

Can adapting the homes of older people and providing assistive technology pay its way?

PETER LANSLEY¹, CLAUDINE MCCREADIE², ANTHEA TINKER²

¹University of Reading, Reading, UK

²Institute of Gerontology, King's College London, UK

Address correspondence to: P. R. Lansley, University of Reading, Reading RG6 6AW, UK. Fax: (+44) 118 931 3856.
Email: p.r.lansley@reading.ac.uk

Abstract

Background: Adaptations and assistive technology (AT) have an important role in enabling older people to remain in their own homes.

Objective: To measure the feasibility and cost of adaptations and AT, and the scope for these to substitute and supplement formal care.

Design: Detailed design studies to benchmark the adaptability of 82 properties against the needs of seven notional users.

Setting: Social rented housing sector.

Main outcome measures: Measures of the adaptability of properties, costs of care, adaptations and AT, and relationships between these costs.

Results: The adaptability of properties varies according to many design factors and the needs of occupiers. The most adaptable properties were ground floor flats and bungalows; the least were houses, maisonettes and flats in converted houses. Purpose-built sheltered properties were generally more adaptable than corresponding mainstream properties but the opposite was the case for bungalows. Adaptations and AT can substitute for and supplement formal care, and in most cases the initial investment in adaptations and AT is recouped through subsequently lower care costs within the average life expectancy of a user.

Conclusion: Appropriately selected adaptations and AT can make a significant contribution to the provision of living environments which facilitate independence. They can both substitute for traditional formal care services and supplement these services in a cost-effective way.

Keywords: *adaptations, assistive technology, social housing, care services, costs*

Introduction

Home adaptations (environmental improvements) and assistive technology (AT) provision are an increasingly attractive means of helping older people to maintain their independence and enhancing their quality of life. Although it is widely held [1–11] that developments in AT will be capable of widespread adoption, will address consumer needs and may yield expenditure savings in health and social care, there has been little systematic research into the feasibility and cost of pursuing such a policy. A 30-month study of the homes of older people, specifically in the social rented housing sector of the UK, considered the adaptabil-

ity of a wide range of properties and the cost of providing adaptations and AT. The research, which involved social policy specialists, rehabilitation engineers, economists, builders, surveyors and an occupational therapist, incorporated three main components:

1. A detailed building audit of a wide range of properties (82 in total) in nine areas of England and Scotland, typical of those occupied by older people.
2. A desk study of typical older users at two points in time, with a detailed prescription of their requirements for a full range of adaptations and AT costed for the 82

properties, the likely input of formal care services to such users and the potential of adaptations and AT to substitute for these formal care services.

- An in-depth interview study with 67 older people, also in nine areas of England and Scotland, about their use and experience of a wide range of adaptations and AT.

This paper reports on components 1 and 2. Further reports detail: (a) the technical aspects of assessing care needs and the adaptability of homes, the associated costs and the implications for housing providers [12]; (b) the methodology for combining the costs of care, adaptations and AT [12]; (c) the experiences and views of older people of adaptations and AT [13, 14]; (d) the construction of user profiles [12, 13]; and (e) implications for policy [15].

Methods

Seven profiles of older users were developed based on prevalence data in two national surveys of disability [16, 17]. The

profiles comprised a description of the hypothetical individuals, and their functional abilities in eight domains: locomotion, dexterity, reaching and stretching, hearing, seeing, continence, transferring and personal care (cognitive impairment was excluded). Each profile was considered at two points in time, 5 years apart, with the user's functional abilities deteriorating between time 1 (current period) and time 2 (the future). Table 1 summarises each of these 'user profiles' together with their disability score based on the disability scales used in the national surveys [16, 17]. Secondly, each profile included a list of adaptations and AT required to enable the user to live independently in their own home. For example, for user F at time 1, the adaptations and fixed AT required were:

entrances – lever door handles, doorbell amplifier, external light with passive infra-red detector (PIR), grabrails;
 internal circulation – lever door handles, grabrails;
 personal care – grabrails for bath and toilet, lever tap handles;
 alarms – community (pendant type), gas, CO₂, intruder, smoke;

