

# Exploring Technological and Architectural Solutions for Nursing Home Residents, Care Professionals and Technical Staff: Focus Groups With Professional Stakeholders

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## Abstract

Buildings with innovative technologies and architectural solutions are needed as a means of support for future nursing homes alongside adequate care services. This study investigated how various groups of stakeholders from healthcare and technology envision the nursing home of the future in the presumed perspective of residents, care professionals and technical staff. This qualitative study gathered data via ten simultaneous monodisciplinary focus group sessions with 95 professional stakeholders. The sessions yielded eight main themes: person and well-being; relatives and interaction; care technology; safety and security; interior design, architecture and the built environment; vision and knowledge; communication; and maintenance and operation. These themes can be used for programming future nursing homes, and for prioritising design and technological solutions. The views between the groups of stakeholders are to a large extent similar, and the personal needs of the residents are the most prominent factor for practice.

**Keywords:** Buildings, design, qualitative, older adults, technology, dementia.

## I. INTRODUCTION

The way long-term care settings are designed, constructed, used and maintained is in a process of transformation, in which both the character and appearance of buildings is noticeably changing [1-4]. The design and construction of nursing homes is a complex and dynamic process, as the very design of these buildings forces us to consider the technology-human interface directly in terms of living-space, ethics and social priorities [5,6]. Technology and architectural solutions are considered to support the well-being, activities of daily living and quality of life of older residents, and support and optimize the work processes of healthcare professionals and professionals in the domain of maintenance [1,2,7,8].

There are approximately 65,000 persons residing in about 700 Dutch nursing homes [9]. Van Hoof et al. [1,2] investigated the innovations known to the professional stakeholders who are involved in the design of nursing homes or are engaged in the care delivery processes. The nursing home is a specific type of care facility for which a large array of technological innovations are available on the marketplace. These innovations often do not make it into the programmes of newly constructed or refurbished facilities for financial constraints and for being unknown to the design and construction teams. Moreover, innovations are often only familiar to specific stakeholders, and therefore, are not purchased at all, or not accepted by the end-users as they have not been involved in the purchase and implementation plans. In recent studies [1,2], it was found that the two main groups of stakeholders, representatives from the domains of healthcare and technology/architecture share the same opinions about technological innovations in nursing home care, but each focus on different aspects. These most important professional stakeholders are often not involved in the design process of nursing homes. It is expected that these two groups have different views and it is, therefore, challenging, to involve both groups and include their needs. Still, it is unknown what

differences can be found in practice, and which themes are considered to be most important to each group of professional stakeholders when considering the innovative aspects of a programme of a future state-of-the-art nursing home.

This study investigates the needs and interests related to the technological and architectural solutions of professionals working in the domain of nursing home care and the design and implementation of technological and architectural solutions. The goal of the study was to find out how various monodisciplinary groups of stakeholders envision the nursing home of the future (as a place to reside and work) and which elements are necessary for its creation. The focus is on the aspects of design, architecture, and technology, although the social aspects of care and housing are also included. The study should clarify which insights and visions groups composed of different stakeholders have in relation to excellent nursing home care and nursing home design. At the same time, we also wanted to study if there are differences in needs and interests between the various stakeholders, and if so, what these differences are.

## II. METHODOLOGY

### A. Procedure

An interactive, qualitative study design was chosen for the study. A total of 95 participants joined in a number of ten focus group sessions that were held simultaneously (Table 1) on May 28<sup>th</sup> 2013. Each session lasted for 100 minutes. The focus group sessions followed a sticky note session described earlier [2]. The participants either had a background in healthcare, or in technology and architecture. This approach allowed for a comparison of the results of the various disciplines. Nursing home residents were not included as the focus was on professionals.

First, the goal of the focus group sessions was explained to the participants in a plenary session. Thereafter, the groups split up. All participants signed informed consent for the use of written data and photographic material. At the same time, personal data were taken, including name, sex, date of birth, type of work and organisation and years of work experience (Table 1). At the start of each session, a scenario was read out aloud. This scenario was the same for each group, and dealt with the potential benefits for residents, professional carers and technical staff of nursing homes.

