The market potential for Smart Homes

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Executive summary

The Joseph Rowntree Foundation commissioned the Consumers' Association to research and report on whether there is a potential mass market for Smart Home technology. Although there are currently few Smart Homes in the UK, this preliminary research suggests that Smart Home technology (or variants of it) could have a mass consumer market.

Background

Smart Homes use electronic networking technology to integrate the various devices and appliances found in almost all homes, plus building environment systems more common in factories and offices, so that an entire home can be controlled centrally – or remotely – as a single machine. This technology offers the prospect of significant improvements in the living standards of the elderly, infirm and disabled who, without automated domestic activities, may otherwise be totally reliant on home care.

However, these benefits can only be realised if the technology becomes affordable and accessible to those who most need it. This is only likely if a broader consumer market develops – thus pushing down prices and increasing availability.

The research conducted by the Consumers' Association helps identify whether a mass consumer market for Smart Homes could exist.

The research comprised:

- desk research to provide background context to the potential development of a mass Smart Homes market
- a survey of over 1,000 households which examined consumers' attitudes and interest in the Smart Home concept
- interviews with relevant experts to identify their views on the prospects for Smart Homes, and their reactions to survey results.

Supply

In recent years, there has been a modest increase in the building and conversion of properties that have embedded Smart Home technology. Moreover, there has been increasing – albeit, too often costly – access to the technology for 'expert home improvers' and 'DIYers'.

There remains, however, a general lack of enthusiasm on the part of construction and property industries, manufacturers and suppliers to push – or even properly promote – this technology. The lack of common standards, an inappropriately skilled workforce and concerns that 'it's just a fad' has meant the Smart Home market has yet to develop a sustainable momentum.

There are, though, changes on the horizon that could stimulate more activity from potential suppliers:

- *Scale economies from the American market*. The growing use of Smart Home technology in the USA could deliver the economies of scale necessary to reduce average costs and, hence, prices. Although it may take time to feed through, this could reduce prices here in Britain.
- *New technologies*. There are up-coming technologies that will add to the functionality, ease of use and convenience of Smart Home systems, while improving their cost-effectiveness. Moreover, the

development of new communications technologies – such as 'Bluetooth' and the 'XML' language – offer the not-too-distant prospect of common standards for electronic dialogue between Smart Home devices (although it is still unclear how many standards will exist!).

- *Interest from the consumer electronics industry*. With an ever increasing range of home and personal electronic gadgets available, many major corporations in the consumer electronics industry consider the user-friendly integration and combined control of multiple devices as crucial to their future success. As such, the addition of Smart Home devices and functionality to home entertainment systems is a realistic medium-term prospect.

Demand

The survey of consumers' attitudes indicates that there is underlying public interest in Smart Home technology that could be unleashed if the market develops – and prices fall – appropriately.

While views are mixed, around half of those surveyed expressed interest in the Smart Home concept (although this may not translate fully into willingness to pay). As a generalisation, the results suggest that people fall into one of three groups:

- *'The interested'* – those interested in living in a Smart Home (45 per cent of respondents). Most likely to be: people aged 15–34; family households; those with pay TV and home entertainment systems (i.e. DVDs and video games consoles); those with PCs and/or Internet access; those on higher incomes; those who hold positive attitudes about new technology.
- *'The ambivalent'* – those who were neither interested nor uninterested in the idea (19 per cent). These respondents were well represented across all groups in the population, though marginally more likely to be older and on medium/low incomes.
- *'The uninterested'* – those not interested in living in a Smart Home (37 per cent). Most likely to be: aged 55 and over; households without children; households without PCs, pay TV or home entertainment systems; those who hold negative attitudes towards new technology.

The results also indicate what characteristics attract interest in Smart Homes.

Unsurprisingly, the Smart Home is most attractive to more *pro-technology consumers*, including the so-called 'early-adopters' vital to the early development of high-technology markets. Households that reported the most positive attitudes towards new technology – and have greater ownership of newer technologies such as home entertainment equipment and PCs – also demonstrated greater interest in living in a Smart Home.

But, in addition, the Smart Home appealed to a broader range of consumers because of its potential *safety and security* benefits. The high level of interest in the safety and security features suggests this might be a powerful

driver to attract less technology-literate purchasers into the Smart Home market. The benefits of remote control also had wide appeal.

The survey also identified *concerns* among consumers about the apparent complexity of the system and the potential for 'technical hitches'. Importantly, consumers across all three groups – interested, ambivalent and disinterested – voiced similar concerns, suggesting this is not a problem that will limit interest in the technology but is something that will have to be overcome if consumers' confidence in Smart Homes is to be nurtured.

Opportunity

With the infant Smart Home and other associated high-technology markets changing so rapidly, any predictions for their future are highly uncertain. Nevertheless, this research does identify reasons to be optimistic that a mass consumer market for Smart Home-type technology could develop.

There appears to be significant consumer interest in the concept which could be unlocked at the right price.

But, if a market does develop, it seems less likely to come from impetus in the building, construction or property sectors. The greater opportunity for growth in the use of Smart Home technology appears to be from its addition to the burgeoning array of consumer electronics – especially home entertainment and personal communication systems – and initial demand from the more technology-literate early-adopter households.

1 Introduction

The Joseph Rowntree Foundation has commissioned the Consumers' Association to research and report on whether there is a potential mass consumer market for Smart Home technology. This report describes the research that has been conducted and outlines the key findings.

What are Smart Homes?

Smart Homes use electronic networking technology to integrate the various devices and appliances found in almost all homes, plus building environment systems more common in factories and offices, so that an entire home can be controlled centrally – or remotely – as a single machine.

The recent report on Smart Homes for the Joseph Rowntree Foundation and the Chartered Institute of Housing offers one of the best descriptions of the Smart Home concept:

> *Cars have central locking, electric windows, remote controlled mirrors, CD auto changers – and the rest! And factories, offices and shops are often highly automated, giving staff control over their environments, and making buildings more efficient. Automatic doors, blinds that close when the sun comes out, infra-red lighting controls – they are all becoming commonplace.*
>
> *But you don't find that sort of thing in people's homes much … or do you?*
>
> *We do have remote controls for our TVs, we do have smoke detectors and passive infra-red burglar alarms, we do have timers on our central heating. But all these devices are separate entities. Each affects only one activity or aspect of the home.*
>
> Smart Homes *are about something much more exciting. They are about using the latest information and communications technology to link all the mechanical and digital devices available today – and so create a truly interactive house.*
>
> (D. Gann, J. Barlow and T. Venables, *Digital Futures: Making Homes Smarter,* Chartered Institute of Housing/JRF, 1999, p. ix)

Research context

Smart Home technology offers the prospect of significant improvements in the living standards of the elderly, infirm and disabled who, without automated domestic activities, may otherwise be totally reliant on home care.

These benefits can only be realised if the technology becomes affordable and accessible to those who most need it. However, this is only likely if a broader consumer market develops – thus pushing down prices and increasing availability.

This report outlines research conducted by the Consumers' Association to identify whether such a mass consumer market for Smart Homes could exist.

Report outline

Chapter 2 provides some background context to the potential development of a mass Smart Homes market. It examines the background to the Smart Home market – both here in the UK and in the USA – and outlines some factors that may influence its potential future growth.

Chapter 3 reports the results of original market research conducted as part of this study. A survey of over 1,000 households examined

consumers' attitudes to the Smart Home concept. This provides the basis of assessing underlying public interest in the technology, and identifies which groups in society are most likely to acquire Smart Homes.

Chapter 4 describes the views of industry experts. Interviews have been conducted with a range of experts to identify their views on the prospects for Smart Homes, and their reactions to the results of the consumers' attitudes survey.

Chapter 5 provides conclusions and Chapter 6 gives detailed research notes.

2 Market context

This chapter examines the background to the Smart Home market – both here in the UK and in the USA – and outlines some factors that may influence its potential future growth.

First, this chapter looks generically at the adoption of new technology by consumers. Second, it identifies some key underlying supply-side drivers for change in the Smart Home market. Third, it looks at the experience from the USA. Fourth, it provides an overview of the UK Smart Home market. And finally, it briefly reviews some relevant technology developments that may impact on future Smart Home provision.

Speed of take-up of new technology

Although every new innovation is unique and its adoption by consumers different, there are lessons that can be learnt from looking at how quickly other technologies managed to reach a mass market, and what factors influenced the pace.

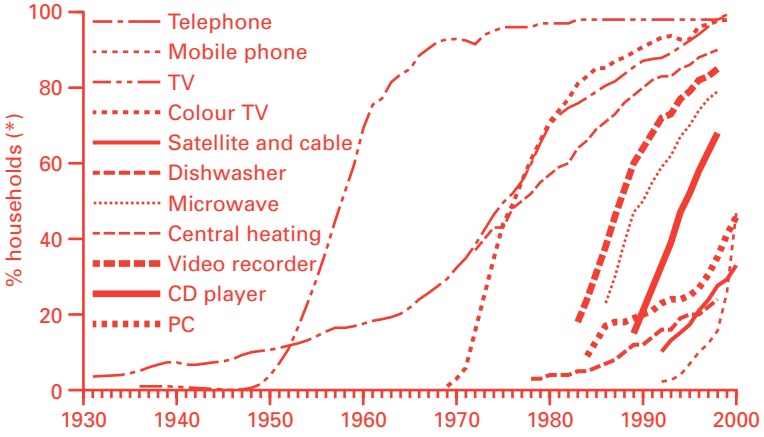
The 'S-curve' of new technology adoption

There is a standard pattern to the adoption of new consumer products – the so-called 'S-curve'.