Table 1. User profiles: the health and functional impairments of the users and the adaptability of the properties

Current period (time 1)					Cost of initial adaptations and AT average ^b (£)				Annual care cost when no carer ^c (£)	
User	Age	Initial condition	Disability score ^a	Number of adaptable properties	Total	Basic	Care reducing	Good practice	Full care package	Reduced care package
A	78	Arthritis, mild sight loss	1.3	82	843	133	0	710	0	0
B ^d	75	Diabetes, mild sight loss, occasional fainting and falling, reduced strength, some forgetfulness	1.5	82	5449	615	45	4789	780	0
C	75	Chronic obstructive pulmonary disorder, reduced strength in left arm and hand	6.9	77	8602	2183	1099	5321	1612	520
D	70	Parkinson's disease, occasional falls, hearing loss	4.9	78	4702	264	277	4161	832	832
E	78	Diabetes, loss of sensation, weakness in limbs	6.3	77	6442	916	3099	2428	1092	520
F	80	Stroke (not severe), poor eyesight, hearing loss, multiple impairments	5.1	82	2065	955	0	1110	0	0
G	70	MS since 50	18.5	64	22,278	13,183	0	9095	23,868 ^e	26,208

Table 1. (Continued)

Future period (time 2)					Cost of further adaptations and AT average ^b (£)				Annual care cost when no carer ^c (£)	
User	Age	Later condition	Disability score ^a	Number of adaptable properties	Total	Basic	Care reducing	Good practice	Full care package	Reduced care package
A	83	Further deterioration	6.3	78	11,449	1629	3449	6372	5044	1612
B ^d	80	Further deterioration, angina, occasional falls	8.6	77	13,817	391	3371	10,056	9152	3484
C	80	Decreased lung function, large weight increase, arthritis	8.8	72	9800	5119	1167	3513	4940	2548
D	75	Further falls	9.5	78	9853	3930	2317	3606	9152	2704
E	83	Further deterioration, amputation of one leg below knee	12.6	71	15,906	4765	8337	2804	15,184	5408
F	85	Further stroke, complications following broken hip, deterioration in sight and hearing	13.1	71	14,385	8547	1190	4648	18,824	14,144
G	75	Further deterioration	19.1	43	13,666	6738	0	6929	23,868 ^e	20,436

^aOPCS disability scores (range -0 to 20).

^bThe average first cost of the adaptations and AT based on 2001 costs for those properties which can be adapted. To obtain full life-time costs given in Table 2 – maintenance, replacement and recovery costs have to be added.

^cCare costs are based on 2001 costs. Users with non-resident and co-resident carers were also considered [see 12].

^dUser B has been specified a large amount of smart home technology, which is comparatively costly in relation to level of disability.

^eFor user G the traditional and augmented packages were not feasible and have been replaced by residential care.

other – extra electrical sockets, additional heating, thermostats, telephone amplifier;
portable AT – adapted cutlery, bathboard, dressing aids, hearing aid, jar openers, kettle tipper, magnifier.

At time 2 (after 5 years) the further adaptations and fixed AT required were:

- entrances – level thresholds, wider doors, visual door bell, remote door release, video intercom, ramp, handrails, possibly short rise platform lift, communal lift;
- internal circulation – level thresholds, wider doors and corridors, manual wheelchair storage, stairlift;
- personal care – level access shower, wall mounted seat, low level wash basin;
- other – lighting with PIR, electric window openers, rocker switches, lowered light switches, raised electric sockets, colour contrast décor, flashing telephone bell;
- further portable AT – manual wheelchair, raised toilet seat, riser recliner chair, shower chair, variable posture bed, walking frame.