Every session was guided by a session leader, and an assistant. All session leaders and assistants had been briefed about the uniform procedure and were provided with a manual and an instruction guide prior to the start of the sessions. The role for the session leader was to stimulate creativity and to obtain a maximum of variety in responses and input. The assistant's role was to support the session leader and to observe the group dynamics. At the same time, the assistant helped by collecting written materials, and making photos. The session leaders were lecturers/researchers working with the organizing university, who work in the field in healthcare and technology. The assistants were students of the Department of Industrial Design of a collaborating university of technology, one staff member with a background in Industrial Design, and one student from the Bachelor course of Applied Gerontology. These assistants were trained and skilled in the applied procedure and methodology.

### B. Focus groups

A focus group methodology was chosen for this study because the aim is to gain insight into how professional stakeholders envisage the nursing home of the future. This a methodology that has been applied to housing studies before [10-12]. A focus group approach enables insights to be gained into participants' shared understanding of the issues [13,14]. According to Kitzinger [13], focus groups are a form of group interview that capitalizes on communication between research participants in order to generate data. Focus groups explicitly use group interaction as part of the method. This means that instead of the researcher asking each person to respond to a question in turn, people are encouraged to talk to one another. The method is particularly useful for exploring people's knowledge and experiences. Focus groups can encourage participation from those who are reluctant to be interviewed on their own, and encourage contributions from people who feel they have nothing to say. Focus groups are useful when exploring subjective meanings and understandings from the research participants' perspective, particularly when it is useful to explore similarities and differences in participants' views and experiences [15]. Within and between group differences were investigated in this study. The group size ranged from 7 to 12 participants (leaders and assistants excluded) (Figure 1). The purpose of this methodology was to present a picture of the needs of three stakeholders, i.e., residents, professional carers and technical staff of nursing homes, as reflected by professionals participating in this study, and to identify elements that contribute to the creation of a nursing home of the future. This type of research has been applied before, for instance, by Barnes et al. [12], who conducted focus groups to feed into the identification of best practice design criteria.

### C. Questions and topics

The focus group session began with an open-ended question enquiring about the needs of certain stakeholders: three in total. Participants were invited to write down their personal thoughts on A4-sized forms (in full sentences), on which one question was printed per sheet for all three stakeholders. These answers were later discussed within the group as a whole. This procedure was followed three times. Participants were requested to focus on the design and construction, the interior design, technology, furniture and assistive aids, and on a sense of home, the support of work processes, et cetera. After approximately 15 minutes of thinking individually, the group as a whole was invited to discuss the answers written down and comment.

During the focus group session the participants were invited to share their views and answers to three themes and (sub)questions (also written on the forms):

- (1) *Residents*: What turns a nursing home into a home? What helps in creating a sense of home? To what extent are residents allowed to bring along their own furniture? Which items increase well-being? Are there examples of best and worst practices? To what extent does the presence of assistive technologies influence the sense of home, of how can this be improved? In Dutch nursing homes, people cannot select home mates: how can architectural solutions compensate?
- (2) *Care professionals*: Which aspects of the built environment and technology are considered as supportive factors in the execution of their work? Which aspects are considered a barrier? What are the most important assistive devices available to care professionals?
- (3) *Maintenance and control*: Which three items require the most action by professionals from the domain of maintenance and control? Why? Which solutions are important to improve hygiene and cleaning? What about the choice of materials? Which building services are important to processes, comfort and control of a building? Homeliness is often related to the choice of furniture and materials. In a nursing home we often see furniture that is upholstered with easy to clean materials. How are homeliness and hygiene related? Are there best practices? How can interests in the domain of maintenance and control conflict with those of living and care? How can we bridge the gap?

#### **D. Data analysis**

During the focus group sessions, conversations were audiotaped. These conversations were afterwards transcribed verbatim by the assistants. Transcripts were anonymised to ensure confidentiality. The transcripts of the focus group sessions were analysed in conjunction with the observations made by the assistants, in order to include group dynamics and the interaction between participants as a part of the analysis. As an additional source of information, the question forms that were filled out by the participants were used as a source of data.

First, the transcripts were each read in their entirety. Then, they were read a second time to develop codes that were grouped into themes, which emerged from the narratives, consistent with the questions. Quotes that summarised the essence of the participants' experiences were recorded. Researcher triangulation was applied during the entire process, for example, separate analyses of the interviews were conducted by two of the authors (AD, JH). This guarantees that the data are interpreted independently and from different perspectives. A method triangulation was applied due to the use of both individual forms and group discussions.

