Designing a supportive living environment for older people with dementia

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SUMMARY
The vast majority of older adults want to remain living independently at home, with or without a sufficient amount of professional home care, even when overall health is starting to decline. The ageing of society and the increase in the number of very old elders goes together with an increase in the number of people with dementia. There are currently about 6 million -mainly older- people with dementia in the European Union, of which the vast majority (over two thirds) live at home. Dementia has severe implications to the quality of daily life, in particular to independent functioning, which sets extra demands to home environments. Standard residential concepts are often not suitable for habitation by older adults with dementia due to, for instance, an increased sensitivity for environmental conditions. This group of older adults and their relatives ask for living environments that support independence, compensate for declining and vitality, and lower the burden of family care.
This paper describes the design and design process of a dwelling for people with dementia and their spouses. This design was made based on the known general problems associated with dementia, and includes modifications in terms of architecture, interior design, the indoor environment, and technological solutions. Modifications have been derived from literature review and focus group sessions, and include modifications to the home's kitchen, living room, bedroom and the bathroom. To date, little systematic research has been done to verify if independence and well-being are supported by the modifications proposed in literature. Current design guidelines are frequently based on practical experience only.

KEYWORDS
Care, Dementia, Home Modifications, Independence, Older Adults

1. Introduction

In today's ageing society, ageing-in-place in combination with a sufficient amount of professional home care is commonly promoted as a strategy for maintaining autonomy, independence, sense of identity, and well-being. The wish to remain living independently, regardless of the condition of housing, neighbourhood, and health, is often a personal choice of older adults themselves (Gitlin, 2003), but is influenced by someone's health status or that of a partner, as well as the ability of the partner to cope with the burden of care posed upon him or her. On the individual level, this desire leads to home modifications, moving, or simply living under less favourable conditions. Older adults do not comprise a homogenous population, particularly in terms of lifestyle and health status. Health problems vary in severity and mix, and tend to increase with ageing. These have a great impact on the type of living environment that suits one best. This is also the case for an estimated and ever increasing group of 24.3 million people with dementia syndrome worldwide (Ferri et al., 2005-2006). Symptoms of dementia can be divided into three kinds: (i) impairment in activities of daily living (ADL), (ii) abnormal behaviour, and (iii) loss of cognitive functions (Ebersole et al., 2004).

