2 Designing Digital Futures

For decades, new technology has offered tantalizing potential for tremendous benefits to people and society. Harold Sackman, in his influential book published in 1967, discussed ideas for augmentation of human capability through the concept of 'human-computer symbiosis'. He anticipated a world in which people would be freed from the drudgery of routine tasks and empowered by computer technology to expand their horizons and creativity (Sackman 1967). But, as computer technology proliferates and becomes ever more sophisticated, how close are we to realising this inspiring vision? This chapter outlines some of the benefits and costs of new digital technologies, and explores the way in which approaches to the design of ICT systems have developed.

2.1 Living in a Digital World

Certain technological achievements have far exceeded the predictions made in the early days of computerisation. The wonders of the Internet, the boundless capabilities offered by rich connectivity of both wired and wireless technologies, are a tribute to human creativity, innovation and ingenuity in science and in technological development. Immense technological challenges have been overcome successfully to enable some of us – a privileged minority worldwide – to enjoy a multitude of facilities undreamed of by most.

The pace of development is breathtaking. It has been said that human achievement is no longer limited by technological capabilities, but only by our capacity to imagine what technology can do for us.

These achievements have delivered an astonishing array of capabilities and devices that, together, offer significant advantages for professional activity, learning, leisure, entertainment, travel, health and every other aspect of human life to those citizens who are privileged to be able to access and use them. The Internet for example delivers the possibility of instant access to more information than we can imagine – and growing by the hour (estimates vary, but the rate is astonishing: millions of new web pages are added each day); the ability to communicate with one individual or with many, for whatever purposes we choose; to send and receive not only text, but pictures, movies and sounds; the ability to browse, order and buy a vast range of goods and services. Whether at an individual level, within organisations, or between communities and nations, the Internet is changing lives in innumerable ways.

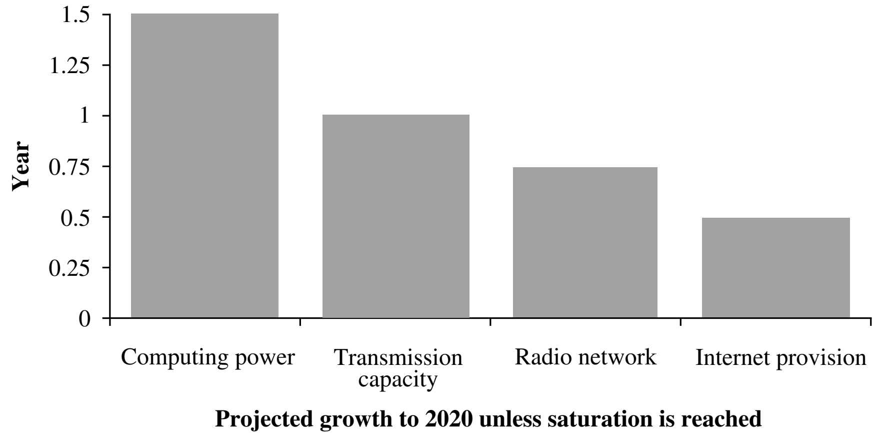

Fig. 2.1. Growth rates for web-related technologies (European Commission 2000).

Devices such as personal computers, laptops and personal digital assistants (PDAs) mean that all this information and communication power can (theoretically at least) be accessed by individual citizens. High speed digital telecommunications deliver the services of the Internet; mobile phones allow us to communicate almost anywhere, accessing both voice and a wide range of other data. Broadband services carry data more quickly and at greater volumes. Wireless telecommunications mean that we can access these resources without the need for physical connections. Geographical Information Systems (GIS) enable us to gather, transform, manipulate and analyze information related to the surface of the earth, in a variety of formats. They are used by citizens as well as by agencies for navigating in vehicles, and also for locating and tracking. Virtual reality – advanced 3-D graphics and immersive facilities enable us to create and explore simulations for a multitude of purposes, including gaming. Digital media (e.g. CDs, DVDs, MP3 players) allow us to store, manipulate and retrieve digital information for a wide range of uses including entertainment and education. These capabilities are being exploited not just to provide new functions and features for individuals to use, but to deliver a vast range of services such as e-learning, e-banking, e-commerce, e-science, e-medicine, e-government – e-etcetera! As well as providing sophisticated new services, they provide new ways of accessing traditional services.