During the data analysis, several themes and subthemes emerged, which were compared in terms of similarities and differences for the stakeholders with a background in technology and healthcare. In addition, comparisons were made between the results from the forms and the transcripts.

### **III. RESULTS**

Because the results of the focus group sessions reflect a wide range of thoughts and experiences, we have chosen to present this diversity, as far as legibility allows. This means that the results are presented in a grouped manner as themes for the three stakeholders. There were eight main themes: person and well-being; relatives and interaction; care technology; safety and security; interior design, architecture and the built environment; vision and knowledge; communication; and maintenance and operation (Table 2). These themes are elaborated in the following sections.

#### **A. Personhood and well-being**

The main theme personhood and well-being is related to important features for the resident (Table 2). The related factors are mentioned by the majority of groups, sometimes all ten. These themes are mentioned in both the healthcare and technology groups. Autonomy and privacy are factors mentioned by all groups as being an important feature for residents. Related to these two subthemes are having a private, single-person, room in which nursing home residents can live alone. A sense of home, which is different for every resident, is another subtheme, which was mentioned by the representatives from focus groups 6 and 7 only. Having your own furniture and personal belongings around you is mentioned by a majority of participants.

According to focus group 1, a nursing home resident should be able to fully be him/herself, and there should be emphasis on the things one can still do independently instead of focusing on activities for which assistance is needed. In addition, residents should be treated as individuals.

According to focus group 2, having a private room with familiar personal belongings is essential. These personal belongings and preferences for interior design are changing over time. The current cohort of residents may prefer Persian carpets and rugs, whereas future older adults may prefer to live in a room with a minimalist design and a floor without carpet. Nursing homes need to consider these changing preferences when making strategies for housing and care.

**FG6:** "If I ever end up living in a nursing home, I would feel at home if I had my personal belongings at hand. I would like to decorate my own room."

**FG8:** “To what extent are residents allowed to bring personal items? It is quite personal. With which toothpaste and toothbrush do I brush my teeth? Which clothes do I put on? May I help choose what food we eat tonight, which television channel is turned on, or may I perhaps watch television in my own room like I used to? Am I allowed to bring my own cabinet, because I know where to find the door handle? I know how my own bed feels, and I will not hurt my foot against a frame that is in a strange position. Where [on earth] did my own sheets go? This thing is yellow and maybe easy to clean, but I love my Mickey Mouse print.”

According to focus group 4, many residents had only a small world they lived in prior to admission. Instead of considering the space alone, the system should have a look at where the resident came from, what he or she did at home, and which items one used. Focus group 3 stated that, ideally, a family situation should be simulated in the nursing home to stimulate a sense of home. Moreover, attention should be given to residents with a different cultural background in order to improve the sense of home.

**FG3:** “If you always had Indonesian or Moroccan food at home this contributes to a sense of home. If this food is taken away, you get lost and without a home.”

Focus group 5 nuanced the image of the nursing home of the future, stating it should be a home, where people go to receive care and assistance. A home is a place with a bed, books and a television set. It is important for nursing home residents that quality of life is continuously added to their lives. Care professionals should listen to the residents in order to facilitate this process. One should try to avoid the obvious situation that medical aspects are coming to the fore at all times.

Focus group 9 stated that nursing homes should facilitate a freedom of furnishing and painting the rooms to one’s personal preferences in order to improve the sense of home. The same is being said about what happens inside the room: control over the solar blinds and temperature, or whether the doors are open or shut. This again contributes to a sense of home.

**FG9:** “Older people can be very insecure when they are admitted to a strange and new environment. Creating a homelike environment is very important.”

Freedom is a key (and multifactorial) element in maintaining personhood: such as the freedom of movement and freedom of choice. Respecting personal wishes and lifestyles and providing comfort are also subthemes. Focus group 6 mentioned the use of technology in relation to freedom of residents, including cameras and other sensors. These are considered to be a fitting tool for monitoring, which, in turn, should provide more freedom of movement and activities, as well as autonomy. According to focus group 2, being able to walk around freely (indoors and outdoors) with the help of technology was considered a relevant area of development.

Focus group 4 stresses the need for acknowledging one’s sexual needs. This is a topic which is often ignored.