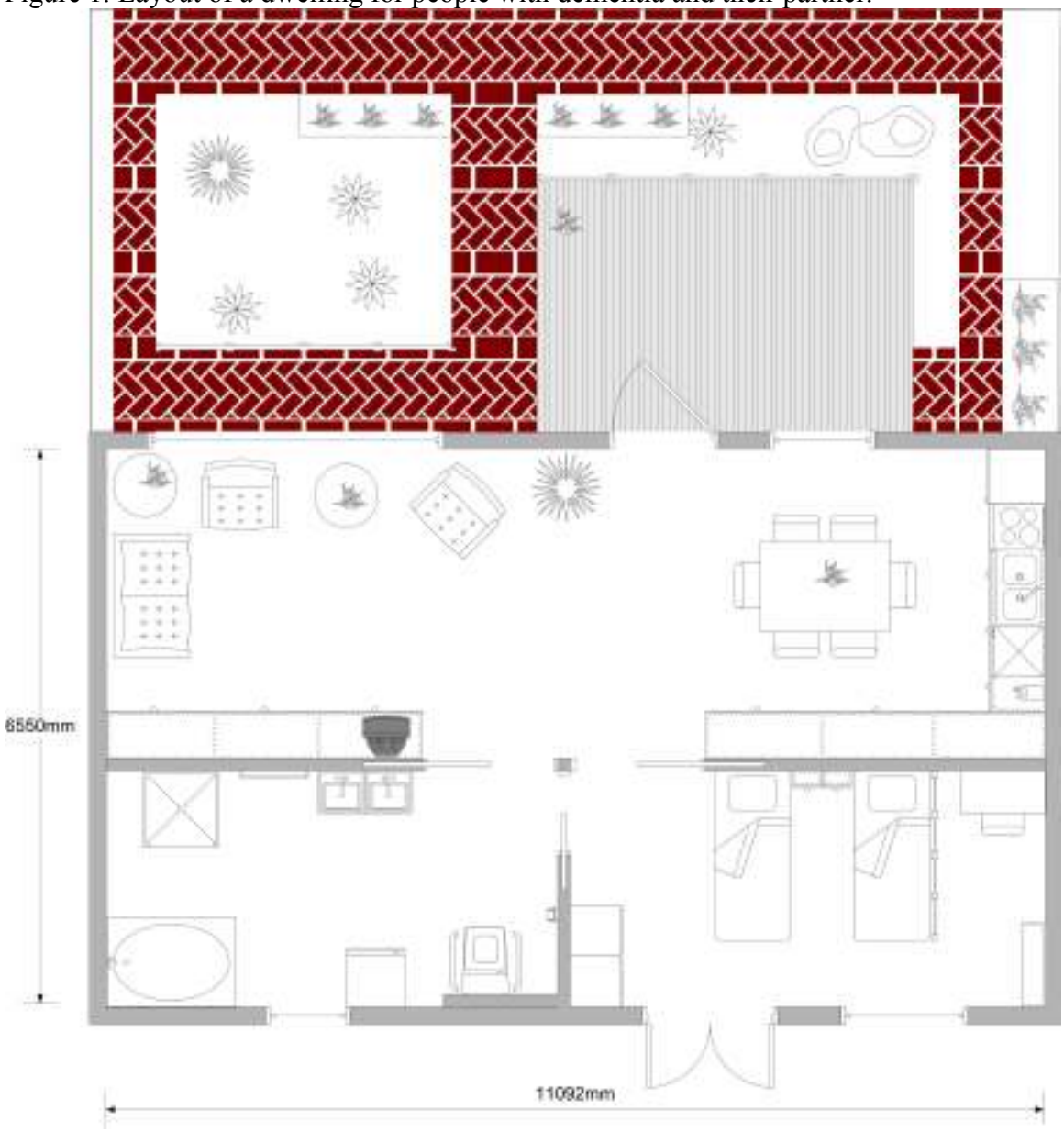
Older adults with dementia pose great challenges in terms of creating appropriate, healthy and supportive living environments in which they can perform optimally and are being compensated for decreasing vitality and overall health status. The current design of - mainly institutionalised - home-like or 'deinstitutionalised' housing for older adults with dementia is regarded as a therapeutic resource to promote well-being and functionality among the residents (Day et al., 2000). Given that in a country as the Netherlands about two thirds of the diagnosed early to mildly demented people live at home, where they are largely dependent on care from a spouse or family (Health Council of the Netherlands, 2002), it is strange that the private home is a largely ignored territory. The exclusion of the private home environment in government policies and studies also means that problems concerning current housing are not faced. Standard housing concepts for older adults are, to a certain extent not appropriate for habitation by people with dementia (van Hoof & Kort, 2006), and contribute to caregiver stress and early long-term institutional placement.

Non-pharmacologic interventions can play an important role in managing behavioural problems seen in people with dementia (Knopman & Sawyer-DeMaris, 1990; Blom et al., 2000; Desai & Grossberg, 2001; Ritchie & Lovestone, 2002). The foundation of non-pharmacologic management is recognising that the person with dementia is no longer able to adapt, and that instead the environment must be adapted to the patient's specific needs (Desai & Grossberg, 2001). Adapting living environments, for instance, the private home, to specific user needs in terms of architecture, interior design and technological solutions - in a balanced combination with pharmacologic, behavioural and occupational approaches - is likely to be most effective in improving the health, behaviour, and well-being of people with dementia (Zeisel et al., 2003). The limited capacity of acquiring new knowledge and skills sets limits on the type of environment that is useful to people with dementia.

At present, numerous pilot projects of supportive dwellings for older adults are being constructed worldwide. Most of these pilots aim exclusively at architecture solutions or technological solutions for a 'homogenous' population of older adults.