These profiles were used to benchmark the adaptability of the 82 audited properties. Half of these were classified as sheltered housing (for definitions, see McCafferty [18]); and

of these, about half were conventional mainstream properties in which community alarms and grab rails had been installed but without other adaptations. Each user was ‘housed’ in each audited property together with their requirements for adaptations and AT at both points in time. A step change in the level of services provided after 5 years may appear artificial, but was a necessary simplifying assumption. Where adaptation was feasible, designs and specifications of the necessary building work and equipment were drawn up.

Secondly, in consultation with Occupational Therapists and other health specialists, the adaptations and AT were categorised into three types:

Basic – it was assumed that some adaptations and AT are essential in order for the user to remain at home. For example, some users in a two-storey property would require a stair lift.

Care reducing – it was assumed that some adaptations and AT may substitute for human input. For example, a level access shower would enable some users to bathe themselves, whereas they need help to use a conventional bath.

Good practice – further adaptations and AT have the potential to improve the quality of life of the user or, in some

Table 2. Total cost of packages of care, adaptations and AT for seven users with no carer, for 5 and 10 years

User	Packages of care, adaptations and AT with no informal care Present value cost ^a (£)						When savings are achieved compared with traditional – years ^b		Life expectancy – (years) ^c	
	Traditional	Augmented	Maximum	Traditional	Augmented	Maximum	Augmented	Maximum	Average	Reduced
	5 years	5 years	5 years	10 years	10 years	10 years				
A	130	351	1090	20,772	9100	15,637	5.3	7.8	9.9	7.4
B	3522	664	5701	38,717	17,331	31,393	0.8	8.1	11.6	8.7
C	10180	6239	11811	34600	23794	31377	0.9	8.0	11.6	8.7
D	4029	4306	9046	43,898	24,578	32,474	5.2	7.2	15.0	11.3
E	6133	7367	9874	69,342	41,131	45,732	6.1	6.6	7.9	5.9
F	1240	– ^c	2583	80,614	64,289	69,789	5.5	6.7	7.0	5.3
G	107,765 ^d	– ^c	145412	198 501 ^d	– ^c	241,508	– ^c	Never	15.0	7.5

^aCosts include initial, maintenance, replacement and recovery costs of adaptations and AT and annual care costs.

^bThe period since the initial investment, even though there is a subsequent investment in adaptations and AT and increase in care costs after 5 years. This is different from the time taken to recoup an investment in adaptations and AT which is typically 1 or 2 years for augmented packages, and 2 or 3 years for maximum packages.

^cAverage life expectancy [25] and reduced life expectancy due to ill-health.

^dCost of residential care.

^eAugmented packages were not feasible for user G or appropriate for user F in the first 5 years.

cases, of the informal carer. For example, a video entry phone for a user with difficulty in responding to callers who would otherwise need to leave an entrance door unsecured.

The third stage of the methodology involved combining the adaptations and AT with a ‘care package’ that allowed for the input of human care. Receipt of formal care services is heavily contingent upon the availability of informal care and three assumptions were made:

- no informal care;
- non-resident carer – assumed to help with domestic tasks such as cleaning and shopping, but not with personal care;
- co-resident carer, who was assumed to help with both personal care and domestic help.

The likely realistic input of formal care services (home care, day care, community nursing and meals, allowing for care management) in relation both to the different levels of AT input outlined above and the assumptions about informal care was then considered. This gave three types of combined care package:

- Traditional* – basic adaptations and AT with formal care.
- Augmented* – basic and care-reducing adaptations and AT with reduced formal care (reduced where adaptations and AT is assumed to substitute for human input).
- Maximum* – basic, care-reducing and good practice adaptations and AT with reduced formal care (as above).

For example, in a situation where there is no informal carer, user F is assumed to require no formal care services during the first 5 years. After 5 years, the weekly care package, with basic adaptations and AT, is assumed to consist of 6 hours of domestic help, 14 hours of personal care, day care once a week, and six ready-prepared meals. The effect of introducing care reducing adaptations and AT is assumed to halve the amount of personal care to 7 hours a week. These combinations of adaptations and AT, informal care

and formal care were analysed for each user profile at both points in time.

