003 Harper 2003, and Tang et al, 2000, Williams et al 2000).

THE ITALIAN EXPERIENCE

Usercentredness of older users in houses and telematics services and facilities.

Italian policies for a comfortable life quality of older citizens aim to blend automation systems and tools at home with provision of telecare services.

At the end of 2001, the Ministry of Infrastructure launched a large nationwide call for “Low cost rental houses for the elderly of the 2000’s”. Regional governments as well as city councils departments for public housing can access special subsidies upon request by submitting urban plans of new or retrofitted housing to be rented to older tenants with low income. For the first time plan submissions must comply with requirements for providing basic packages with home technology and telecare facilities. Definition of the basic package based on tests on users’ samples and assessments by stakeholders, as well as on EU housing experiences. However, basic package does not exclude additional tools or measure case by case.

Upon this call, city offices and public housing agencies have been promoting related programs for housing renovations and/or developments, where older residents can perform daily activities with full independence, thanks to the adoption of suitable and user-friendly home technologies and with the support from outdoor telecare centres (Maggi 1998) (Foster 1998) (Tang et al. 2000) (Porteus and Brownsell 2000).

In some of those programs, policy makers have successfully encouraged user’s direct involvement in assessing appropriateness and usefulness of packages.

Therefore, *participation of end users* in decision making is now becoming a relevant method as well as additional to traditionally used instruments like indirect survey, technical specifications and definition of prerequisites.

Current Telematics Applications

Telematics services, as applied in standard and community housing as well as in day/health centres/facilities, include the following:

Teleaid: It was the first milestone of telecare service supply and ensures real time alarm operations: users can push an emergency button on a remote control linked to an assistance centre. Teleaid can then alert emergencies of many kinds, so it works as a basic and comprehensive tool. As soon as alert is on, the assistance centre staff provides to define the emergency problem, so to empower the most appropriate aid/assistance/rescue measures and drive the emergency time till the end of the alarm event.

Telechecking: It is a supportive personal and social service: staff of social services department keeps periodically planned contacts with older users via telephone (f.i. once a week), in order to check any family problems, health and care needs, social expectations and assessment of life quality of the performed daily activities. It works then as a social call centre, able to address emerging needs to qualified health operators as well as to prevent user’s isolation inside home.

Telemonitoring: It is a recent advanced implementation of the ordinary telemedicine service and consists of the following subcategories:

- Telephone monitoring: users are queried via phone about their needs, social life, habits but they are also given useful information to access leisure and/or educational activities; the useful information flow is then redirected to the concerned care/assistance/health facilities.
- Clinical data detector: user with health problems are periodically monitored depending on their conditions and to the detection method agreed with the social care department. The service detects basic health data (heartbeat and breath frequency) through a tool provided to the user. In addition, data

of vital factors are monitored and collected in every user's health file card. This procedure allows then disease prevention, tailored on every user's specific measures.

- Telecardiology, Pressure Telemetry and Telespirometry: additional telemedicine service that monitor heart-related data, blood pressure and breath functionality for people in serious health conditions. These services, specially targeted to those needing continuous check-ups, is linked to day hospital assistance centre, whose staff updated one's health file card with reports transmitted by users' ECG tools. The head of the assistance centre is also responsible for planning emergency situations where a patient needs an immediate treatment.

A project for housing and care/assistance facilities integration

ITC has been recently involved in a city office consulting group for defining technology guidelines and supportive care/assistance facilities/tools for the benefit of older tenants accommodated in a newly built housing complex in Piemonte, Northern Italy (Biocca and Morini 2003).

The pre-requisite of the project was a housing scheme able to integrate the requirements of suitably planned dwellings equipped with accessible and easy-usable furniture/fittings to the need for life independence, which may be hindered in older users as to outdoor mobility and home activities also because of health problems (Van Berlo 1999) (Gottschalk 1999).

The goal was then to enhance users' lifestyle at home, with both home and health supportive systems/tools, also through communication systems with outdoor facilities centres (Biocca and Morini 2001).
The work plan consists of the following two addresses:

- Survey of the state-of-the-art of the newest technologies and products available in the marketplace and suitable to older tenants' needs;
- Definition of guidelines of suitable house design in harmony with the suggested technologies/tools/facilities to install for the real and useful benefits of the future residents.