This paper deals with the development and design process of this conceptual dementia dwelling, and addresses the following –non-pharmacologic- aspects of the home environment: (i) architectural and interior design, and (ii) technological solutions connected to the dwelling.

Figure 1. Layout of a dwelling for people with dementia and their partner.



2. Design of a 'dementia home': methodology

The development of the dementia dwelling was based on three pillars (i) general knowledge of construction and architecture, (ii) literature research, and (iii) focus sessions with representatives of client groups.

The layout of the dementia dwelling is shown in Figure 1. This home has a surface area of approximately 72 square metres, a medium-sized home for older people that is dwelled by two people for the situation in the Netherlands. The design shown is the version that is located on the ground floor of an apartment block in order to create an accessible garden. In short, the home is characterised by a couple of remarkable features, which are described in more detail later. The living room is open and is characterised by a closet wall for storage of items and the heating and electrotechnical systems. Occupants can observe all parts of the dwelling from practically all positions in the home, and thus watch each other. The wide sliding doors in the centre of the home can be easily operated and allow a view to the toilet from the living room. A corridor is omitted from the design. The bathroom is wheelchair-accessible and is equipped with modified sanitary equipment. A corner of the bedroom offers room for the caring partner to retreat. Between the bedroom and the bathroom, there is a shortcut sliding door. The kitchen is positioned next to the living room and designed for extra safety. The demented partner can take a seat and participate in easy food preparation tasks. The garden offers a possibility to go outside and walk around safely.

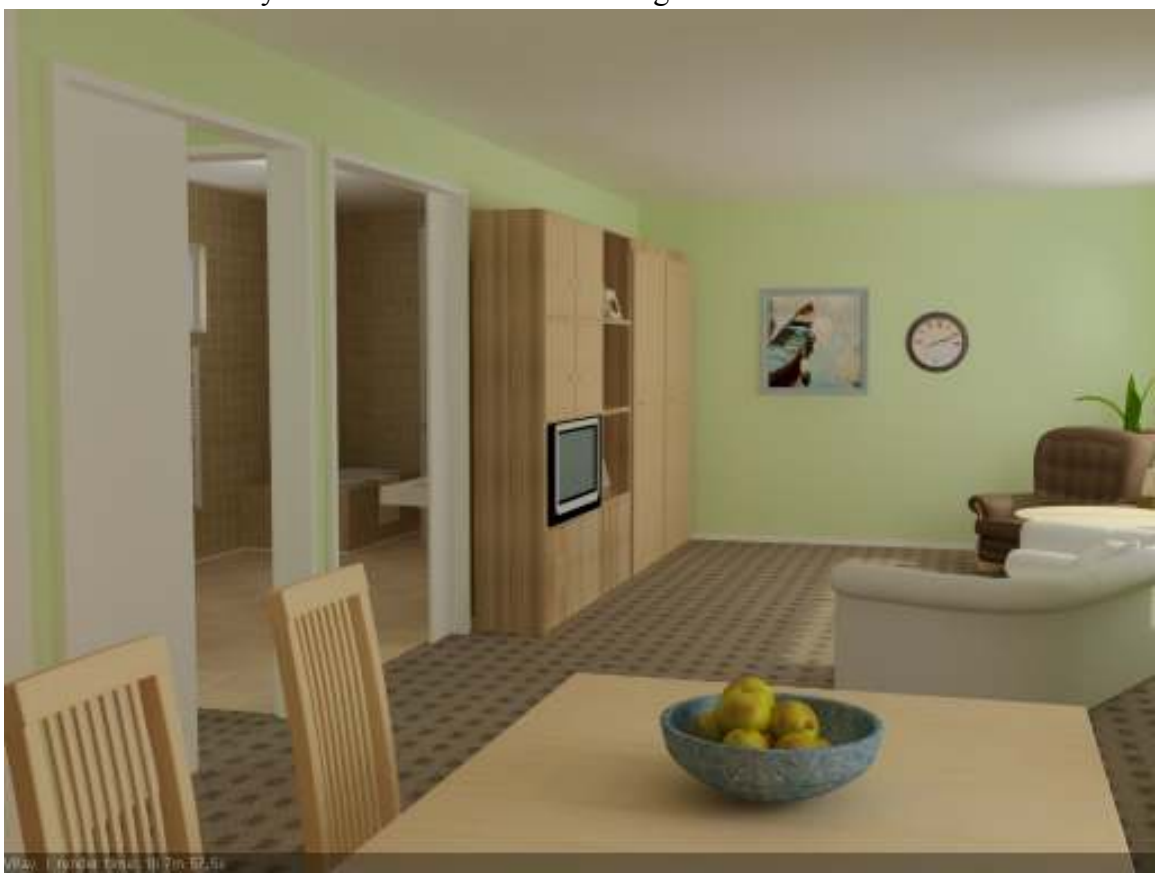