Finally, formal care costs were combined with the costs of adaptations and AT taking into account installation, maintenance, replacement and recovery costs through applying standard investment appraisal methods, on an annual basis for 15 years. Cost calculations drew on building cost data [19, 20], unit costs of health and social care services [21, 22] and residential care costs [23]. Costs were discounted using Treasury investment appraisal guidelines [24], adjusted to take account of both normal life expectation and the reduced life expectation that might be expected from the user’s disability [25]. Table 2 shows the average length of time the users will live (and receive adaptations and AT and formal care) on this basis.

Results and discussion

The number of the 82 properties capable of adaptation in time 1 ranged from 82 (users A, B and F) to 64 (user G). In time 2, this fell to between 78 (users A and C) to 43 (user G). Locomotion disabilities have a major impact on the feasibility of adaptation. Two-storey properties become progressively more difficult and eventually impossible to adapt with increasing locomotion impairment. A total of 87% of the properties could be adapted to meet the requirements of a wheelchair user capable of using a stairlift; 52% could accommodate an electric wheelchair, through-floor lift and fixed hoist from bedroom to bathroom. For user G, the most severely disabled profile, only 25% of the houses and maisonettes could be adapted compared with 67% of the bungalows and flats.

As might be expected, the properties that provided the most scope for adaptation were ground floor flats and bungalows, and properties with at least two bedrooms. Often they were characterised by combinations of: accommodation on one level – no vertical circulation; spacious layout with rooms separately approached from hall or landing;

internal stud partitions and timber floors; large bathrooms or space to enlarge an existing bathroom; and large walk-in cupboards. Flats in converted houses, maisonettes and flats with either no lift or an inadequate lift, and one bedroom properties and bed-sits provided the least scope for adaptation. Often they had: changes in floor level within the same floor; restricted accommodation layout; small bathrooms and no scope for enlargement; and restricted spaces around the property – limiting space for ramps, scooter stores and extensions. For modest requirements, sheltered flats designed for extra care (category 2.0) were easier to adapt than standard sheltered flats (category 1.5), which in turn were easier to adapt than mainstream flats. However, on average, more complex requirements were equally difficult to achieve across the different types of flats. Sheltered bungalows (mostly category 1.5) were generally smaller and more difficult to adapt than conventional bungalows for user profiles requiring wheelchair movement within the property (see Figure 1). Independent sheltered bungalows are a popular choice for both older people and housing providers, but they often incorporate avoidable difficulties. Kitchens and bathrooms often have minimal space provision, entrances are unsatisfactory, space for wheelchairs and carer assistance is frequently over-looked.

There were very strong correlations between scores of overall disability and cost, with locomotion disabilities – and hence mobility requirements – having the most important impact. Costs also varied greatly in relation to the characteristics of a user’s housing. Despite large variations in costs within groups of similar properties, statistically significant differences were identified between groups. Table 1 shows average costs for all properties in terms of the three types of adaptations and AT: basic, care reducing and good practice. For all user profiles, except user G, both basic and care-

reducing adaptations and AT average costs are low in time 1, ranging from £133 (user A) to £2183 (user C) for basic adaptations and AT, although the considerable variations in the adaptability of properties results in large variations in costs. The introduction of good practice adaptations and AT put costs up, often substantially. In time 2, the deterioration in user capacities leads to a considerable increase in the average costs of basic adaptations and AT rising to £8547 (user F). One effect is that there is more scope for care-reducing AT, since the level of need is assumed to require more formal care input, so there are substantial costs here as well. Again, the average costs for each user mask a substantial variation between and within property types.