**FG4:** “Sexuality is a very important issue if you look at it from the perspective of technology. Camera surveillance is a very attractive solution, but if people want to be alone in their bed at night, they are constantly monitored using cameras.”

Technology can thus have an impact on the factors contributing to this current theme. But freedom is more than just a factor that is being facilitated through the use of technology. According to focus group 6, the scale of the facility determines the amount of rules and regulations for residents, and there needs to be room for self-actualisation and freedom. Focus group 8 mentioned that the sense of freedom is considered to be of significance. This goes together with having a feeling that you can enter a building without having to think that most of the things surrounding you actually belong to someone else, including fellow residents and care professionals.

**FG6:** “There are many things we do in a nursing home, of which I wonder if we do them at home too? We need to ask ourselves, would we do this at home the same way. If the answer is no, we should also not do this in a nursing home.”

Having pets around is mentioned by five of the focus groups as a way to preserve personhood. Two of the technology groups (focus groups 6 and 9) mention trust as a key element for nursing homes. In order to be able to engage in activities is considered important by focus groups 2, 3 and 9, as well as means to exercise.

A nursing home should embrace the concept of hospitality according to the representatives of focus group 9.

**FG9:** “Facility management in healthcare should actually be called hotel management: hospitality.”

Focus group 6 stated that the nursing home of the future is believed to blend in with society and other dwellings in the area, just like a hotel or an all-inclusive facility. This is believed to also lower the mental threshold for admission.

## **B. Relatives and interaction**

Relatives are the second theme emerging from the focus group sessions (Table 2). The group of ICT and home automation mentions the importance of partners being allowed to live in with nursing home residents. Moreover, there should no longer be visiting hours (although these have largely been abolished). This would also improve the autonomy of residents, which was a subtheme in the previous theme of personhood and well-being. Related to these subthemes are the right for overnight staying and facilities for this desire, which is mentioned by participants from healthcare and architecture.

According to focus group 4, inviting relatives and friends should not be limited to cursory visits. Focus group 9 mentioned the many different responses to whether one should be able to live together with a partner. Focus group 7 stressed the right of say of relatives as an important matter. Focus group 8 stressed that the value of home does not only apply to the residents, but also to the professional caregivers and other stakeholders. A nursing home should also be a second home for relatives.

**FG4:** “[Relatives] should be able to stay for the night and have breakfast if they want to. To me that is very important. It is part of offering a secure place.”

**FG9:** “Sometimes it is better to protect the partner from the impairment of his/her loved one. You do not want to be confronted with it on a daily basis.”

**FG6:** “Every aspect [of the nursing home] is focused on older people, and that is the problem why relatives do not often visit. There is nothing to do for grandchildren 12 years old. There are no facilities for playing or a garden, particularly in closed wards.”

In addition, there should be a private space (mentioned by education and research), which could be the own room, for receiving visitors without disturbing fellow residents or being disturbed by them. Maintaining a social network is mentioned by representatives from construction and architecture. Fellow residents and interaction with them is another subtheme important for the well-being of residents. There should be sufficient room for individual and group activities with fellow residents and relatives.

**FG4:** “Moving to a nursing home offers the potential to meet new people, and to get new neighbours.”

Being able to do things together with relatives contributes to a sense of home. Focus group 6 stressed the need for a communal area which facilitates being together with others. Focus group 7 deepened the discussion on relationships between residents. In their view, the sense of home needs to be present with the residents, both on an individual and on a group level. A care organisation should match the characters of persons living together based on equal relationships. These views are to a large extent shared by focus group 8, who stated that matching the residents based on their background is important in small-scale group accommodations. Like-minded residents can then interact with people who are literally on the same wavelength. Focus group 9 also stated that in many nursing homes, one cannot select one’s fellow residents, and this is seen as a threat. Residents should be offered the possibility to have dinner in their private rooms, and engaging with fellow residents should not be an obligation. In order to match the needs of residents, new residents should be interviewed about their needs and wishes.

**FG9:** “Your health condition needs to be ever worse in order to be admitted to residential care. The time people spend in a facility is ever shorter. Specific needs should be fulfilled.”