Figure 1 demonstrates how ownership of different consumer technologies has changed over time. The graph illustrates that most technologies appear to follow an 'S-curve' pattern of technology adoption. This is characterised by slow take-up in the early years, followed a more rapid increase in adoption which moves the product into the mass market arena. Finally, as the market matures and take-up slows, the gradient of the S-curve become more shallow as it approaches a maximum level of market penetration (or 'saturation').

While most technologies follow the S-curve pattern of adoption, they do so at varying rates (i.e. the S-curve varies in steepness and shape). For example, the telephone took over 50 years to reach 80 per cent of households yet the television took only 15 years. Similarly, the dishwasher has only reached 24 per cent market

Figure 1 Adoption of new technologies over time



Source: General Household Surveys 1972-98, BARB, BT, Oftel, ITC, BskyB, ONS.
Note: Data refer to percentage of households for all goods except mobile phones; here data refer to percentage of population.

penetration after being in the marketplace for over 20 years, whereas the microwave has reached almost 80 per cent penetration over a similar period.

Factors that affect take-up

A range of factors influence the take-up of new technologies as follows:

1 Economic
- price and availability
- income levels
- consumer spending levels

2 Social
- patterns of work and leisure
- gender roles

3 Consumer
- attitudes towards new technology
- needs and wants
- confidence in new technology

4 Technological
- degree of innovation
- development of competing and complementary technologies

5 Global/political
- environmental concerns
- world events
- economic and social policies.

These factors work together to determine the final shape of the adoption curve. For instance, rising standards of living and the increasing participation of women in the workplace were two of the key drivers which led to the mass-market adoption of labour saving technologies (e.g. washing machines, microwaves, etc) in the 1970s and 1980s. Rising levels of wealth have also led to demand for more comfort in the home; over 90 per cent of households now have central heating.

Consumer attitudes towards new technologies are also key to determining take-up. In general, consumers have become more accepting and less wary of new technology in recent years and this has led to steeper adoption curves for newer technologies (e.g. CD players, video recorders and mobile phones). Nevertheless, the more familiar the technology and its use, the quicker its likely take-up. For example, the rate of adoption of colour TV, which was an incremental improvement on the popular black and white model, was much more rapid compared to that of the PC, where few predecessor technologies existed. It has taken 15 years for PC ownership to rise from 9 per cent to 45 per cent, whereas ownership of colour TV rose by a similar level (6 per cent to 44 per cent) in only five years.

This may bode well for the adoption of Smart Home technology. Although Smart Homes are innovative, most of their components – i.e. the household devices and appliances – are familiar. This should make the concept easier for consumers to understand and, hence, could make them more willing to purchase.

The pace of adoption is also heavily dependent on the degree to which consumers feel they need or want the technology in question – and this is something that changes rapidly over time. Microwaves were once seen as a luxury item but are now considered, by many, to be a necessity. Dishwashers on the other hand are taking longer to become mass-market items. This may reflect in part the fact that consumers still regard them as a luxury item or perhaps that many consumers don't

have room for a dishwasher in the kitchen!

A survey of consumers' attitudes to Smart Home technology has been conducted as part of this research. This survey (see Chapter 3) provides some original insight to consumers' underlying motives for and against acquiring Smart Home technology.

The development of one new technology can also affect take-up of others. For example, the introduction of Internet access via digital TV is likely to initially have an adverse impact on the pace of adoption of home PCs. However, digital TV may also act to increase adoption of widescreen televisions, DVD players and surround sound systems. This illustrates how new technologies can act as both complementary and competitive forces. There are a number of technology developments that could impact on the future adoption of Smart Homes; these are discussed in the section on technology developments.

Key supply-side drivers for change in Smart Home technology

Growth in a market depends both on demand- and supply-side factors. Looking specifically at the supply of Smart Home technology, there do appear to be drivers for future change.

While at a less sophisticated level than today's Smart Home technology, 'automatic' home network facilities and functions became a real possibility over 20 years ago in 1979 with the introduction of a technology called X-10. This was developed in the UK where it failed to take off, though was more successful in the USA. Indeed, X-10 is still marketed extensively in the USA, primarily as a DIY product. The system controlled home electronic devices by sending and monitoring the results of command signals sent across the electrical wiring. This made the systems, previously restricted to the industrial and commercial office building sector, available economically to builders for embodying in new homes and retrofitting into existing residential properties.

Currently, two of the more important system control and integration protocols are European Installation Bus (EIB) and LonWorks. EIB is designed to operate in homes and large commercial buildings, with applications that include control of heat and ventilation, lighting, shutters, and monitoring and supervision. LonWorks is designed to provide communications over a variety of physical media for a wide range of products and systems in building automation and other networked, distributed control applications.

Twenty years on from X-10, there are two new technological drivers which could give new impetus to the Smart Home concept.

- First, the advent of powerful microprocessors now allows the electronic control of almost all mechanical appliances. Whereas washing machines, dishwashers and televisions were once controlled using mechanical devices, nowadays the microchip facilitates their control and operation by electronic means including remote control.
- Second, the increasing pervasiveness of new digital communications protocols – such as the Internet and, maybe more importantly, new wireless protocols like 'Bluetooth' – provide opportunities for standardising communications between appliances and equipment, and for

making the interface between users and equipment more straightforward and easy to use.

The upshot of this change is that the line between consumer electronics, household appliances and computers is growing increasingly blurred. In this context, appliances in the home may become conceived more in terms of integration than mere automation. Smart appliances and devices will increasingly function not as remotely controlled stand-alone gadgets (e.g., television, telephone or garage door), but as components of an in-home hard-wired or radio driven network – which, in turn, will connect to the outside world via the Internet or telephony. In this context, it is also important to consider powerline signalling, which improved digital signal processors and now offers a robust communications technology which is 'plug and play'.

Evidence from the United States

Although there are Smart Home experiments – e.g. by Integer and, of course, the Joseph Rowntree Trust – in the UK, it is also relevant to look at evidence from the USA as this may give some indication of how the European market for this technology will develop.

Developments in the US market

The level of functional sophistication reached at the top end of the US market can be gauged from the recent opening of a Californian beach house with a 'central network machine' in the basement. This integrates Ethernet hub, land-line and satellite telephone equipment with digital lighting control units, satellite and cable television master controllers, an intelligent video–audio system, and the fire and security system control. The level of light entering the house from outside is controlled by photosensitive window glass and the system is networked with the house air-conditioning and ventilation system. In the main lounge a small television monitor displays a control interface, which the occupant can access using wireless technology. The lighting control and power cables are concealed behind wall panels.

Even outside California, the American experience demonstrates it is possible to link up kitchen appliances, intruder alarms and home entertainment centres. This has been successful even in the absence of standard components or a common operating protocol. Moreover, some modern home network solutions now have a consistent and logical look and feel about them, and their use is becoming more intuitive.

Prices for new build or retrofit systems are falling, both for builders and for hobbyists in the DIY market, and the latest systems are expandable at only modest outlay. This is the result of an enlarging market size, combined with the availability of 'design modified systems' formerly used in commercial office building. Moreover, the recent backing of the major computer companies for home wireless local area networks (and also for Phonenet and high-speed powerline LANs) has further helped to positively stir the market. Another stimulus has come from the prevalence in America of software houses able to lay the basis for standardisation regarding home network protocols.

The growth in the market has, to a limited extent, established a virtuous circle of increasing demand leading to cost and design improvements in the industry, which stimulates

further demand. For example, the increasing availability of engineers – with relevant skills and competencies – able to demonstrate the systems to potential customers, and to support existing customers, has helped raise consumers' confidence in the USA and may have had a positive impact on demand.

Currently the high-technology companies in the USA are anticipating that some of this Smart Home functionality will be demanded by a growing number of less wealthy consumers. As a result these corporations are struggling to establish standards for operating in and across the wide variety of communications media most home networks are expected to employ – namely, coaxial cables, phone and cable lines, and infrared and wireless signals.

On the software front, Sun Microsystems and Microsoft are already engaged in a code war. Sun is pushing 'Jini', a 'Java-like' language that will automatically configure components to 'announce' themselves to networks. This technology is derived from the 'manufacturing automated protocol' developed for integrating US automobile assembly plants. Meanwhile, Microsoft is developing its 'Universal Plug and Play', which is based on its own 'open standards'.

Take-up in the USA

Although the market for Smart Home technology is growing in the USA, one should be wary of overstating the rate of growth. Despite the technological developments, the adoption of Smart Home technology has been relatively slow, especially given how technology-literate American consumers are.

With the industry still in its infancy, there are conflicting expert views about the potential for market growth in Smart Home technology.

Some industry experts see computing everywhere in the house, connecting anything and everything. For example, optimistic estimates suggest 50 million homes will be internally networked across the USA over the next ten years.[1] Forrester Research is forecasting sales of $1 billion in the home networking market by 2002,[2] though this refers to Forrester's simpler definition of a networked home rather than a Smart Home.