Table 2 illustrates the impact on costs of the different levels of adaptations and AT provision, under the assumption that there is no informal care, a situation that has been estimated to affect around 25% of those aged 65 and over living at home [26]. In the first 5 years, with the exception of user G, the costs of adaptations and AT and formal care are modest. After time 2, costs and savings accumulate rapidly. The period after which the augmented packages achieve savings compared with traditional packages are short and, for all the maximum packages, the period occurs between 6.6 and 8.1 years, typically within 2.5 years of the provision of further adaptations and AT. Similar findings arise when using the assumption of non-resident informal care. Consideration of the average life expectations of the users and life expectations reduced because of ill-health [12], suggests that the costs of care-reducing adaptations and AT are usually recouped within these life expectancy periods. When good practice adaptations and AT are included, costs are usually recouped within the average life expectancy, and for about half the packages they are recouped within the reduced life expectancy. These findings

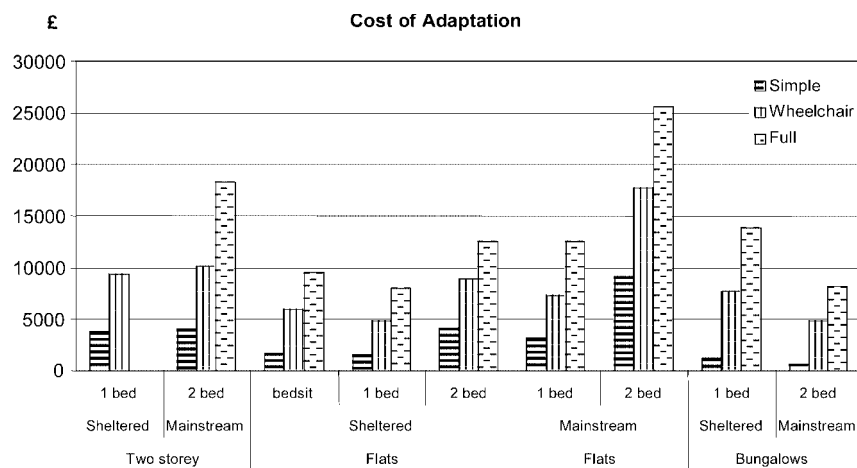


Figure 1. Average cost of adaptation of properties. (1) The average first cost of adaptations and fixed AT (but not portable AT) for those properties which can be adapted is given for three levels: simple – basic safety provisions and stairlift; wheelchair – as for simple plus wheelchair accessible entrance, rooms, corridors and shower room with gulley shower; full – as for wheelchair but wheelchair accessible bathroom, vertical lift and fixed hoist from bedroom to bathroom. (2) Sheltered one bedroom two-storey properties are generally adapted mainstream properties, often maisonettes. (3) Statistical tests indicate significant differences in average costs between property types ($P < 0.005$) and between sheltered and mainstream properties within property types ($P < 0.01$). There are insufficient data to enable more detailed comparisons.

apply to all users where there is no informal care, a non-resident informal carer, or a co-resident carer, except for user G with no carer.

Conclusions

Although these findings are sensitive to a number of assumptions, they do suggest strongly that increasing the input of adaptations and AT leads to savings, which are sometimes significant. In terms of practice, the successful achievement of this desirable outcome depends on the sensitive specification of care, and adaptations and AT requirements arising from a user's needs and ensuring that these are appropriately matched to the user's home and their individual preferences. Of course, properties vary greatly. Some can be very easy to adapt for all users, resulting in significant savings, whereas others can be difficult to adapt for most users and yield no saving, although adaptation may still be worthwhile through supporting the independence of the user. Given this, adaptations and AT can both enhance quality of life and do this in a cost-effective way. The findings point strongly towards an affirmative answer. *Yes*, adapting the homes of older people and providing AT can pay its way.

Key points

- Adaptations and AT can substitute and supplement care.
 - For many older people adaptations and AT can be cost effective.
 - Pay-back periods from investment in adaptations and AT can be quite short.
 - The design of the home has a major impact on cost effectiveness.
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