Focus group 6 discussed that financial aspects such as costs are mainly considered from the perspective of staff, not of the building or facilities themselves. Receiving assistance from volunteers and technology are seen as ways to save expenses. Particularly in smaller communities, one could consider living in compact nursing homes or villas, and neighbours could keep an eye on the residents. In any kind of facility, the way nursing homes are designed should stimulate the involvement of relatives. Free access to Wi-Fi and a communal restaurant which is also accessible for relatives and neighbours are considered solutions.

### C. Care technology

Given the numerous innovations in the domain of nursing home care and the attention for these innovations in practice, the theme of care technology is made up of many factors (Table 2). All groups mentioned the importance of assistive and supportive technologies for the daily lives of both residents and care professionals. Focus group 7 stressed the importance of a positive approach to care technology. Ageing goes together with losing one’s independence. By focusing on the remaining capacities and abilities, the dependence is minimised, according to the participants. This is one way to improve the image of an assistive device as a positive attribute. Assistive technologies do not necessarily have to look like as such. The control of home automation systems through a remote control that looks like the remote of one’s televisions makes it more acceptable to residents. Today’s generations are tomorrow’s residents, and are more used to working with all sorts of technologies.

**FG4:** “Those are technologies which are already found at home. And then the step to use them in a nursing home is much smaller.”

**FG7:** “There are many facilities for older where people actively chat with one another using technology, and where many things that were once considered ‘strange’ are now perhaps rather fashionable.”

**FG 6:** “Assistive technologies are good but, depending on the generation you work with, older persons will, to some extent, have problems with the integration of technology.”

Focus group 7 discussed the many technologies that are available on the market place and that can be used in nursing homes. These include tablet computers and smart phones to help find data of residents, and a digital care file for relatives in which they can leave personal messages that a care professional can use for communication with a resident. These types of technologies are common practice for older people in the near future. Materials should be robust, as broken items cost a lot of money to replace.

Home automation is mentioned by three groups from both healthcare and technology, but not by the representatives of the home automation field. According to focus group 3, technological developments in the field of assistive technologies, home automation systems and health monitoring are indispensable in nursing homes and the professional lives of carers these days. According to the participants of focus group 10, there is an obvious distinction between somatic and psychogeriatric nursing home residents in terms of the implementation of technology. As the focus is shifting towards dementia care, one should ask oneself the question whether home automation solutions actually support the resident him/herself.

**FG3:** “Patients with diabetes already do it like this. They monitor their own health status and get an alarm call telling them to go see a doctor when something is wrong.”

**FG3:** “Shutting curtains, browsing for information when you don’t know the specifications of certain types of medication..... I can imagine that this kind of labour is very pleasant.”

Another talking point in focus group 10 was the supposed preference of facility management for automated controls. For many residents automated systems can be a reason of fear. Having buttons to control items in the private room is much better than having everything fully automated, such as lights and shades. This is both beneficial for staff and residents.

**FG10:** “It would be nice that staff feel that they have a bit of control.”

**FG10:** “When the sun starts to shine and the temperature goes up the trouble starts. It is so difficult to control.”

Robotics is a subtheme mentioned by four groups with a background in healthcare, whereas only the participants of the assistive aids and bed group mentioned it from the perspective of technology. According to focus group 1, a washing robot may be an option in the future, although opinions are varied. A robot should be a technology of choice, and residents should be able to choose for being washed by a real person. If residents value more frequent or longer showering, for instance, to relieve pain, this cannot be done with the current care regime. An ‘automatic car wash’ may be one of the options in the near future.

**FG1:** “When I think of myself in 50 years’ time, many new technologies will have been developed, but I cannot imagine that I’d like to be washed by a robot.”

**FG1:** “I envision a robot that is a combination of a hoist and an automated toilet.”

Focus group 3 discussed the use of Paro, the robotic seal. This is a social robot which improves engagement among nursing home residents and which supports care professionals by improving interaction with the residents. Technologies that stimulate engagement among residents are very important new developments. New technologies including robots develop very fast, and so is the implementation within nursing home care. Technologies, however, should be free from malfunctioning.

**FG3:** “Today’s older adults are in a transition phase, but our generation already uses iPads. In the 1990s, many people thought that having a mobile phone was nonsense. We did not need one. Nowadays, it is most normal.”