2.2 Fulfilling the Promise?

With all these miraculous functions and capabilities, it seems, to paraphrase Nardi and O'Day (1999), churlish to criticise. Yet, on the one hand, there are still billions of people across the globe who do not have access to the potential benefits of the digital world. On the other hand, for those of us who do, enjoyment and recognition of the achievements is often overshadowed by the shortcomings of the products, systems and services and the ramifications for society more broadly. Some examples of the limitations of services aimed at the general public are discussed below.

2.2.1 Government Services

In the UK a new computer system was implemented in 2003 to manage tax credits for families with lower earnings, an initiative aimed at alleviating poverty. However the computer system has been blamed for the fact that many who were eligible for tax credits either received underpayments or overpayments. Neither of these situations is satisfactory for people on low incomes – particularly since the agency involved (the Inland Revenue) has requested immediate repayment of amounts overpaid, totaling thousands of pounds in some cases. Unfortunately the recipients of overpayments were often unaware that they were receiving more than their entitlement and had thus assumed the money was theirs to spend. As a consequence when the Inland Revenue made demands for repayment, they had no funds available to do so. Some turned to loans at high rates of interest in order to make the repayments. Thus a system which was designed to help families on a low income has resulted in some situations where people now have less money to spend rather than more (BBC Radio 4 2005).

2.2.2 Digital Television

In the UK, the Government has embarked upon a process of switching over from analog to digital broadcasting, with plans to switch off analog broadcasting completely by 2012. Digital television offers a high quality signal and an enhanced range of programmes. It also offers the potential to access the Internet and its corresponding benefits from home without the need for a personal computer, by using interactive services. While there are numerous potential advantages, there are also some challenges. Although more than half the population has already switched over voluntarily (OFCOM 2005) a significant proportion of the population has not, and many cannot see why they should – they are not interested in the additional content and facilities that it would deliver. The new services require new equipment both to receive the broadcast signal and to access the new functions and features (precisely what depends on what you already have). The hardware involved is far more complicated to operate.

Fig. 2.2. A and B The difference in complexity of TV remote controls.

Figure 2.2A and 2.2B illustrate one of the consequences that the explosive growth in functionality and choice of features has for the user. Fig. 2.2A is an early remote control (circa 1980) for an analogue television set. This remote control enabled the TV viewer to remotely change the major parameters of their TV viewing with just three buttons. A simple toggle switch allowed the viewer to move between the four terrestrial TV channels that were available at that time or switch the TV off, and two buttons controlled the sound volume – one to increase it and the other to decrease it.

In sharp contrast, Fig. 2.2B shows the remote control for interactive digital television received via satellite. This has more than 40 buttons which greatly increases the complexity of the task facing the user to change channels and volume. In addition the user can also control and programme a range of other features. Because of the vast number of channels available, the user is given a variety of means of changing channels. For example, one button gives access to a seven day electronic programme guide, then there are buttons to navigate up, down, backwards and forwards through this, and another button to select the desired option. Alternatively, numbered buttons allow the user to enter the channel number directly, or (when watching a particular channel) the user can use the navigation buttons to move backwards and forwards through the channels in numeric order. There are other buttons which enable the user to move through the electronic programme guide day by day. Yet more buttons give access to menus of user services, interactive services, teletext, programme synopsis information, etc. The whole control process thus relies on the user having a mental model of the concept of multi-layer functionality and the capacity to memorize the procedure for navigating through these layers.

The remote control in Fig. 2.2A was an additional optional control device; the television could still be operated by buttons on its panel. However, with new devices (Fig. 2.2B) the only way in which specific features can be setup and changed is using the remote control, with the user no longer having the option of using the television set itself.

Studies have shown (e.g. Carmichael 2001) that these more complex controls present particular difficulties for the older citizen and those with certain disabilities – many of whom are perfectly able to operate their existing analog equipment. Citizens who face these difficulties may not only face the threat of losing access to a familiar and highly valued service, but also a sense of loss of control and a sense of powerlessness over their lives.