Such addresses have been conducted with the concept of aging in place and home modifiability, i.e. to give solutions also to be adopted or implemented in the next future, according to changing needs of residents, so they can choose to enjoy a good life quality at home with any kind of aid they can need.

State-of-the-art

Assessing the most proper home technologies and supportive aids to the persons is being conducted by ITC at different levels of technology complexity as a research hypothesis for home technology classification. The follow-up will be to mainstream future housing surveys/renovations/installation/guidelines into a grid of the defined relations user needs/requirements/solutions/technologies (Morini 2002 and 2003)

Classification is then in accordance with the following system subcategories:

First Level System (or Basic System): this category includes products, tools and/or technologies resulting in a 'basic' system equipment of housing, suitable for elderly with fairly good abilities or, in any case, with no need of specific supports.
Second Level System: this category includes products, tools and/or technologies resulting as additions to the basic system, in order to comply with specific needs we can find in some cases of non self-reliant older citizens (aids for orienting, dementia, Alzheimer, support to cognitive problems).

First Level System

The first level system or basic system includes four automation types, two of them related to safety and two for supporting home daily routines:

Home safety: Components for preventing home dangers and damages (intrusion, water flow, smoke and gas alarms) belong to this category. Safety systems can be set up independent or connected altogether in an integrated system (technologies) and in any case they use sensors.

Safety of people: Additional components for home safety, and more specifically addressed to persons. They can be products, tools or supports for preventing or intervening after chronic or impairing health problems of people living at home and, in most cases, alone (active alarm for illness/fall emergencies).

Easy house management: This system can integrate technologies of different kinds (sensors, actuators, alarms, etc.) to a network connected to a station (PC or control panel), enlarged through peripheral control terminals (e.g. home or mobile phone, remote control). The system is especially aimed to optimizing the basic home routines, as follows:

- Air conditioning/energy control
- Routine planning and online maintenance of appliances
- Garden watering automation

Easy management of some routines:

- Provides for controlling and managing additional home routines, specifically aimed to an easier use and comfort for the user.
- Entrance door automation (smart card)
- Doors, windows, shutters and curtains automation system
- Lighting system control
- Motorized components for furniture and fixtures.

Second Level Systems

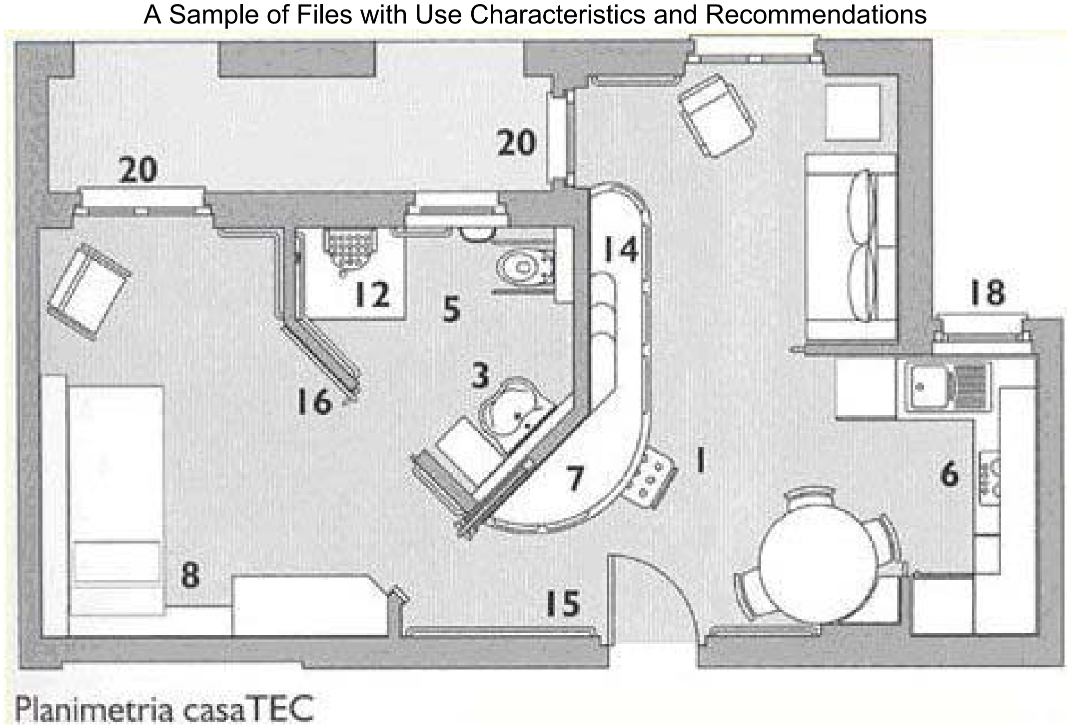
In addition to characteristics of first level systems, the second level supplies technologies and supports for specific needs, which mostly take advantage of informatics (PC) or communication tools (screens, messages, LAN networks). They can be mainly divided into four categories:

- *Supporting tools* (for memory, to perform some activities) in order to allow users with cognitive problems perform easily the basic daily life activities (e.g. personal care or eating) (Keijer 1999).
- *Health data monitoring* (pressure, glicemy, ECG, etc.);
- *Wandering monitoring* in order to assess the wandering event so to prevent from environmental dangers (e.g., if a person goes out and does not know how to come back),
- *Lifestyle monitoring* (to prevent, instead of reacting; passive systems) (Fisk 2001 and 2002).

Outcomes from the checklist of supportive tools/technologies at home

The definition of guidelines for supportive tools/technologies at home, resulted in the checklist illustrated above, is a first milestone to include a larger range of newly built or renovated housing stocks for the benefit of older citizens' life independence in home-related activities. These guidelines are collected in files of products/tools/technologies/facilities with description, information, user target and installation/use characteristics, criteria and recommendations (see Figure 2) (HBGroup 2001).

FIGURE 2
A Sample of Files with Use Characteristics and Recommendations



Legend: 1 – Living room; 3 – Washbasin; 5 – Bathroom; 6 – Height adjustable cupboards; 7 – Workplace; 8 – Bedroom with pivoting bed; 12 – Color project: yellow shower area; 14 – Adjustable light intensity; 12 – Automation control system; 16 – Motorized sliding door; 18 – Motorized window; 20 – Easily accessible thresholds.

Files and guidelines will be then periodically updated and/or implemented by introducing new products/tools developments or evolutions. In addition, a collection of some representative samples of good practices of home equipment and installation covering a large range of needs is filed with the aim of promoting them as a current ordinary practice for next housing renovations.

Major housing and technologies EU programs

The 6th Framework Program is currently a mainstream of research project funding in the EU. In particular, technologies as a support to frail citizens are mostly addressed to IST (Information Society Technologies) umbrella and continued from previous FPs, where the Quality of Life umbrella focused on people's needs also across the built environment. Relevant funded EU projects and their scopes/outcomes throughout the last FPs are as follows:

- TIDE (Technology Initiative for Disabled and Elderly people – 4th FP): a large reference project enhancing the role of assistive technologies and support at home for the benefit of elderly and people with disabilities;
- COST219 (Telecommunications Access for Disabled People and Elderly): a cooperation action involving most EU members since the 90's in the field of science and technology; there have been two follow ups.

Conclusions

This paper commenced with a discussion of William Buxton's notion of the computer and has demonstrated that designing socio-technical systems requires a holistic view. This view extends beyond the individual components and their utility into a view of the design being user defined in a co-operative development. Stakeholder and user views form the essence of the design, and the building architecture and internal spaces should be tailored to meet overt and covert needs. The technology should be dependable accessible and appropriate and blend into to the overall design milieu. These ideas extend to telecare/telehealth systems as well as 'smart homes' and general buildings that use technology to support people in their own homes. The UK and Italian experiences described above share some familiar and common features, in that they place the person living in the space at the centre of the design process. The design of technology is therefore driven by the needs of the resident and supporting people who inform the use of the spaces and the activity patterns. The two systems outlined above are both telecare systems although only one releases information 'off site' and as telecare systems their concern is less on what the technology can do, choosing instead to redefine the question in terms of what technology is really required to support a person's quality of life. The fact that in the EU older and disabled people are increasing in number and proportion is significant and technology can augment the support process only if it is co-operatively designed with the users views as a constant design reference.

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