Another method applied to gain information were two rounds of consulting by focus groups, consisting of representatives of various patient organisations and organisations for the aged with expertise from the field of care and home modifications. The members of the focus groups have extensive knowledge of home modifications and user needs, and have long-standing experience with specific diseases and the ageing process. The members were invited to provide feedback on a preliminary home design and its program (design features), which was designed based on literature research and general knowledge of construction. Also the members were asked to bring various notions concerning the home environment and related design solutions together. Apart from providing feedback on the design, the members came up with additional design principles they knew from daily practice. Problems indicated by the focus group were studied and new design solutions were sought to address these problems. They present additional data applicable to the Dutch situation and countries with similar building traditions. Actual people with dementia or their relatives were consulted indirectly via a representative of the Netherlands Alzheimer Foundation. This representative discussed the design during a number of ‘Alzheimer Café’ sessions in the Netherlands with people with dementia and their partners, and brought the feedback to the focus group sessions as input for the design process.
The first round held on May 17 2006 of consulting focussed on the dwelling’s layout and architectural design, while the second round held on October 2 2006 focussed on the changes made to the original design and the technological solutions included in the dwelling. The first round included four, the second round seven experts. Based on visualisations of the design and the technical program, discussions took place, resulting in (i) direct feedback, (ii) individual reactions, and (iii) testing of technical feasibility. After each session, the members of the focus group responded to the design by filling out sheets pertaining to the technical program. The feedback led to amendments to the design.