2.2.3 Local e-Government

Government in the UK had the aim of making all its services available online by the end of 2005. As a part of this process, all local authorities now have a website. A number of these are well designed and offer a range of useful services to citizens including the ability to pay bills electronically. However annual surveys of local authority websites carried out by Socitm (e.g. Socitm 2005) show that many of the websites at this point simply provide citizens with an alternative format for accessing information about their local authority and services. Other studies (e.g. Olphert and Damodaran 2004) have suggested that even so, local authority websites may not be fully meeting citizens' information needs. In a small pilot study, searches were performed on a sample of 20 local authority websites on queries of interest to citizens (such as the availability of local play facilities, or disabled access to local attractions). While the searches returned 'hits' in about 50% of the sampled sites, often the information that was found was not relevant or sufficient to answer the query. For example, in many cases the search brought up internal council documents (e.g. minutes of meetings) where reference might be made to the council's expenditure on play facilities, rather than describing the facilities themselves or their locations. Furthermore, the annual Socitm surveys reveal that a significant proportion of local authority websites are not easy to use or fully accessible to citizens.

2.2.4 Mobile Phones

Mobile phone companies have invested billions of pounds in developing new 3G services which allow customers to access the Internet and all its benefits from their mobile phones. So far, however, the general public have not rushed to adopt this new technology. Sales have been disappointing, and indeed there is evidence of a degree of 'backlash' in the market against the complex range of features which many mobile phones now offer. Some companies have recognized that some customers at least want a phone which is very easy to use simply as a phone, rather than as a camera, games console, music player etc. They have also recognized the difficulties that some users (in particular older people, who are under-represented in the mobile phone market) experience with small buttons and small screens. Consequently some companies are now making a virtue of producing simple, easy to use phones with fewer functions, large buttons and large screens.

2.3 Vision versus Reality

Four decades on from Sackman's predictions (1967), where is the freedom and fulfillment we were promised in place of human drudgery? Instead of freedom from drudgery, new forms of techno-drudgery have evolved. Thus, for example, a simple visit to the bank to raise a query has been replaced by the mind-numbing tedium and error-prone frustration of telephone banking: entering passwords, remembering how to negotiate security checks, and entering 16 digit account numbers. If you succeed in avoiding all the built-in traps in this process then you may have the privilege of speaking to a human being. Your communication problems may not end here however. The capabilities of modern technology may mean that the person you are speaking to is in a call centre on the other side of the world. They may be unfamiliar with your accent, your locality, your culture or even the country where you are domiciled and you may have trouble understanding each other.

Let us review Sackman's predictions (1967). One was that computers would free us from drudgery. And indeed there are now many digital tools available to relieve us of tedious chores in the workplace and in the home. The awesome 'number crunching' power of computers has freed us from the chores of mathematical calculation; word processing programmes and electronic publishing facilities make producing and manipulating text based documents a relatively simple task, compared to preparing them in the traditional way. Spell checking, formatting and reformatting, grammar checking, changing one word for another – all can be done with a few key presses. Optical character recognition can even remove the need to type a document.

Table 2.1. Sackman's vision and the reality of digital developments

Vision	Reality	
	Benefits include:	Drawbacks include:
Freedom from drudgery	data processing 'instant' printing and publishing background processing	neo-Taylorism loss of control tedious security procedures
Enhanced creativity and greater leisure time	tools for creativity office and factory automation mobile working	not everyone wants the extra work job losses work-life boundaries blurred
Augmented human capabilities, 'human - computer symbiosis	microtechnology immersive environments pervasive computing	concerns about security and privacy authority control

We no longer have to develop photographs using wet chemicals – we can simply slot the memory card from our digital cameras into the computer and print them at home. We can have computer programmes running in the background, with no need for supervision – to perform tasks like searching for signals from radio telescopes for signs of extra terrestrial intelligence, or (more mundanely) to print out a document, while we get on with more important or interesting things. But this same technology has also enabled the creation of call centers, which are growing all around the world and which are employing increasing numbers of people. Here often the jobs of workers are highly routinized with little or no scope for variation, imagination or learning, counter to well-researched principles of good job design (e.g. Davis and Taylor 1972). Work is paced by the computer and performance is closely monitored – an unwelcome return to the principles of Scientific Management developed by FW Taylor at the beginning of the 20^{th} century (Taylor 1911). The need for security and protection of our personal information and systems brings other kinds of drudgery – such as the need to enter (and remember) numerous passwords and logins and registrations and PINs whenever we interact with a system; or the need to make backups and store copies of our digital data, in case of system failure; and the need to contact helpdesks when we find it has all gone wrong. We may find we cannot retrieve money or information from our own bank accounts because we have entered the wrong sequence of numbers, or we can't access all the work we did yesterday because the system has locked up. Computers have also given us 'information overload' – wading through 'spam' emails, throwing out junk mail, trying to find the right document in vast databases or even in the mountains of paper which we have too easily printed out – these are all chores that we can do without and which impact on our quality of life.