But not all industry observers see the market growing in this way. Some are less sanguine. 'This is still technology looking for an audience', according to Rob Enderle of the Giga Information Group. In his view, 'The appliance makers are going to need to see real market activity before they start to build more than a few prototype refrigerators with browsers in them. And consumers are going to have to carefully balance novelty, utility and price'.

Notwithstanding this more sceptical view, experience from American DIY, luxury housing and condo markets demonstrates that demand for Smart Home functionality is growing. Smart Home systems are also being built into US prefabricated and trailer homes, which provides additional buoyancy in this nascent market.

Market in the UK

As things stand, there is currently no mass market for Smart Home technology in the UK and consequently prices for both new build and retro-fitted integrated intelligent home technology are high.

At the low end, integrated systems tend to be crude and sometimes unreliable, and there are no common standards for components or software. At the high end of the housing market,

meanwhile, there are high quality Smart Home systems already in situ in expensive London riverside properties.[3] However, these are costly projects and the volume they deliver is unlikely to yield the economies of scale needed to reduce average costs.

Demand side

As with the United States, the UK consumers' interest in the Smart Home concept has been mainly from the DIY or hobbyist segment of the market. Indeed, many of the Smart Home web sites, and to some extent the technical literature, are the preserve of these somewhat technically minded 'incremental' home improvers.

Full-blown Smart Home projects have until now been the preserve of the wealthy home owner, located most commonly in the south east of England and more specifically within the London area.[4]

Consumers who do buy into the technology seem, at least from the press reports,[5] relatively satisfied with their partial systems, which typically conjoin security lighting, intruder alarms and fire and security sensors. While some consumers may be willing to pay extra on a new or converted property to obtain limited Smart Home functionality, there may be greater reluctance to retro-fit such systems into their existing residences because of the anticipated mess and disruption.

Supply side

Currently Smart Home technology is dominated by US, Asian and European manufacturers and suppliers of equipment, control, network and software systems.

As in the USA, Smart Home equipment suppliers in the UK focus almost entirely on the expert home-improver and DIY markets. There is also a limited spillover into the domestic market from commercial and industrial building suppliers.

Implications of developments in the USA on the UK market

Although there are significant differences[6] between the US and European markets, one would expect the growth of Smart Home technology in America to have an impact on the UK market.

Even if the American market fails to race away and there is only low percentage growth, given the absolute size of their market, the actual number of installations may still be sufficient to generate economies of scale. This should feed through to lower prices which, in the longer-term, may be followed by reductions in Smart Home costs here in the UK as more cost-effective technology arrives as a result of imports or licensing deals with US firms.

Technology developments

There are new and emerging technologies coming to the fore that could provide added impetus to the future expansion of the Smart Home market.

On the appliance front, home appliance and electronics corporations such as Electrolux and LG are bringing intelligent kitchen systems to market. More generally, as with Sony intelligent integrated home entertainment products, these systems are integrated *within* the home rather than being integrated *into* the home.

There are near-to-market technologies emerging from the university research laboratories and corporate research centres that

could provide innovations that both speed up universal integration and possibly push down installation and maintenance costs.

'Bluetooth' – and other wireless protocols – could provide a common basis for communications between devices and, importantly, would eliminate the need for installing or using cables for data exchange between Smart Home devices.

Meanwhile, at Massachusetts Institute of Technology, computer hardware experts have created 'match-head' computers. These tiny devices have the potential to revolutionise Smart Home technology as they could easily be embedded in all domestic appliances and devices, from dishwashers to light sockets.

In addition, there are advances in how easily users can operate electronic/computer devices. For example, the latest voice recognition technologies offer the opportunity of a more 'human' and intuitive interface between man and machine.

Other developments that have Smart Home implications include the body temperature sensor technology being developed by Daikin in Japan which would automatically regulate air conditioning and heating systems according to the occupants' changing needs. And, the light control software – called 'Heliodon' being developed at Bristol University – which, when it comes to market, will simplify and cheapen the light control software used in Smart Home integrated window, screen and lighting set-ups.

In combination, these – and other – up-coming technologies will add to the functionality, ease of use and convenience of Smart Home systems, while potentially improving their cost-effectiveness. Moreover, the development of new communications technologies – such as 'Bluetooth' and the 'XML' language – offer the not-too-distant prospect of common standards for electronic dialogue between Smart Home devices (although it is still unclear how many standards will exist!).

3 Consumer attitudes

Introduction

This chapter summarises the findings of a survey on consumer attitudes towards Smart Homes.

The aims of the survey and the methodology used are explained in the next section. The remaining sections summarise the key findings and cover the following topics:

- attitudes to new technology in the home
- views about the key features of Smart Homes
- consumer concerns and worries about Smart Homes
- interest in the Smart Home concept
- the Smart Home consumer.

The last section concludes by taking a view about the future market potential of Smart Homes.

Methodology

The role of the survey

The survey was carried out by the Consumers' Association to establish, in broad terms, whether there is a potential mass market for Smart Homes. The survey explores what consumers think about the prospect of living in a Smart Home and provides some insight into the likely pattern of future demand.

It can be difficult to assess future demand for a product which people have little awareness of, especially when the product specification and pricing is not yet developed. The approach taken here minimises this problem by focusing on consumers' underlying attitudes and interest towards new technology in the home and then relates this to how consumers view the Smart Home. This provides a more robust basis on which to take a view about market potential.

Survey objectives and methodology

The main objectives of the survey were:

- to assess views about the key features of Smart Homes
- to identify concerns about living in a Smart Home
- to assess the level of interest in the Smart Home concept and ultimately to establish whether people would want to live in one
- to identify what type of consumers are the most and least likely to want a Smart Home in the future.

In addition, the survey assessed more general attitudes towards new technology in the home.

The survey was conducted by a reputable market research agency, Ipsos-RSL, as part of their weekly Capibus Survey and comprised 1,044 in-home interviews. The results have been weighted to be representative of the Great Britain population. Full details of the survey methodology are provided in the research notes (Chapter 6).

The interview

During the course of the interviews, 16 statements about new technology and Smart Homes were read out to each respondent and they were asked to say to what extent they agreed or disagreed. The first five statements covered the subject of attitudes towards new technology in the home. Then, the interviewer

introduced the idea of a Smart Home by giving the respondent a script to read which described the concept (see research notes). The next seven statements explored views about the key features of Smart Homes and concerns people might have about living in one. Then, the four remaining statements were used to tease out to what extent people were interested in the idea and more importantly whether they wanted to live in a Smart Home.

New technology

Attitudes to new technology in the home

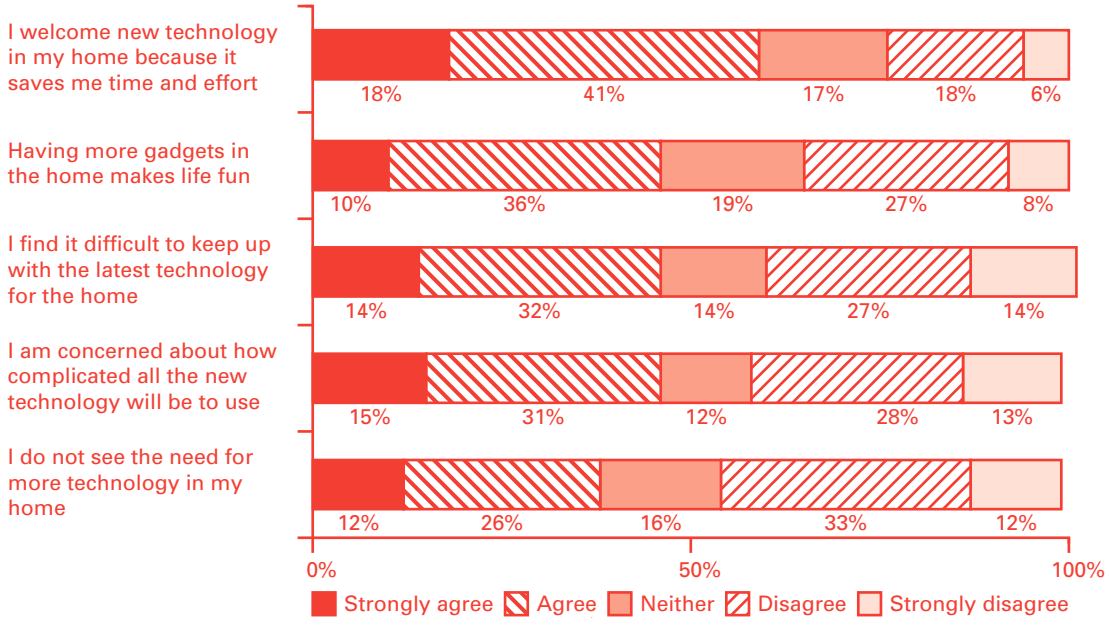
In general, opinion was fairly mixed on the issue of whether new technology in the home is a good or bad thing (Figure 2). Over half (59 per cent) of those surveyed agreed with the statement 'I welcome new technology in my home because it saves me time and effort' and just under half (46 per cent) agreed with the statement 'Having more gadgets in the home makes life fun'.