The home's design is described as a sequence of spaces, in which each space is used for carrying out specific activities by the residents. Limitations to functioning mentioned in literature and the focus groups are mentioned first in the description, followed by the design solutions chosen. In this description, there is a differentiation of the (latent) needs of both the resident with dementia and the partner.

3. Architectural and interior design for dementia

The following paragraphs describe the design of the dementia dwelling based on a specific health-related problem for which a certain design or adaptation has been made. These design solutions cover the openness of the home and interior design.

Figure 2. View from the kitchen towards the bathroom. While cooking, one could still watch over the safety of the other one while bathing.



3.1. Open and accessible floor plans

In order to deal with *clinging behaviour*, both residents (and carers) should have an overview of spaces to keep in contact with one another. Therefore dementia dwelling has an open floor plan, which is obtained by reducing the number of walls. It is known from institutional settings that corridors can make people with dementia restless (Cohen-Mansfield et al., 1990). The dementia home has no corridor but an American-style entrance that directly leads to the central living room. The open character of the home is enlarged by the 1.6 metres wide sliding doors, which can be opened and shut in compliance with openness and privacy wishes. This is particularly true for the sanitary

rooms, which are visible from the kitchen and from the sofa area when the sliding doors are fully opened (Figure 2).
Some residents with dementia may face *difficulty in locating the toilet* when needing to visit this facility. It is assumed that toilets are easier found (and thus used) when clearly marked or visible from the living room. Since the amplitude of the daily rhythm of urine production also decreases in older adults, sleep at night is more likely to be disturbed by the need to go to the toilet (Waterhouse et al., 2002, pp 100). This need is of course also influenced by the intake of certain types of medication. To make going to the toilet easier during the night, there is a sliding door between the bedroom and the bathroom that serves as a shortcut. One of the people in the focus groups recalled a story on a couple with dementia that went camping but made sure they were close to the sanitary facilities to minimise walking distances. Another problem in older people with dementia is the risk of fall incidents, which is even larger at night, for instance, when people have to walk long distances to reach the toilet. The shortcut may therefore also limit the risks of night-time accidents including falls.
The open character of the home is further enhanced by the large windows that allow people to look outside. Bowlby Sifton (2007) states that windows can help in offering reality reassurance by providing outdoors views that *help with orientation to the season and time of day*. Building physical aspects related to these windows are treated later.
Spouses and relatives may feel the need for privacy. Therefore, not every part of the home should be open and accessible. In the bedroom, there is a special section for the partner or carer to withdraw or carry out activities in privacy. In other designs that offer more surface area, this could be a separate room that can be locked. The need for such a room that could also be used by a professional carer is one of the most important desires from the focus groups. Gitlin (2007) also mentions the need for setting up a so-called quiet room with comfortable furniture for rest breaks in case of extreme agitation.
In order to maintain safety at home, the amount of clutter needs to be kept at a minimum, and dangerous items should be safely stored when needed. For this purpose, a closet wall is built in the dwelling for storage of (dangerous) items. It also contains the home's heating and ventilation system, and the meter cupboard. A part of the closets can be locked. The focus groups have indicated that in order to guarantee resident autonomy and empowerment, not all closets should be equipped with locks, although child-proof locks should be a good alternative.
Many older adults cope with diminishing mobility and start to use assistive devices. Nearly all homes in the Netherlands do not provide enough space to store the larger devices, not inside the home or outdoors on an institutional corridor. Near the front door of the dementia dwelling, there is enough storage space for mobility aids, such as walkers, wheelchairs and mobility scooters.

3.2. Interior design

One way to account for the *decline in cognition* is to ensure that all features of the environment, including furniture, would have been familiar to persons with dementia in their early adulthood (Fleming et al., 2003). Apart from this need for familiarity, there is also a need for safety given the risks and dangers of wandering, (kitchen) fires, medical aids-related injuries, and falls. In terms of interior design, one could improve the home environment by a number of interventions. It is hypothesised that reflections and

repetitive patterns, for instance, wall paper prints, can be experienced as depth, which can cause fear, restlessness and confusion (Cohen-Mansfield et al., 1990). Based on this hypothesis, the dementia home is decorated with pastel colours (Marx et al., 2002) without patterns and prints. In order to *minimise confusion* and possibly reduce the number of fall incidents, doorsteps and colour accents on floors are avoided to. In order to reduce the risk of falls, walkways are kept free of clutter, and all furniture that might be grabbed for support while walking or during a fall should be stable. Moreover, floor covering is secured. The focus groups indicated that the table and chairs in the kitchen section should be robust but light-weight in order to be able to move them when needed. The table should be high enough for use by persons in a wheelchair. To minimise the space taken by the table, one should choose a fold-up version.

To *minimise risks of confusion* and to increase safety at home, floral decorations in the home should always be non-poisonous plants and flowers. Plastic plants are getting dusty over time and are difficult to clean. These should therefore not be used as a substitute. To further reduce the risk of falling, all loose cables in the home should be covered. This also prevents the collection of dust and lessens the need for intensive cleaning and hovering. A solution to this problem is the installing of a cable plinth along the walls. There is sufficient space to store away dangerous goods, clutter, cleaning chemicals and kitchen utensils safely by the creation of a closet wall in the kitchen and living room. Some of these closets, as well as some of the kitchen drawers, can be locked if the person with dementia is at immediate danger of injury, or poisoning. In the early stages of dementia, all closets and drawers are accessible to preserve dignity.

To accommodate any problems concerning *temporal orientation* the rooms are equipped with clocks and calendars. A board can be used for leaving messages as a reminder of events. Other decorations on walls may include a photo wall that can be used for reminiscing and gives the residents a sense of home.