Sackman (1967) also envisaged a future where we would expand our creativity. Certainly digital technologies can offer us this. Not only can we store and access vast quantities of music, games, TV programmes, films and radio, but we can create and manipulate them too; we can make our own recordings, produce our own films, create our own radio shows, make our own digital artworks, build our own websites and write our own blogs – and make them available to a potential worldwide audience through the Internet. He also envisaged a world where we would have more leisure time (possibly even excessive leisure time) as computers took over aspects of 'work'. Indeed, we have automated vast swathes of traditional activities, with computer controlled production, office automation, etc. This has of course led to excessive "*spare*" time for some – i.e. those who have lost their jobs as a result of automation – but it has changed the nature of work. Service industries have grown, and in the information age, knowledge work and computer support have become important. The demand for these skills never stops – and thanks to computers and telecommunications, workers can be reached at any time or any place. For many people in employment, the work/life boundary has become blurred and the idea of excessive leisure time is pure fantasy.

Finally, Sackman (1967) envisaged a world of human-computer symbiosis. And yes, we have this too. Microtechnologies, embedded technologies, immersive environments – the future promises even more pervasive technology. Current research and development is making it possible to embed intelligence in our surroundings and in the objects or artefacts that surround us, which has led to the term "*smartifacts*" being coined to describe items that have embedded intelligence and sensors enabling them to detect changes in their environment. Computing, communication and intelligent user-friendly interfaces are converging to create the "*ambient intelligent landscape*" where intelligence will be embedded in our phones, in our clothes, in our household appliances, and even in our pets. But such developments raise significant questions about control, authority, security and privacy – who is in control of these technologies that we cannot see, are not aware of? How do we know what they are doing, what data they are collecting about us, how it will be used?

While new technologies have undoubtedly delivered many exciting and rewarding opportunities, it is clear that they have not come without a cost. The vision of fulfillment and opportunities to enjoy human-computer symbiosis can seem a long way off. Although there are undoubtedly many benefits from the advent of new technology, it could also be argued that, in many cases, the technology has simply brought new kinds of drudgery and different kinds of routine tasks. Since such systems now underpin every aspect of our lives in the Information Society their impact is considerable. In the sections below we consider some of the factors which might have led to this situation, and examine possibilities for influencing ICT design in order to deliver more desirable digital futures.

2.4 How Did We Get Here?

There has for centuries been a strong body of opinion that technology is deterministic, that is to say, that the developments themselves are inexorable, and that despite the benefits, negative impacts are inevitable and unavoidable. Negroponte (1995) for example asserts that being digital is inevitable, "*like a force of nature*". It is suggested that both the speed and the scale of technological change that we face in the modern world contribute to this sense of inevitability; Toffler (1980) calls this 'future shock'. Nardi and O'Day (1999) make the point that the speed of communication in the modern world has had the effect of accelerating the speed of change in every aspect of life, and note the erosion of tradition and identity entailed by the constant necessity of moving on to the next tool, the next technology, the next fundamentally different way of doing things. "*We are adapting to technology rather than controlling its fruitful and pleasurable use.*" They add that nothing about tool use is fundamentally new to us as a species, but that our ability to absorb new tools – and the different ways of "*doing*" and "*being*" that emerge with technological change, are challenged by the avalanche of innovation we are experiencing. The suggestion embedded in their observations is that it is our sense of powerlessness in the face of such diffusion and complexity that makes us believe that technological advancement is inevitable and inexorable.

In contrast to the deterministic view of technology is the belief that technologies are shaped by multiple factors in its social and political context. Williams and Edge (1996) assert that there are choices (though not necessarily conscious choices) inherent in both the design of individual artefacts and systems, and in the direction or trajectory of innovation programmes, and that these choices may have differing implications for society and for particular social groups. If this is the case, then technology can be seen as negotiable, with scope for particular groups and forces to shape technologies to their ends, and the possibility of different kinds of technological and social outcome. Although the form and direction of future technologies may be negotiable, there are many reasons why we may not exercise real freedom of choice. New technologies tend to develop cumulatively, erected upon the knowledge base and social and technical infrastructure of existing technologies, and where increasing returns are sought for investment, this can result in 'lock-in' to established solutions (Williams and Edge 1996). The way in which ICT design is approached also exerts a powerful influence on the possible outcomes.