However, others felt fairly negative about the prospect of more technology in their home and almost two in five (38%) agreed with the statement 'I do not see the need for more technology in my home'.

Many voiced concerns about the prospect of dealing with new technology. Almost half (46 per cent) indicated that they were worried about how complicated new technology would be to use and the same proportion (46 per cent) agreed that they found it difficult to keep up with the latest technology for the home.

Across all statements there were also a significant number who said they 'neither agreed nor disagreed', reflecting that, for some, new technology just isn't an emotive issue one way or the other.

Figure 2 Attitudes to new technology in the home



Who is most interested in new technology in the home?

Young people were much more likely than older people to be positive about the prospect of new technology in the home. Over three-quarters (76 per cent) of those aged 15–24 agreed with the statement 'I welcome new technology in my home because it saves me time and effort' compared to 41 per cent of those aged 55 and over (Figure 3).

Similarly, those with home entertainment systems (i.e. video game consoles, cable/satellite or digital TV, DVD players) and those who have a PC or Internet access via home or work were also more likely to be positive about technology in the home.

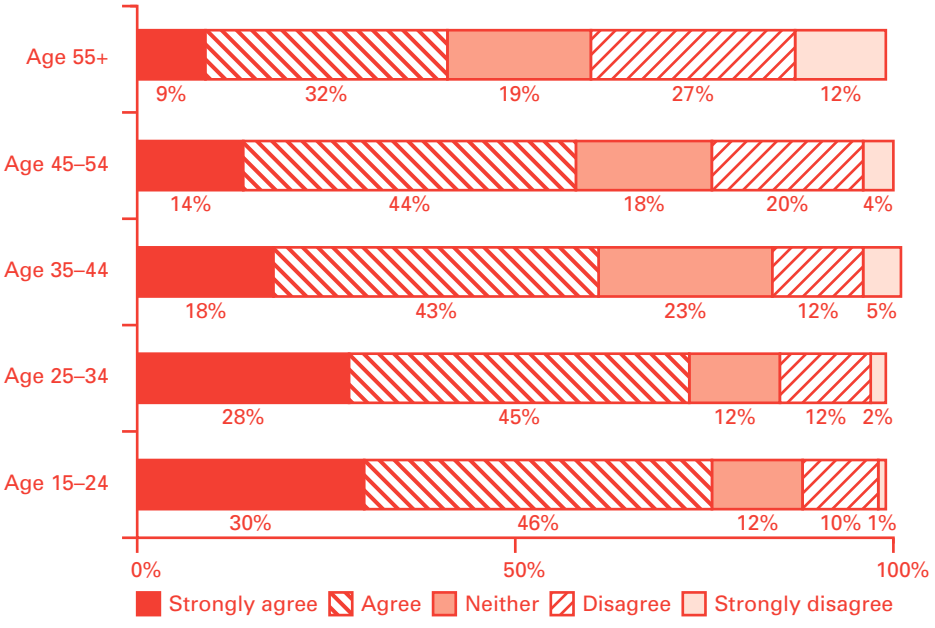
Older people were most likely to express concern about new technology. Almost two-thirds (64 per cent) of those aged 55 and over expressed worries about how complex future technology might be to use compared to less than a third (28 per cent) of 15–24 year olds. Other groups who were more likely to express concern about coming to terms with new technology are women, those in social grades C2 and DE and those on lower incomes.

Views about the Smart Home concept

When asked to comment on the issue of Smart Homes, views were again fairly mixed. While some features of Smart Homes clearly had wide appeal, at the same time many respondents expressed concern and worries about living in one. Four key features of Smart Homes were tested out with respondents using the following statements:

- *remote access* – 'Being able to control devices in the home when I was out would be really useful to me'

Figure 3 Agreement by age group with the statement 'I welcome new technology in my home because it saves me time and effort'



- *safety and security* – 'I would really value the safety and security features a Smart Home could offer'
- *centralised control* – 'I like the idea of one remote control that could control everything in the home'
- *convenience* – 'A Smart Home appeals to me because it would save me time and effort'.

Of the four features, security and safety aspects were the most popular with over two-thirds (70 per cent) agreeing with the statement 'I would really value the safety and security aspects a smart could offer' (Figure 4). The benefits of remote access also had wide appeal. Opinion was more divided on the benefits of convenience and centralised control. In both cases around half of those surveyed indicated these features would be of use to them.

Groups most likely to value the benefits of Smart Homes were: those in work, men, people aged 15–34, households with children and those who already have access to new technology in the home (i.e. video games consoles, DVDs, pay TV services and PCs).

Concerns about Smart Homes

The technical aspects of running a Smart Home caused concern among many of those surveyed. Three specific areas of concern were tested out with respondents:

- *system failure* – 'I would be concerned about technical hitches and things going wrong'
- *lack of control* – 'I would worry about the system being difficult to override'
- *complexity* – 'I would worry that the system would be too complex'.

People were most concerned about the system failing and around two-thirds (65 per cent) agreed with the statement 'I would be concerned about technical hitches and things going wrong' (Figure 5). Around half (51 per cent) were worried that the system would be too

Figure 4 Views about the Smart Home

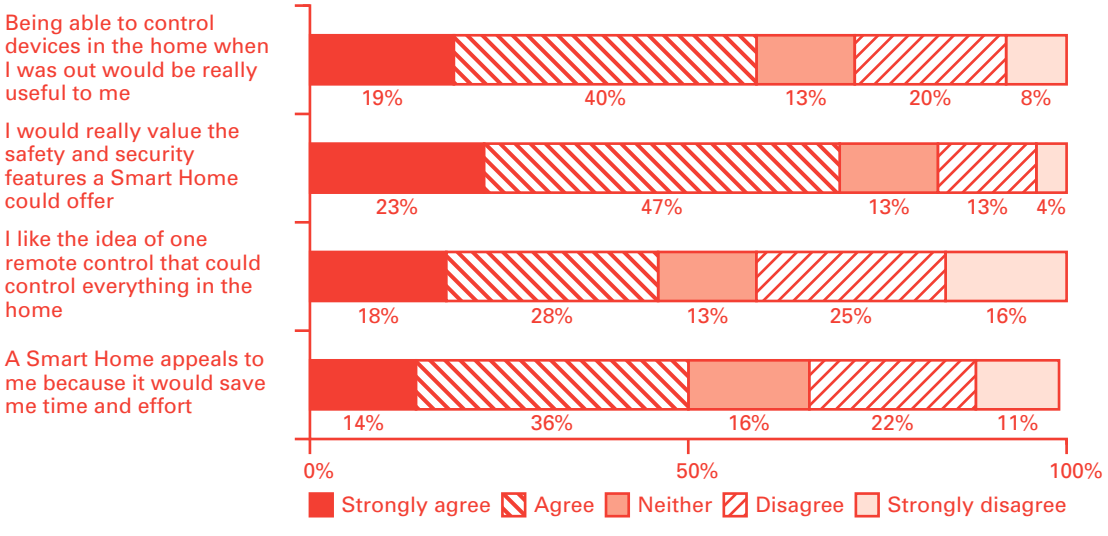
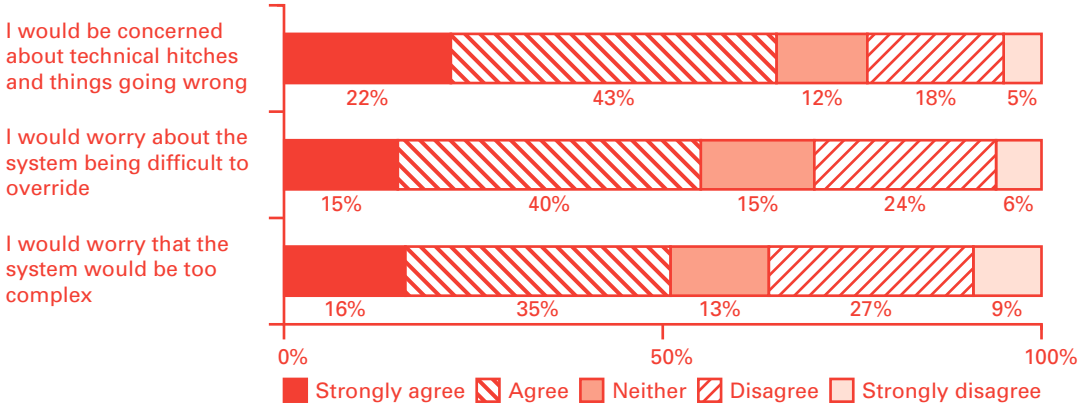


Figure 5 Concerns about Smart Home technology



complex and a similar number (55 per cent) said they would worry about the system being difficult to override.

Older people were one of the groups that were the most concerned about potential technical problems. Two-thirds (67 per cent) of those aged over 55 agreed with the statement 'I would worry that the system would be too complex' compared to 38 per cent of the group aged 15–24. Other groups with relatively high levels of concern were: women, those on lower incomes, and those in social grades DE. Those households with home entertainment or PC equipment were less likely to be concerned about technical problems as were those who had Internet access at home or work.