To enable independent or assisted use of sanitation, the bathroom and toilet space are equipped with grab bars and handles. If for any reason residents need to use wheelchairs, one should be able to adapt kitchen blades, toilet seats and wash-hand basins in height. To allow for wheelchair accessibility, the bathroom is not only equipped with a bath tub but also with a roll-in shower that allows maximum freedom of movement for a carer when assisting the other (Figure 3). The focus groups have indicated that mirrors should be mounted to the movable systems, and that one should be able to tilt the mirrors to allow people in wheelchairs and smaller people to watch themselves. In order to prevent burns to, for instance, the knees of people in wheelchairs, drainage pipes are insulated. For the same purpose, the kitchen's cooker top is equipped with a 'crash barrier' for securing pans, as can be found in many sailing boat galleys.

The focus groups advised to place two separate beds in the bedroom (Figure 1). This should enable helping people to get in and out of bed. Also, many partners do not longer want to share one bed when people are slowly becoming incontinent.

4. Supportive technology

The complexity of the technology around people with dementia plays a role in their loss of abilities, and carers often emphasise the disabling of contemporary technology (Hagen et al., 2004). Older adults with cognitive impairments use the least number of assistive devices among all impaired seniors (Mann, 2003). Devices for physical disabilities

tended to be more readily accepted and used, than devices for cognitive impairments. The actual needs and abilities of people may vary considerably depending on the stage of dementia and earlier experiences with technology and equipment.
Some studies on utility and usability of technology at home (Bjørneby et al., 2004; Orpwood et al., 2004) have resulted into a series of general guidelines and design recommendations for technology for people with early to mild dementia. Technology and equipment should (i) not require any learning, (ii) look familiar, (iii) not remove control from the user, (iv) require a minimum of user interaction, and (v) reassure the user (Orpwood et al., 2004). Some people with dementia are curious about new equipment and are often uninhibited about dismantling it to "find out how it works" (Adlam et al., 2004), and technology should therefore be robust. Moreover, this group of older adults needs rapid responses to perceived difficulties, as they are often unable to understand the reason for a fault occurring, or work around it (Adlam et al., 2004). These statements and requirements have led to a very conservative introduction of technology in the dementia dwelling.

Figure 3. View of the bathroom, with position of the roll-in shower with shower seat, loose hand-held shower, laundry machine (top-loader), heating panel for warming towels and a non-slip tile floor.

4.1. Applications

A wide range of applications, of which most claim to increase safety, are already in the marketplace to (in)directly support people with dementia and their partners. Although

many applications can be used by both residents, one should make a distinction between technological applications that serve or benefit the person with dementia or the partner. The applications in the dementia dwelling are such that they can be used by a person with dementia. Complicated systems, such as the meter cupboard, can be locked, also for reasons for safety and thoughts expressed by Adlam et al. (2004).

Concerns about the dangers of electricity and electrical appliances in the dwelling have been solved in the following ways. The cable plinth is put in place to limit the length of cables that collect dust and form a risk of falling. The meter cupboard is placed in the closet wall, and leaves room for installing additional home automation services or control of the indoor environment. All outlets are ground fault interrupted for extra safety. Plug sockets are quipped with childproof locks that require a twisting movement. In the bathroom, the use of electrical appliances is limited. The hair dryer is installed, but is screwed to the wall like those found in many hotels. The mirrors in the bathroom are heated so that moisture from the air does not condensate on them and make reflections impossible. All electric switches in the home are equipped with prints of light bulbs and text to indicate what they are for. Additional switches, for instance, for controlling shades, can be applied to along with manual control levers.

To cope with the problems accompanying the potentially lethal wandering, movement detectors and door contacts are installed. Such systems do not put an unethical restraint on people as does, for instance, locking them up. The alarm can be set to only alarm during the hours of darkness, or to alarm if a person has left their dwelling for a longer than usual length of time/time of day, and some systems can even discourage people with dementia from leaving or send a warning message to a carer or service provider. In early dementia, online route planning software can help people to find their way around town and to provide a sense of security. For this purpose, stressed by the focus groups, a computer is placed in the home. Various services available on the personal computer can moreover help support both the person with dementia as the partner (Lauriks et al., 2007). Braudy Harris (2006) also found that some older adults with dementia used computers, for instance, to keep in touch with family members, and to keep track of their appointments. The opposite of the aforementioned online route planners are GPS-based tools that allow carers to track people when wandering and bring them back home safely.