2.5 The Influence of Design Methods for ICT

From the earliest experimental days up until the early 1970s, the use of computers was confined to specialist research laboratories, and computing operations were primarily carried out by centralized, mainframe computers. Since they were both designed by, and used by, programmers and engineers, there was no need to involve anyone else in the process.

During the 1970s, however, developments in electronics – in particular the very large-scale integrated circuits and silicon chips – made possible the microprocessor and visual display units with integrated keyboard and screen. This led to the advent of the personal computer, which in turn enabled the migration of computers out of specialized laboratories and onto the desktop. When their potential for promoting efficiency and reducing costs became evident to leading business institutions, large-scale IT system development projects began to proliferate both in commercial organisations and in the public sector. At that time, appropriate off-the-shelf software was not available and organisations wanting to take advantage of the benefits of computerization had to finance and develop their own 'bespoke' applications. This was a costly exercise, undertaken only by the largest and most well-resourced corporations. To achieve a return on such major investments needed large-scale implementations aimed at achieving significant cost savings and efficiencies. Computer system design of this nature was complex, hugely demanding of time and resources and embryonic expertise in IT development.

Consequently during the 1970s and 1980s, a number of methodologies evolved to support the development of large-scale, bespoke computer systems. Many of these were developed by systems analysts, such as DeMarco (1978), Gane and Sarson (1979), and Jackson (1983). Systems analysts tended to be drawn from the ranks of the computing profession, starting off as programmers, with formal training in mathematics, and then moving into analysis work. Such approaches to design tend to reflect this. They embody a technocentric focus, in which design is seen as the specification of a technical system, and where human activities are largely either automated or ignored. The focus of analysis is on the flows of information through a given environment and the different entities that make up that environment.

But although relatively influential, methods like these unfortunately did not solve all the problems associated with designing effective computer systems. Examples of truly successful computerization projects were few and far between and there were many examples of partial successes and even catastrophic failures (e.g. Mowshowitz 1986). The scene was set for what became an all-too-familiar pattern in large-scale IT systems developments. Typically the sequence begins with the statement of ambitious objectives, projections of significant improvements in productivity, forecasts of significant cost savings, and expectations of increased competitive advantage and improvements in service to customers. In reality the outcomes were (and, unfortunately, still are) often late delivery, escalating costs, a shortfall in performance and productivity, and user disillusion. Contemporaneous studies of the reasons for the lack of success of many high profile IT projects conducted in the 1980s (e.g. Kearney 1984) consistently highlighted the key areas of weakness as poor project management, inadequate definition of user requirements, and a failure to involve users adequately.

The realization that many design problems can be attributed to other than purely technical issues led to the development of new specification techniques and methodologies to assist in the design activity. Several were influenced by the concepts of systems thinking (e.g. Checkland's Soft Systems Methodology 1981) and sociotechnical systems theory (see Chapter 7 for more details). While these developed from a diverse philosophical and experiential base, they shared the recognition that the specification of requirements for information technology systems was the most difficult part of the design process, and that achieving a sound understanding of users' needs in turn required some interaction with users. It was also recognized (sometimes explicitly, sometimes as a by-product) that interaction with users helped to create user 'buy-in' which was an important element in successful systems implementations. But such engagement was typically confined to a small sample of users, who were relatively easy to identify because much of the systems development activity was targeted at 'bespoke' systems built for specific applications within individual organisations. User involvement was also typically confined to specific points in the design process, e.g. as part of the requirements definition process once the initial computer system had been scoped, and then again in user testing of prototype and final versions of the developed system. Users therefore had little opportunity to influence the scoping, planning and overall shaping of the systems, or to explore alternative options and their consequences. Yet at the level of the individual user, their experience of existing technologies and products will influence and constrain their expectations about the "*shape*" of future technologies and products.