Interest in living in a Smart Home

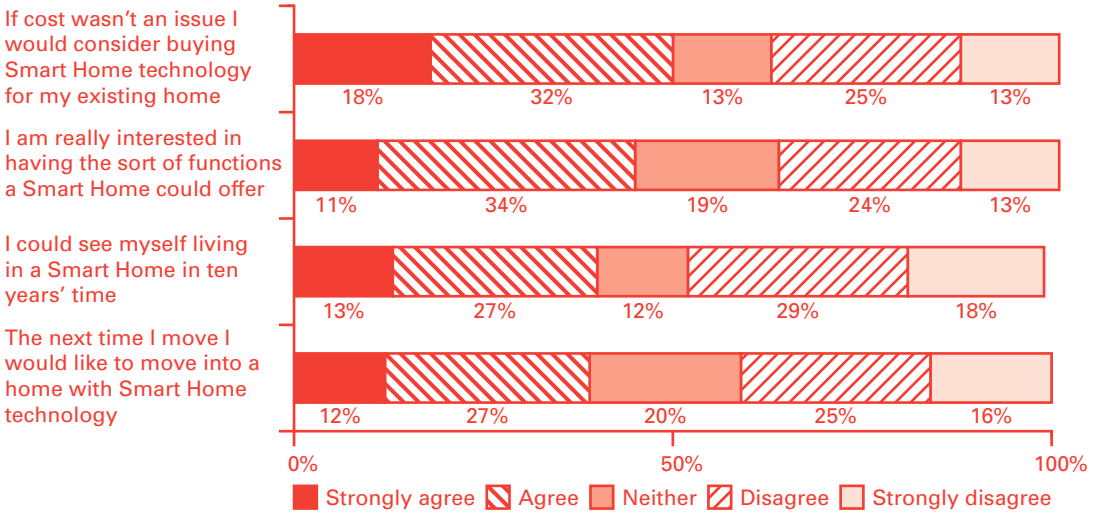
The last part of the survey was designed to establish how interested people were in living in a Smart Home. Respondents were given four statements which assessed both their current level of interest in the concept and their views about the future.

- Interest in the concept
  - 'If cost wasn't an issue I would consider buying Smart Home technology for my existing home'
  - 'I am really interested in the Smart Home concept'
- Expectations/aspirations
  - 'I could see myself living in a Smart Home in ten years time'
  - 'The next time I move I would like to move into a home with Smart Home technology'.

Again opinions were fairly mixed in relation to each statement. Less than half (45 per cent) of those surveyed agreed with the statement 'I am really interested in having the sort of functions a Smart Home could offer' while 37 per cent disagreed (Figure 6). The remainder (19 per cent) of those surveyed were ambivalent about the prospect of a Smart Home and said they neither agreed nor disagreed.

Half (50 per cent) indicated that they would consider buying Smart Home technology for their existing home (if 'cost wasn't an issue').

Figure 6 Level of interest in the Smart Home concept



There was also support for the idea of moving into a home with new technology although this was weaker (39 per cent agreement). In terms of future expectations, two in five people (40 per cent) said they could see themselves living in a Smart Home in ten years time.

Who wants to live in a Smart Home?

Across all four interest statements, respondents tend to fall consistently into one of three groups – 'the interested', 'the ambivalent' and 'the uninterested'. Table 1 compares the level of agreement with each statement between different groups within the population. The strength of agreement is measured using the 'mean agreement score' which can range between one and five; the higher the score, the higher the level of agreement.

The data illustrate how the strength of agreement varies between different groups in the population and helps build a picture of the type of person who is most likely to show interest in acquiring Smart Home technology.

Age emerges as one of the strongest predictors of someone's interest in living in a Smart Home. Generally, younger respondents reported higher interest. People in the age group 15–34 have high levels of agreement with all four statements. For example, almost two-thirds (65 per cent) of 15–24 year olds agreed with the statement 'I am really interested in the sort of functions a Smart Home could offer' compared to just over one fifth (21 per cent) of people aged 55 and over. This is reflected by the higher mean agreement score of 3.65 for the younger age group compared with 2.45 for the older.

Those households who already own home entertainment equipment or a PC were also more likely to be in favour of the idea of having a Smart Home. Other groups with high agreement scores include: men, those with Internet access at home or work, those who own a mobile phone and households with children.

Those on higher incomes were more likely to be interested in the Smart Home concept

Table 1 Interest in the Smart Home – mean agreement scores by group

Groups	Interest statements – mean agreement scores[1]			
	I am really interested in having the sort of functions a Smart Home could offer	If cost wasn't an issue I would consider buying Smart Home technology for my existing home	I could see myself living in a Smart Home in 10 years time	The next time I move I would like to move into a home with Smart Home technology
All	3.06	3.16	2.88	2.94
Gender				
Male	3.20	3.34	3.06	3.10
Female	2.92	2.99	2.70	2.78
Households with children				
Yes	3.33	3.50	3.17	3.24
No	2.93	3.00	2.75	2.80
Age				
15–24	3.65	3.65	3.55	3.46
25–34	3.46	3.66	3.33	3.36
35–44	3.15	3.34	3.15	3.03
45–54	3.13	3.25	2.93	3.10
55+	2.45	2.51	2.13	2.33
Social grade				
AB	2.94	2.93	2.90	2.82
C1	3.16	3.23	2.95	2.99
C2	3.10	3.21	2.90	2.98
DE	3.00	3.23	2.77	2.96
Technology ownership				
Cable/satellite	3.37	3.49	3.26	3.21
Digital TV	3.44	3.41	3.30	3.25
Video games console	3.46	3.56	3.24	3.24
DVD[2]	3.74	3.60	3.70	3.43
Video recorder	3.11	3.21	2.94	3.00
Mobile phone	3.27	3.35	3.09	3.10
PC	3.32	3.32	3.19	3.14
Internet access	3.31	3.28	3.16	3.09
Income				
Under £9,500	2.80	2.98	2.48	2.87
£9,500–£17,499	3.08	3.26	2.96	2.99
£17,500+	3.22	3.28	3.25	3.09
Housing tenure				
Owner	3.03	3.09	2.86	2.89
Rent/other	3.08	3.26	2.88	3.01

1 The mean score indicates the strength of agreement across the whole sample. Values are assigned to answer categories as follows: strongly agree (5), agree (4), neither (3), disagree (2), strongly disagree (1) and then the mean score is calculated by taking the average score for the whole sample. Scores can range from 1 to 5. A maximum score of 5 would mean that everyone in the sample had strongly agreed with the statement.
2 Mean scores for DVDs are based on relatively low sample size of 48.

although the relationship is not particularly strong, especially compared to the others noted above. Similarly, the relationship between social grade and interest is comparatively weak.

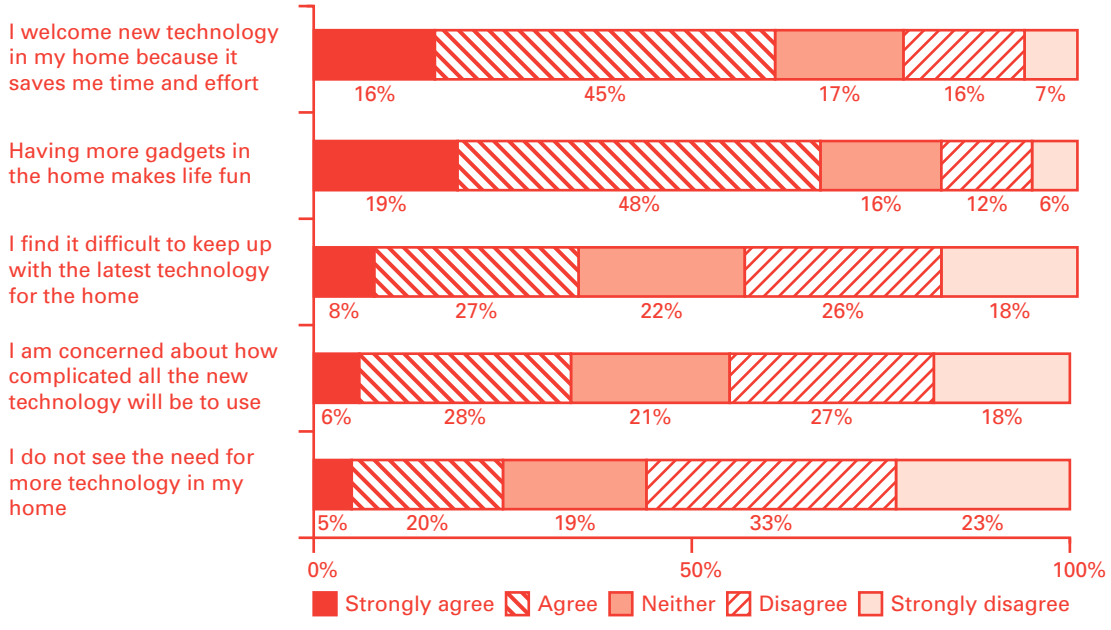
The degree of interest in Smart Homes is not strongly related to housing tenure. People who own and those who rent their homes were equally likely to agree with the statement 'I could see myself living in a Smart Home in ten years time'. Furthermore, there was no statistically significant relationship between housing tenure and the statement 'I am really interested in having the sort of functions a Smart Home could offer'. Moreover, people who rent their home were marginally more likely than home owners to say they would like to move into a Smart Home or buy Smart Home technology for their existing home, though these relationships were relatively weak compared to those described earlier.