The home is equipped with a personal alarm system that is in direct contact with a control post, in analogy with the modified model of Stefanov (van Hoof et al., 2007). This personal alarms system not only warns care professionals at this centre, but also affects the electrical systems in the home. For instance, when the alarm goes off, all lights are switched on, while at the same time all other appliances are turned off (except for the refrigerator, telephone, and environmental systems). This also means that pans on the cooker top are no longer heated, which minimizes the risk for kitchen fires. This was also an explicit desire from the focus groups. The types of alarm systems chosen have a minimal impact on privacy, and ethical issues of such systems are discussed in various publications (for examples, see Bjørneby et al., 1999; van Berlo, 2005; van Hoof et al., 2007). Moreover, the dwelling is equipped with fire and smoke detectors. When alarms go off, a warning signal is send to a central control post. At the same time, all light in the

home are turned on and doors unlock. The control post then seeks contact with the home via telephone or via a camera to check on the residents (for example, see van Hoof & Kort, 2008a). When people want to go to the toilet at night, red night orientation lights, placed above the cable plinth, are turned on via infrared sensors. These lights should provide minimise the risk of falls.

To protect against burning hot water, thermostat taps are built in underneath the washbasins and bath tub for safety. According to the focus groups, people with dementia are unfamiliar with thermostat taps, and some are known to break them by overturning. In the bathroom, the faucet is equipped with a long handle that allows a carer to grasp over the tub without the risk of falling into the water. For the same reasons, the focus groups have recommended to install a bathtub with enough space below to put your feet when having to bend over. At the same time, the panel has asked for the hand-held shower hose not to be too long, so that it cannot hang over the rim of the tub to prevent the floor from flooding.

The refrigerator door is equipped with a sensor that monitors how often the door has been opened and closed (Leikas et al., 1998), as well as a sensor than monitors the weight of the refrigerator. These sensors provide carers to estimate how often and how much is being eaten, or hoarded, hidden or thrown away, and may be a simple and unobtrusive means of health monitoring.

A new trend in technology for care are inexpensive support systems for older adults staying alone at home, allowing care and health centres to remotely observe and help them, for instance, with the intake of medication. For this purpose, the television set can be used, for instance, for broadcasting wake-up video messages from children or loved-ones. The television can also be used for watching photos or reminiscing. At the same time, it can also be digitally locked against adult content and violence, to prevent unwanted negative feelings.

5. Discussion

This paper presented the first notions of how a dementia dwelling could be designed, taking into account all aspects of the built environment. More design features of the dementia dwelling, relating to the indoor environment and building services engineering, are presented elsewhere (van Hoof and Kort, 2008b). Based on the results of the literature search in this paper and the outcomes of the focus group meetings, a systematic review is to be carried out by the authors and colleagues. This study showed once more what has previously been stated by Day et al. (2002), which is that current design guide(line)s for housing older adults with dementia typically offer hypotheses on spatial organisation and appointment of the physical environment. They are frequently based on practical experience of designers or facility administrators, although in some cases findings from clinical research are applied in the form of design ‘solutions’(Day et al., 2000). Even though compelling arguments are made for the therapeutic efficacy of an appropriate living environment, which can be regarded as non-pharmacologic intervention, little research has been carried out to date to determine whether the special design features are, in fact, effective in reducing symptoms, and to quantify to which extent they contribute to self care, well-being, and vitality (Desai & Grossberg, 2001; Zeisel et al., 2003). This paper provides items for further study to find evidence of the efficacy of the design recommendations. More research is also needed when recommended design solutions

conflict with each other, or when such measures have major or controversial impacts for cost or well-being (Day et al., 2000).
Although some design data exist for institutionalised housing, the own dwelling is a largely ignored territory. Little research has been done on day care and assisted living facilities too. These places often have different resident populations, care practices and philosophies, physical environments, and regulatory realities (Day et al., 2000). Because of the newness of the field, the limited research, and the small number of significant demonstration projects, the existing guidelines are best viewed not as inflexible directives, but as an effort to expand and stimulate thinking on the relationships between dementia and design. They are hypotheses amenable to, and requiring, implementation and validation (Cohen & Day, 1993). Measures to improve home safety may need periodical re-evaluation by spouses or carers when memory loss progresses (Gitlin & Corcoran, 2000). This is also a point that deserves further study in relation to the different stages of dementia.