**FG3:** “ICT is just like care: it should always work.”

ICT is mentioned as a way to support administration and other processes such as electronic patient records (ICT and two health care groups). Tablet computers and apps are promising new technologies mentioned by all healthcare groups and the assistive aids and ICT groups. According to focus group 3, the creation of a sense of home goes hand in hand with new technologies, and technology can contribute to autonomy of the resident. One of the participants of focus group 5 asked if the sense of home is not being threatened with all the assistive technologies being used. Then again, assistive devices can be purchased in many shops, which offer them at better prices than do specialized stores. When purchasing and implementing assistive technologies, it is important to consider the needs of the end-user.

**FG5:** “Don’t we all use some assistive technologies? A knife and a fork to eat with, a remote control for the TV...”

**FG5:** “An older woman told me that she has an iPad. Her granddaughter was very ill and needed surgery. It was very exciting. When she was out of surgery, grandma had a Skype session with her granddaughter. [...] ‘I’m so happy I live to experience this, that all of this is possible’.”

**FG4:** “I think the iPad is the nicest innovation for people who lose their abilities.”

According to focus group 4, care professionals would benefit from a system which monitors stock. Focus group 6 concluded that care professionals need to realise the importance and need of technology as a means to support their tasks. Direct access to resident data through tablet technology is seen as a facilitator. The more technology is being introduced, the higher the chances for false alarms or the technology not being compatible with other systems. A well-designed environment is considered to be beneficial to the care professionals, for instance, in terms of logistics. According to focus group 9, supportive technology can be beneficial for professional carers, for instance, for taking over non-core business as administration, which allows carers to spend more time on the core business of providing care. Actions that do not have a direct benefit to the residents, such as repetitive night-time surveillance check-ups, can also benefit from new technologies. Wireless communication devices are considered to be the most promising of all innovations.

**FG9:** “There is a great example of a sort of Segway with an iPad on top which does the surveillance tasks at night.”

According to focus group 4, there are numerous technological solutions which enable residents to have contact with the outside world without receiving visitors, such as online communities and online agenda platforms for informal carers. Other examples include social network sites and videoconferencing. These options may, in the long term, help reduce loneliness. Residents say that they do not have the urge to go outdoors when having access to social network sites, and that they already meet people they like to meet in the common living room. A mix of opportunities to meet other people and interact is an ideal, especially in the period just after admission when new bonds have to be made. In order to be able to use technology you first need to know which problems or needs are going to be addressed. Technology itself cannot decide which problem to solve.

Monitoring and camera surveillance are mentioned by four healthcare groups and only two technology groups. It seems that the representatives from healthcare are more aware of the wide array of technical options that are available for nursing home care. Technologies from making transfers are a subtheme only among care professionals. Wandering detection is a technology discussed by the ICT and architecture groups, as well as healthcare professionals. One of the participants of focus group 9 raised the issue of the fear having a camera in the private room may cause. Breaching one’s privacy weighs heavily and therefore, non-image forming sensor-based technologies may be able to take over the monitoring. The final two factors, dynamic lighting, used to mimic day and night are mentioned by focus group 2, and focus groups 9 and 10. Focus group 10 found that care professionals

have access to a large array of assistive technologies, including home automation systems for controlling lighting. New lighting systems can be used to support circadian rhythmicity.

**FG9:** “One can monitor deviations and this can be a solution to the ‘Big Brother is watching you’ problem.”

**G3:** “Recently, I was in a nursing home where there were screens right above the dining table, projecting daylight, or clouds, or the sun. It was dynamic and matched with the outdoor world. It did not do much but it did provide a topic to talk about. People stared up and said: ‘Oh, the sun is shining’.”

#### **D. Safety and security**

Safety and security are important factors from the perspective of the three groups of stakeholders considered in this study, and this theme is mentioned by eight of the groups (Table 2). Fire alarm systems are an explicit elaboration of a technology used to improve the sense of safety and security. Care professionals with whom residents are familiar, also contribute to a sense of security, according to focus groups 2, 3 and 8. Cleanliness is another subtheme that is mentioned in relation to safety and security, which goes together with the choice of materials, for instance, certain types of floors can be slippery when wet. The prevention of Legionella outbreaks is another factor mentioned. For instance, focus group 5 mentioned fire alarms and *Legionella* as building-related safety issues, particularly because the municipality stresses these issues, but these factors are also related to maintenance and operation, as well as care technology, and building services engineering.