Attitudes to new technology and interest in Smart Homes

The survey demonstrates a strong relationship between general attitudes towards new technology in the home and the level of interest in Smart Homes. Those respondents who were positive about the prospect of new technology were much more likely than others to express interest in living in a Smart Home (see Figure 7). Conversely, those respondents who expressed a fairly negative attitude towards technology in the home (i.e. those who agreed with the statement 'I do not see the need for more technology in my home') were less likely to want to live in Smart Home; for this group there was only 25 per cent agreement.

Those who had concerns or worries about new technology in the home were also less likely to be interested in living in a Smart Home – though this relationship was weaker than the

Figure 7 Agreement with statement 'I am really interested in having the sort of functions a Smart Home could offer' among those who agree with attitude statements



ones described above. As Figure 7 shows, of those who expressed worries or concerns, over a third (35 per cent and 34 per cent) still said they were really interested in the idea of Smart Homes and a fifth (22 per cent and 21 per cent) implied they were neither for nor against the idea.

Market segmentation

Generalising, the survey suggests that people fall into one of three groups:

- *'The interested'* – those interested in living in a Smart Home (45 per cent of respondents[1]). Most likely to be: people aged 15–34; family households; those with pay TV and home entertainment systems (i.e. DVDs and video games consoles); those with PCs and/or Internet access; those on higher incomes; those who hold positive attitudes about new technology.
- *'The ambivalent'* – those who were neither interested nor uninterested in the idea (19 per cent). These respondents were well represented across all groups in the population, though marginally more likely to be older and on medium/low incomes.
- *'The uninterested'* – those not interested in living in a Smart Home (37 per cent). Most likely to be: aged 55 and over; households without children; households without PCs, pay TV or home entertainment systems; those who hold negative attitudes towards new technology.

Clearly, those who are 'interested' are most likely to acquire Smart Home technology in the future if an appropriate market – with realistic prices – develops. Those who are 'ambivalent' are also potential Smart Home owners but are less likely to enter the market in the short term.

Conclusions

The survey of consumers' attitudes suggests a mass market for Smart Home technology could develop. While views are undoubtedly mixed, around half of those surveyed are positive about the role of new technology and are interested in the Smart Home concept. Furthermore, it is encouraging that interest is higher among the under 35s as this group will be the potential purchasers of the Smart Homes of tomorrow.

Those most interested in living in a Smart Home are those who have positive attitudes towards new technologies and those who have already purchased new technologies for the home. These early adopter groups are pivotal to the uptake of high technology products.

The findings suggest that worries about the technical aspects of running a Smart Home could constrain initial demand. However, it is likely that these concerns would diminish as the Smart Home product rolls out and awareness grows, or could be overcome with appropriate marketing communications.

On the negative side, there is a segment of the population – the 37 per cent who are 'uninterested' – who are likely to prove the most difficult to sell to. These are more likely to be older people who have fairly negative attitudes towards technology.

4 Views of the industry experts

Introduction

Although the main thrust of the research focused on consumer attitudes, as part of the study the project team also canvassed a small number of industry experts in order to assess their views of potential future market growth and their reactions to the results of consumer survey.

The survey covered experts in six relevant sectors:

- architects
- building contractors
- specialist contractors and service providers
- property agents and developers
- equipment manufacturers
- academic and commercial researchers.

In addition to a general discussion of the interviewee's views on and experience of Smart Home technology, the interviews addressed the following questions:

- What is your prediction for future growth in use of Smart Home technology?
- Where (or with whom) will that growth be?
- What is the basis for your prediction?
- What are the major inhibiting factors to the growth in Smart Home technology?
- What could provide a significant spur to growth?
- How do your views change in light of the results of the survey of consumer attitudes to Smart Home technology?

This chapter looks at the responses from experts in each of the six sectors.

Architects

Architects are one of the many parts of the design–build process. They have (varying degrees of) influence on the type of services and systems integrated into buildings. They do not normally initiate or configure technical standards and protocols, but importantly they do (along with control and electronic engineers) give approved systems 'credence via recommendation'. With this in mind, the views of the architecture profession regarding Smart Home technology need to be treated with some degree of seriousness. It is however recognised that architects are less influential in the field of social housing where guidelines for design are pretty much laid down by the housing associations and the Housing Corporation.

However, the main impetus for Smart Home development is currently in the top end of the private market. Architects designing properties for this market, more particularly in the London area, think that demand for Smart Home technology will, within four to five years, become quite well established. The pattern of demand will, they hold, be for a basic 'wired home' with integrated information and communication technology (ICT) systems. Intruder and fire security systems will be linked into the overall control facility of a type that will be common to many future high specification properties. They are not sure about the likely effectiveness of wireless frequency technology as a means of creating 'cableless' local area networks (LANs) for domestic properties.

There was a strong feeling among

respondents that the process of embodying Smart Home technology is often incremental; they are unconcerned by the concept of 'total solutions'. To begin with it will continue to be the avant-garde high-value end of the property market that gets the technology. But, even here, systems may often be partial or modularised (home entertainment and lighting linked, or heat–ventilation and window openings). Thus, apart from the most expensive developments, advanced total integrated home solutions will generally be completed through 'add-ons' integrated over time. Moreover, proven systems will only incrementally percolate down to mid-range properties: rather as Daimler-Benz advanced auto-technology trickles down so as to eventually equip the standard family saloon. In short, the technology is advancing, and will become more commonplace, but the speed of dissemination will depend on trends in the economic and construction cycle.

In this context, architects believe that rising income and wealth will drive the market for advanced Smart Home technology. Also, tastes will, it is thought, be led to some degree by glossy design and lifestyle magazines. But there is also a view abroad in the industry that the technology is not effectively marketed to potential property buyers. A major design and engineering group, for example, believes that the technology is not marketed forcefully enough by builders and developers, and that the benefits require broadcasting to a much wider audience than that of the coffee table design magazines. In particular, they think that efficiency and environmental net benefits need more emphasis.

Architects also feel that to some extent latent consumer demand for this sort of technology is not being addressed because of the innate conservatism of the building industry. The lack of skilled contractors experienced in design–install–maintain programmes is also seen as a reason for the relatively slow widespread adoption of Smart Home technology, even at the top end of the market.

Among the architects interviewed there was a consensus that the main factors driving Smart Home technology will be manifold: for example, the adoption of common system operation and integration standards; an improvement in skills training in the relevant electronic specialisms (particularly in respect of fault-finding and maintenance); as well as a fall in the price of components. Architects also feel that Smart Home electro-mechanical equipment requires enhanced design features that are in harmony with the home environment, rather than being borrowed from the industrial building sector.

There was no fundamental disagreement on the part of architects with the survey findings. Interestingly, Ballast Wilshire, the Anglo-Dutch construction specialists, said that the results pretty much matched those of a recent study they had undertaken into Smart Home technology in conjunction with The Bartlett School of Architecture and Planning at University College, London.

Building contractors

Generally, the view of building contractors is that advanced Smart Homes will remain a rarity at the lower and middle end of the housing market. But even the sceptics feel that the future demand for the integration of communications, entertainment and security systems will see a steady increase in the next decade at the higher

end of the market. As with other respondents, the builders interviewed believe that affordability is partly the key to a greater level of demand for this technology.

Some building contractors see the Smart Home as a 'fad', and in some cases regard it as a distraction where they are building for the top end of the housing and apartment market. Others have marketed the technology but have been dissuaded from carrying it forward due to the rather mixed responses that they received from their clients. A major builder, for example, had somewhat mixed client responses to the Smart Home technology used to equip recent Thameside luxury flat developments. On a subsequent development they dropped the technology. The main problem identified by this builder was that the electro-mechanical systems and security equipment manufacturers fail to effectively market their technology. The builder also opined that these companies need to follow the exemplary marketing strategies instigated by the home entertainment systems integrators.

Builders believe that retro-fit of Smart Home technology will remain a very narrow market niche, although they think that it could expand, as it has in the United States, as a DIY market. Moreover, they consider that while some new home buyers are prepared to bear the cost of limited embedded advanced technology, current occupiers are far less willing to stand the financial and disruption costs of retro-fit.

Builders also mention the problem that skill shortages pose for the faster development of Smart Home technology. Many of the best specialist electrical–mechanical and electronics contractors, it is held, are totally committed to commercial and industrial construction, leaving a shortfall of expertise in the residential new build sector. Some respondents in the building industry think that householders fear being saddled with Smart Home technology that is both difficult and expensive to maintain. In particular, householders fear that there may be problems finding adequately experienced maintenance contractors able to provide aftercare back-up.

Respondents from the construction industry showed perhaps the greatest surprise regarding the generally optimistic tone of the survey findings. Although the results did not radically alter their less than sanguine view, they believe the survey results demonstrate interest and a general intention on the part of the consumer to look harder at the concept. However, and characteristically, they caution that even strong interest is not a purchase intention.

Property agents and developers

Property agents – particularly the London agents dealing with the top end of the London property market, e.g. Docklands, Hampstead and the City – believe that computerised intelligent homes will come to represent a growing segment of the over £500,000 property market in the next few years. Agents and developers maintain that show-homes set up so that the technology can be demonstrated effectively provide the best hope of stimulating an interest in the Smart Home concept.