An issue raised by the focus groups was on the profile of the residents of the dementia dwelling. The dwelling was designed as a residential unit within larger residential building or assisted-living facility for housing a couple. The design is explicitly based on such a type of living together, and does not pose a direct solution for older people living in with adult children. Apart from the people living with a spouse or offspring, there are many people living alone. People living alone may benefit from the dementia dwelling's design solutions, but do not form the initial target group.

Even though many people want to stay in their own and known home for as long as possible, there often comes a time that living together, non-institutionally, comes under pressure. In the Dutch situation, one of the partners remains living at home, while the other is institutionalised. The dementia dwelling could be an intermediary housing option in one's sequential living career, close to numerous facilities and a professional care centre, in which both partners can remain living together in a supportive environment.

It should be determined how to implement the design features in existing dwellings that are housed by people with dementia. It is very unlikely that one day everyone dealing with dementia lives in a specially designed dementia home. Also in the Netherlands, there is an enormous pressure on the existing housing stock, given the fact that the amount of specialised senior housing can hardly keep up with the demand (de Boer, 2006). Therefore, the number of dwellings that can facilitate care and compensate the effects of ageing needs to increase dramatically anyway. Moreover, the need for accessible dwellings is much larger than the need for living arrangements with care services. Features of the design of the dementia dwelling can also be used for other target groups, such as parents with a mentally handicapped child, although claims of efficacy need to be researched in more depth.

People with dementia may find it difficult to utilise equipment due to apraxia, tremors, muscle weakness, and vision problems (Health Council of the Netherlands, 2002; Orpwood et al., 2004). These problems mainly stem from both physical ageing and illnesses, and of course the inappropriateness and 'confusing' nature of certain

technology for this group of users. The overall supply of suitable technology to support both patient and carer is insufficient. Areas that need special attention are IADL, time spending, orientation, communication and safety (Sweep et al., 1998).
The emergence of home automation, smart home technologies, and intelligent equipment in the home environment can lead to confusion and anxiety, especially when things (seem to) happen automatically (lights turning on and off, curtains moving) that are not understood and cannot be controlled by the people with dementia themselves, especially in the more advanced stages of dementia. This can lead to anxiety or frustration, and therefore such systems should be installed with caution. Some intelligent systems, however, might be suitable to monitor and control less visible and invasive aspects of the dwelling, such as the indoor climate, when systems are supplemented by a manual thermostat to allow user control. Such solutions are suitable to serve many, including people with early dementia. Also, technology in the living environment too, should have an appearance, and require the same user interaction, as things familiar from early adulthood (Fleming et al., 2003). All new technology should to be explored in terms of usability by older adults with dementia living at home, particularly in early and moderate dementia.

6. Conclusion

The design of the dementia dwelling as presented in this paper can be seen as a non-pharmacologic strategy to support living independently, improve self care capabilities, and increase well-being of older adults with dementia. Besides these benefits for the care recipient, informal or family carers are supported in care through the home's infrastructure and technology installed, and the improved behaviour of their impaired partners. Professional carers can benefit from the same features, as well as the increased self care capabilities of the care recipient. In order to create appropriate dwellings for older adults with dementia, all aspects of the living environment should be addressed in a holistic manner. Moreover, continuing to live independently delays the demand for expensive institutional care – a form of care that is under pressure due to the ageing and hazing of society with respect to capacity. Further research should be executed with persons with early and mild dementia and their partners to examine how home modifications and technological solutions can meet the needs of the end-users, how the progress of dementia influences abilities, and if the design conditions proposed are indeed correct.

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