An exception to this 'ping pong' approach to user involvement occurs in participative ICT design approaches, which have been adopted by a relatively small number of ICT design projects. Mumford, a pioneering advocate of participative design, who developed a method called ETHICS (1983) in response to the limitations of existing approaches summarizes her perceptions thus: "*my interest in changing system design practice was stimulated by observing the bad human effects of many early computer systems. Work was frequently routinized and controls tightened as a result of the new technology. Systems analysts, as designers were called then, appeared to have little understanding of the human consequences of their work. The difficulties of technical design appeared to displace any concern for human feelings.…When computers first appeared in the offices in the late 1950s and 60s, their costs and limitations meant that they were often introduced in an authoritarian manner. 'This is what we can provide and you must have it' was a common technical attitude. Then as user resistance was encountered, strategies changed to a soft sell approach: 'This is what we can offer and it is just what you want.' Overselling of poor systems led to user scepticism and gradually analysts began to realise that they need to talk to users before producing a product: 'We think we know what you want but we'd like to discuss this with you'. This led to the practice of interviews with single users*" (in Schuler 1993).

The need for designing systems around the needs of users (human-centered design) is now well accepted by the design community (and indeed is embodied in standards such as ISO 13407 Human Centred Design Processes for Interactive Systems 1999). But, as Clement and Van den

Besselaar (1993) note, "*while modern methods for information systems development generally accept that users should be involved in some way, the form of the involvement differs considerably. Mostly, users are viewed as relatively passive sources of information, and the involvement is regarded as "functional", in the sense that it should yield better system requirements and increased acceptance by users*."

Designing technologies for use by a wide variety of citizens is currently one of the biggest challenges facing those involved in the design, development and delivery of ICT based products and systems (e.g. Shneiderman 2000). In addition to the well established procedures for human-centred design there is now a bewildering array of information, guidance, tools and techniques available to designers for inclusive design (known in the US and Japan as 'universal design' or by the goal of 'universal usability'; sometimes referred to as 'Design for All'). These provide, for example, information to designers about the physical parameters of specific groups within the population such as older people and disabled people – 'extra-ordinary users' (Newell and Gregor 2000) – who may have special needs compared to the 'ordinary' population.

Despite the growing recognition of the need for the involvement and engagement of users in the ICT design process, however, surveys of design practice suggest that in many situations designers still do not seek information directly from the end users they are designing for. Rather they rely on personal experience and imagination to define their needs and characteristics (e.g. Hasdogan 1996).

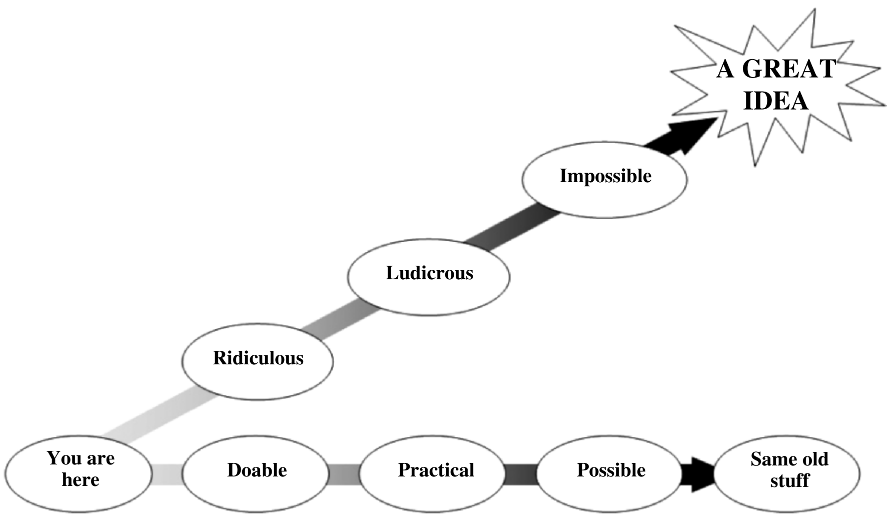

Fig. 2.3. Different approaches to design (Cooper 1999).

Another serious limitation of design methods is that they limit the scope for imagination and creativity. Cooper (1999) observes that "*when engineers invent, they arrive at their solution through a succession of practical, possible steps*." Because of this, their solution will always be a derivative of the old, beginning solution. What happens through successive iterations of prototyping and evaluation is that, while unsatisfactory qualities and features may be eliminated, it is harder to ensure that novel and desirable qualities and features are 'designed in'. To do this requires a different strategy from the conventional systems analysis approach – one which begins not with analysis but with imagination, and which encourages the widest exploration of opportunities and possibilities before commitment.