Property agents do tend to view the property world in terms of affordability. Hence, in a world of rising income and asset wealth, they believe that an increasing number of their clients will be prepared to stand the extra cost of purchasing a home with quite sophisticated embedded Smart Home systems.

The main barrier that developers see to the advance in Smart Home technology is the lack of powerful marketing on the part of the systems integrators and some builders. On the other hand, they do see the publicity being achieved by the durable goods manufactures (such as AEG, Bosch, Electrolux and Toshiba) for linked intelligent appliances as a step in the right direction.

Property agents and developers generally agreed with the survey findings. In particular they concur with the finding that the main sales potential is associated with high earning young technophile couples. Nevertheless, they also tend to feel that it will be some time before anything but the basic form of smart home systems (e.g. sound and vision, computing and security systems) become more widely available, even at the middle market level.

Specialist contractors and service providers

The specialist contractors and service providers are at the sharp end of the Smart Home industry. It is they who design and specify electronically integrated service, appliance and ICT systems for the home. They implement and network the technology and are responsible for providing 'aftercare' maintenance services for householders. These specialist contractors are also the technical experts that can best convince architects *vis-à-vis* the integrity, robustness and reliability of Smart Home technology.

Because most of these contractors have been party to the rapid growth of smart intelligent systems in the commercial office and industrial building sector they are generally very optimistic about the growth of similar smart solutions in the domestic home. They believe that as far as discrete part-integrated systems – such as security, home entertainment and ICT become more commonplace – are concerned, then it will only be a matter of time before the sort of total integration currently found in only the most up-market properties becomes more widely designed into new houses and apartments. They base their confidence on the gradual emergence of common standards (EIB European standard) and protocols covering the integration, operation and control functions of Smart Home technology. There is also a belief among integration and control engineers that 'Bluetooth' wireless technology will accelerate the expansion of Smart Home technology. In the main this is because it is non-intrusive when compared with cable runs around a property.

Some systems designers think that tax relief on Smart Home technology capital expenditure that has provable efficiency and/or environmental benefits would provide a distinctly valuable fillip in the market.

On the downside contractors with Smart Home installation experience cite the recent lack of standards and common protocols as a major inhibitor of market development. Technical 'commonality' – such as prevails in mains electrical power, heating and ventilation, and water and sanitation – is regarded by engineers as being critically important in helping this technology market to grow.

Furthermore, skill shortages were once again highlighted as an underlying reason for inertia in some areas of the Smart Home market. Likewise, poor inter-trade co-operation on building projects is seen as a major factor undermining the intelligent technology installation process, particularly on larger residential new build projects. This manifests

itself negatively in terms of both cost overruns and poor installation quality. Added to which, the poor quality of cheaper components has, it is said, undermined the reliability of some recent mid-market Smart Home installations. Outcomes that if not remedied by the industry could, according to some respondents, seriously damage the reputation of Smart Home technology.

Respondents also think training is failing to keep pace with the growing complexity of smart services and systems installations. A shortcoming that may, it is thought, lead to a shortage of specialists who are capable and competent in either installation or maintenance support. This view is shared to some degree by the industry's representative bodies.

The technical experts mostly agreed with the survey summary findings. The market potential is seen by them to be strong, but affordability is regarded as being the key to achieving faster growth in the residential middle-market. According to the technical experts most growth will occur in residential new build, rather than within the refurbishment or renovation segments of the market.

Equipment manufacturers

The equipment manufacturers, which were surveyed, offered strong support for Smart Home technology. The Smart Home concept is not too far from the intelligent digital home vision of many multinational manufacturers. For example, Siemens and Sony are, along with the domestic appliance manufactures and ICT conglomerates, at the forefront in developing the common protocols and standards needed to speed up market development in this home technology (e.g., iLINK (IEEE1394) and HAVi).

The appliance equipment players regard the forward march of the intelligent home as almost inevitable. Once the standards issues are fully resolved they believe that only the innate conservatism of some builders and architects stands in the way of dramatic market growth. Again, they also feel that the innovation process will be an incremental one. Accordingly, they feel that the totally integrated intelligent digital house will in the short-run remain something of a rarity.

Siemens made the point that in Germany the Smart Home technological revolution has been effectively linked with the notion of the eco-friendly home. The environmental perspective has consequently provided impetus to market growth. Generally they felt that this positive association has not been made to the same extent in the UK.

Overall, however, the appliance and equipment manufacturers tend to see the positive message of the survey as an echo of their own findings. They also concede that it will be mostly middle to upper income house purchasers who will buy into the technology initially.

Academics and researchers

The experts from academic institutions and research organisations took the most positive stance towards the concept of the Smart Home. Many of these respondents are directly involved in the technology and as such have something of an affinity with the concept.

However, even the strongest advocates of Smart Homes realise that affordability is of critical relevance in respect of take-up and

adoption of Smart Home technology. The researchers agree that the advent of standardisation and common protocols is critical to the future broader adoption of Smart Home technology. Also, the research community realises that to no small degree the selling of the Smart Home idea is a 'hearts and minds' publicity and marketing exercise that will mainly have to be undertaken by architects, builders and developers.

In spite of their enthusiasm for the technology, academic researchers, such as Tim Venables at the University of Brighton Science Policy Research Unit clearly recognise that there are a number of other impediments that are currently preventing Smart Home technology from becoming more commonly and speedily adopted. One is the lack of one-stop-shop contractors willing and able to take on large complex high technology installation contracts. Another is the fact that there is little reliable evidence hitherto that capital expenditure on what remain high-cost total technology solutions can be meaningfully offset by household operational efficiency gains and cost savings (particularly energy saving). Safety is another issue that has to be addressed. The Consumers' Association Research and Testing Laboratory cautions that the overall safety of integrated intelligent control systems in the home requires long-term monitoring in order to ensure such systems meet fail-safe standards.

Academic and industry researchers accept the finding of significant consumer enthusiasm for Smart Home technology. But again, the real potential for the adoption of Smart Home technology is viewed by them as being essentially driven by consumers' willingness to pay. An intention that is seen quite correctly to be limited both by purchaser income, and the range of barriers to adoption discussed above.

5 Conclusions

Although there are currently few Smart Homes in the UK, the research suggests this technology (or variants of it) could have a mass market.

Supply

In recent years, there has been a modest increase in the building and conversion of properties that have embedded Smart Home technology. Moreover, there has been increasing – albeit, too often costly – access to the technology for 'expert home improvers' and 'DIYers'.

There remains, however, a general lack of enthusiasm on the part of construction and property industries, manufacturers and suppliers to push – or even properly promote – this technology. The lack of common standards, an inappropriately skilled workforce and concerns that 'it's just a fad' has meant the Smart Home market has yet to develop a sustainable momentum.

There are, though, changes on the horizon that could stimulate more activity from potential suppliers:

- *Scale economies from the American market*. The growing use of Smart Home technology in the USA could deliver the economies of scale necessary to reduce average costs and, hence, prices. Although it may take time to feed through, this could reduce prices here in Britain.
- *New technologies*. There are up-coming technologies which will add to the functionality, ease of use and convenience of Smart Home systems, while improving their cost-effectiveness. Moreover, the development of new communications technologies – such as 'Bluetooth' and the 'XML' language – offer the not-too-distant prospect of common standards for electronic dialogue between Smart Home devices (although it is still unclear how many standards will exist!).
- *Interest from the consumer electronics industry*. With an ever increasing range of home and personal electronic gadgets available, many major corporations in the consumer electronics industry consider the user-friendly integration and combined control of multiple devices as crucial to their future success. As such, the addition of Smart Home devices and functionality to home entertainment systems is a realistic medium-term prospect.

Demand

The survey of consumers' attitudes indicates that there is underlying public interest in Smart Home technology that could be unleashed if the market develops – and prices fall – appropriately.

While views are mixed, around half of those surveyed report interest in the Smart Home concept (although this may not translate fully into willingness to pay). As a generalisation, the results suggest that people fall into one of three groups:

- *'The interested'* – those interested in living in a Smart Home (45 per cent of respondents). Most likely to be: people aged 15–34; family households; those with pay TV and home entertainment systems (i.e. DVDs and video games

consoles); those with PCs and/or Internet access; those on higher incomes; those who hold positive attitudes about new technology.

- *'The ambivalent'* – those who were neither interested nor uninterested in the idea (19 per cent). These respondents were well represented across all groups in the population, though marginally more likely to be older and on medium/low incomes.
- *'The uninterested'* – those not interested in living in a Smart Home (37 per cent). Most likely to be: aged 55 and over; households without children; households without PCs, pay TV or home entertainment systems; those who hold negative attitudes towards new technology.

The results also indicate what characteristics attract interest in Smart Homes.

Unsurprisingly, the Smart Home is most attractive to more *pro-technology consumers*, including the so-called 'early-adopters' vital to the early development of high-technology markets. Households that reported the most positive attitudes towards new technology – and have greater ownership of newer technologies such as home entertainment equipment and PCs – also demonstrated greater interest in living in a Smart Home.