2.6 Did Anybody Ever Ask Us?

Our disappointment and frustration with the shortcomings of ICT are perhaps exacerbated by the underlying sense that we can't remember anyone ever asking us if we really wanted all these amazing widgets – nor were we told of the price we would have to pay in frustration, lost time, and loss of control over aspects of our own lives. We were never consulted about the desirability, the dangers, the consequences, what we might have been able to have instead, how we might want to interface with the technology, what we would like it to do most, and how much we wanted to pay for it. We have accepted what has been provided, awed by the wonder of technological progress and the immense capabilities now in our hands.

2.7 Conclusions

In this chapter we have briefly reviewed the evolution of the design processes which underpin the development and implementation of ICTs and their use by a growing range of people. We conclude from this examination that, despite the high cost of failing to engage citizens, active practice of citizen engagement in the design of ICTs is still very limited. We have observed that the expansion of the user population, beyond the confines of the employment sector to now include all citizens in our society, has stimulated a growth in inclusive design methods and tools. Yet most of the approaches in use are not participative in nature – even those which have the explicit objective of achieving inclusivity through the resultant design outcomes. Moreover, the focus of design effort continues to be on technological systems, rather than sociotechnical systems. For our nascent Information Society, this means that the design of the digital technologies fails to benefit from the immense pool of creative talent, wide and varied knowledge and expertise of many stakeholders in our society – its citizens.

References

BBC Radio 4 (2005) 'Inside Money' – Taking the credit – Broadcast on 13/08/2005 – 12.04 BST. More information at: http://news.bbc.co.uk/1/hi/programmes/inside_money/4740091.stm

Carmichael A (2001) Elderly Users of Interactive Television: Challenges and Opportunities. Presentation to ITC 'Easy TV' Seminar.

Checkland P (1981) Systems Thinking, Systems Practice, Wiley, Chichester.

Clement A, Van den Besselaar P (1993) Participative design projects, a retrospective view. Communications of the ACM 36(6), pp 29-37.

Cooper A (1999) The Inmates are Running the Asylum. SAMS Publishing, Indianapolis, Indiana.

Davis LE, Taylor JC (1972) (eds) The 'Design of Jobs', Penguin, London.

DeMarco T (1978) Structured analysis and system specification. Englewood Cliffs, NJ: Prentice Hall.

European Commission (2000) Information Society and Technologies Advisory Group Report 2000.

Gane CP, Sarson T (1979) Structured System Analysis: Tools and Techniques. Prentice Hall, Englewood Cliffs, NJ, 1979.

Hasdogan G (1996) The Role of User Models in Product Design for Assessment of User Needs, Design Studies, 17(1) pp 1-33.

Jackson MA (1983) System Development, Prentice Hall, Englewood Cliffs, New Jersey.

Kearney AT (1984) The Barriers to Information Technology – A Management Perspective. Orpington: Institute of Administrative Management.

Mowshowitz A (1986) Social Dimensions of Office Automation. Advances in Computers. 25, pp 335-404.

Mumford E (1983) Designing human systems. Manchester Business School Publications, Manchester.

Nardi BA, O'Day VL (1999) Information Ecologies: Using Technology with Heart, Massachusetts. MIT Press.

Negroponte N (1995) Being Digital. New York, Knopf.

Newell AF, Gregor P (2000) Designing for Extra-ordinary People and Situations CSERIAC Gateway (Crew System Ergonomics Information Analysis Center), XI, 1, 12-13.

OFCOM (Office of Communications) (2005) Digital television UK household penetration reaches just under 60%. http://www.ofcom.org.uk/media/news/2005/03/nr_20050330

Olphert CW, Damodaran L (2004) Dialogue with Citizens – the missing link in delivering e-government? In: Proceedings of the International Conference on Politics and Information Systems: Technologies and Applications, Orlando, Florida, 21-25 July 2004. International Institute of Informatics and Systemics, pp 95-99. ISBN 980-6560-21-3.

Sackman H (1967) Computers, System Science and Evolving Society. New York, Wiley.

Schuler D (1993) (Ed) Participatory Design: Principles and Practices. Lawrence Erlbaum Associates.

Shneiderman B (2000) Universal Usability. Communications of the ACM 43(5) May 2000.

Socitm (Society of Information Technology Management) (2005) Better Connected. SOCITM, London.

Taylor FW (1911) The Principles of Scientific Management. Harper, New York.

Toffler A (1980) The Third Wave. Bantam Books, New York.

Williams R, Edge D (1996) The Social Shaping of Technology, Research Policy, 25, pp 856-899.