But, in addition, the Smart Home appealed to a broader range of consumers because of its potential *safety and security* benefits. The high level of interest in the safety and security features suggests this might be a powerful driver to attract less technology-literate purchasers into the Smart Home market. The benefits of remote control also had wide appeal.

The survey also identified *concerns* among consumers about the apparent complexity of the system and the potential for 'technical hitches'. Importantly, consumers across all three groups – interested, ambivalent and uninterested – voiced similar concerns, suggesting this is not a problem that will limit interest in the technology but is something that will have to be overcome if consumers' confidence in Smart Homes is to be nurtured.

Opportunity

With the infant Smart Home industry and other associated high-technology markets changing so rapidly, any predictions for their future are highly uncertain. Nevertheless, this research does identify reasons to be optimistic that a mass consumer market for Smart Home-type technology could develop.

There appears to be significant consumer interest in the concept that could be unlocked at the right price.

But, if a market does develop, it seems less likely to come from impetus in the building, construction or property sectors. The greater opportunity for growth in the use of Smart Home technology appears to be from its addition to the burgeoning array of consumer electronics – especially home entertainment and personal communication systems – and initial demand from the more technology-literate early-adopter households.

6 Research notes

Introduction

The research comprised three elements: desk research, a consumer survey and interviews with experts. This chapter provides some background about how this research was conducted.

Desk research

The programme of desk research involved a literature survey and judicious use of the World Wide Web. The main sources of information that added significantly to our understanding of the Smart Home concept, from both the building and technology perspective, included:

- *Automated Home*
- *Construction News*
- *Electronic House*
- *Financial Times Information Technology*
- *Home Automation*
- *New Scientist*
- *Scientific American*
- *Strategy Analytics*
- *The Home Automation Times*

Consumer survey

Methodology

The survey was carried out by Ipsos-RSL and was part of their weekly Capibus survey. The fieldwork was undertaken during the week of 28 April – 4 May 2000.

The sample size was 1044 and comprised British adults aged 15+. The sample was based on a random location design employing 180 sampling points selected each week. ACORN data were employed to set quota controls specific to each interviewer location. By using this proven sample design the survey represents all sub-sectors of the population – at a regional and national level. The sample is representative of the population of Great Britain.

In-home Ipsos interviewers using the advanced 'Top CAPI' computer assisted personal interviewing system for data collection carry out all interviewing for Capibus. CAPI provides more accurate data than conventional interviewing. All Capibus data is processed in-house by Ipsos-RSL. All interviewers are trained to a recognised standard and one in ten interviews are back-checked by telephone.

Data availability

The results are summarised in Chapter 3. Full results are also available in the form of printed tables. These provide details of the 16 main questions cross-tabulated against a range of socio-demographic variables (i.e. gender, age, social grade, working status, terminal education age, income, TV viewing, access/use of Internet, telephone banking, household durables/technologies, children in household and standard region). Data are also available on disk in SPSS format. The SPSS file includes additional socio-demographic variables including housing tenure, Acorn categories, newspaper readership, credit cards owned, ITV stations received.

Description of a Smart Home used during the interview

The following description was provided to interviewees as a show card:

20 years ago – who would have expected cars to have features like central locking or electric windows. These days, from your driving seat you can change a CD, alter the temperature or even receive the latest local traffic report. Now the same concept is coming to our homes …

A Smart Home is one where you can have one button control of everything in your home. Many homes already have central heating, remote controlled TVs, telephones, burglar alarms, computers and the like. A smart home is one which integrates all these and many other devices into one, simple-to-operate system controlled by a single remote control.

A Smart Home will be more convenient. With one remote control you can turn on the TV, start the dishwasher, open an upstairs window or lock all the doors. You could also do all your grocery shopping from your armchair by accessing the Internet on your TV.

A Smart Home will be more comfortable. In your Smart Home sensors would make sure rooms were automatically lit and heated when you were using them. And in cold weather, sensors would ensure heating was activated to protect against frost. The system would also use energy more efficiently and save you money!

A Smart Home will be more secure. Video cameras which are linked to TV or computers will enable you to see who is at the door before answering. When you are on holiday, the system would set lights or music to come on and off at different times to deter burglars.

A Smart Home will be safer. Devices can be programmed to react in emergency situations. In the event of a gas leak, electrical systems would be switched off, windows opened and the system would contact the emergency services and even phone you at work.

A Smart Home means someone is at home when you are away. For example if you forget to videotape one of favourite programmes, you could use your mobile phone to send a message to switch on the video player. The system could even phone you if there are any problems at home – such as the security being breached.

In a Smart Home you will be able to automate and control your home. You will have integrated control of every device in your home which means they will be able to work together to suit you and your lifestyle.

Interview script and questions asked

The script for all interviews was as follows.

These days, technology is becoming more and more common in our everyday lives ranging from things like the washing machine, through to the video or the latest computer. I would like to know how you feel about the prospect of new technology in the home. I am going to read out some statements and would like you to say to what extent you agree or disagree with them.

- *I do not see the need for more technology in my home.*
- *Having more gadgets in the home makes life fun.*
- *I am concerned about how complicated all the new technology will be to use.*
- *I welcome new technology in my home because it saves me time and effort.*

- *I find it difficult to keep up with the latest technology for the home.*

I would now like you to take a moment to read this description of a Smart Home. [Interviewer hands the explanation of Smart Homes to the respondent and allows them to read it fully.]

We would like to know what you think of the 'Smart Home' concept – I am going to read out some statements and would like to know to what extent you agree or disagree with them.

- *A Smart Home appeals to me because it would save me time and effort.*
- *I would be concerned about technical hitches and things going wrong.*
- *I like the idea of one remote control that could control everything in the home.*
- *I would worry that the system would be too complex.*
- *I would really value the safety and security features a Smart Home could offer.*
- *Being able to control devices in the home when I was out would be really useful to me.*
- *I would worry about the system being difficult to override.*
- *I am really interested in having the sort of functions a Smart Home could offer.*
- *I could see myself living in a smart home in ten years time.*
- *The next time I move I would like to move into a home with Smart Home technology.*
- *If cost wasn't an issue I would consider buying Smart Home technology for my existing home.*

For all statements a common scale of responses was permitted: strongly agree; agree; neither agree nor disagree; disagree; strongly disagree (allow 'don't know').

Expert interviews

The interview programme consisted of face-to-face and telephone interviews, with a fairly representative, but not necessarily exhaustive, sample of industry experts. The interviews included discussions with appliance manufacturers, estate agents, builders, contractors, electronic and electrical equipment suppliers, as well as with industry and academic researchers. The main organisations contacted are listed below.

Building and construction and property industry

Ballast-Wilshire (Anglo-Dutch Corporation, Harmondsworth UK Headquarters) – Bob Heathfield, 020 8759 3331
Chestertons Estate Agents (York House) – Rowena Wild, 0207 495 7282
Furlong Homes (Essex and London) – Stuart Braddon, 01992 782222
JRT Electrical Systems (York) – Colin Taylor, 01347 868187
Savills Estate Agents (Central London) – Richard Donnell, 020 7499 8644
The Building Societies Association – Simon Rex, 020 437 0655
Norwich Union Property – Nick Mansley, 01603 622 200
Sir Mott-McDonald Consulting Engineers (Cambridge) – Charles Rickard, 01223 463500

Appliance and equipment providers

Ambient Energy Systems (AES, Isle of Wight Ltd) – Alan Ridett, 01983 520571
British Radio and Electronics Manufacturing Association (BREMA) – Gerald Harvey and Nick Glover, 0207 930 3206
Electrical Contractors Association (Technical Division) – Phillip Buckle and Dave Steffanovich, 020 7313 4800
Siemens Electronics (Consumer Electronics, Manchester) – Andy Barnes, 01908 328 427
Sony (UK Headquarters) – Karen See, 01932 816000
Steve Moore Associates (SMC, London) – Steve Moore, 0171 3498050

Built environment research organisations and higher education institutes

The Building Centre – Neil Martin, 020 7692 6205
Integer (I and I Consultancy) – Alan Kell, 01923 665960
Ove Arup (Research) – Jim Read, 0207 465 2216
University of Sussex, Science Policy Research Unit – Tim Venables, 01273 678135
University of Cambridge, Martin Centre of Architecture and Urban Studies – Professor Paul Ritchens 01223 331700

Notes

Chapter 2

1 'Living in technology' by Patrick Joseph, published in 1999 special edition of *Scientific American* on 'Your bionic future' (pp. 84-7).

2 This is relatively modest given the size of the USA market. Moreover, the figure includes home entertainment, which is the rump of this embodied technology in US homes.

3 For example, Lincoln Radley's Boardwalk development in Docklands, along with Barratt's Virginia Quay property, at a nearby Thames-side location.

4 The exceptions are properties that have been put together as demonstration homes or as research projects, e.g. Edinburgh, Portsmouth, York and Watford.

5 *Mail on Sunday*, 27 February 2000.

6 For example, the greater use of timber frame and prefabricated construction techniques in North America makes the financial and disruption costs of fitting Smart Home technology lower in the USA than in Europe, where brick and concrete architecture is more common.

Chapter 3

1 Based on responses to the question 'I am really interested in having the sort of functions a smart home could offer'.