**FG4:** “Within a nursing home there are numerous maintenance and control issues, including safety and security in case of fires and outbreaks of Legionella.”

According to focus group 7, fire safety in an important property of materials, especially in relation to the furniture people bring with them from their own home. Fellow residents need to be safe and secure from hazards others and their belongings may pose. Fire doors between compartments are often open all day long. Communicating about the risks with care professionals is important, even though it is practically impossible to open and close these doors all the time.

**FG7:** “Talk to one another about the risks [of bringing your own furniture], so you can consider things together. One’s quality of life can be improved this way.”

Monitoring, wandering detection and camera surveillance are also technologies used to improve safety and security, but are labelled as factors within the theme care technology. Factors of safety and security are overarching factors of the other themes.

#### **E. Interior design, architecture, and the built environment**

The theme interior design, architecture, and the built environment encompasses a large number of factors. Apart from design aspect and architecture, building services are included in this theme (Table 2).

Focus group 4 discussed the numerous questions and challenges associated with admission to nursing home, including having to settle in a smaller space. Some rooms are smaller than 30m<sup>2</sup>, but the private home was much larger than that. This means that residents need to settle with less space. According to focus group 2, personal preferences may shift over time, which may raise the demand for flexible building concepts with moveable walls.

According to focus group 10, residents should be able to make their own decisions concerning the indoor design in a nursing home. The basis should be a sufficient design by an architect. According to focus group 3, there are many alternatives to shiny institutionalized floors, and suspended ceilings. In Focus group 10, the views regarding bringing your personal belongings are ambiguous. Being allowed to choose independently is like a ‘never-ending’ discussion. Where it all comes down to, is that we need to look at the person at stake and his or her character and the items he or she brings. In addition, the resident should also be able to enjoy the attractive aspects of a building, such as the view outside.

**FG10:** “People with dementia no longer recognise their own chair. It is important that they recognise a chair to be a chair and a couch as a couch.”

Focus group 2 presented the case of the elevator, as persons go stand in front of the elevator doors and wait. One of the participants called for painting a bookshelf on the doors in order to camouflage. This is a way to adjust the design of building to the needs from a healthcare perspective. Too often, the construction process is based on the creation of a building, instead of the care processes. According to focus group 7, the lay-out of a room is important. All rooms are designed bearing right-handed people in mind. For left-handed people, rooms are mirrored to cut costs. As a result, these rooms do get a different lay-out which may not work out for the resident. Participants of focus group 8 stated that a sense of home does not match with having rows of doors in long corridors, as this is not a part of one’s own home.

There are a number of factors mentioned by only one focus group, including the need for better logistics of a building so that care processes are supported better, the need for garden and green spaces, and an attractive entrance, accessible and easy to clean buildings, a number of aspects related to building physics and services, flexibility and having a private bathroom. The communal areas deserve more attention when designing, according to five of the focus groups. Three health care focus groups stressed the importance of sufficient workspace for care professionals. Focus group 8 mentioned that a home goes together with a logical layout of the spaces, where there is sufficient daylight access and where there is a view on green areas, trees and nature. Moreover, a home should be easy to access and exit.

**FG8:** “It is important to leave and come back home.”

Focus group 5 stressed the need for nursing home to be designed in such a way that it supports logistics. Ideally, walking distances are short and there should be a number of dispersed storage rooms.

**FG5:** “We based our work on what is needed, and have built the rest around it.”

The participants of focus group 1 mentioned that when installing large systems, for instance, sanitary equipment in bathrooms, decisions are often made by professionals with a technological background. These people have a passion for technology. Modern bathroom technologies are often unrecognizable for people with dementia, and, thus, not usable. A bathroom design can add up to a sum of €80.000, and this would be a waste of money if the resident is not able to use the design appropriately.

Eight groups stress the importance of climate control, pointing at the options for personal control of heating and protection against the effects of warm summers. Also, light, both in daylight and electrical light, are important factors in the design of nursing homes in order to support vision and non-image forming effects. Focus group 6 stressed that a fitting physical indoor environment (factors including temperature, lighting, indoor air quality) is an important feature for both residents as care professionals. Ceiling-mounted fluorescent lights are seen as unwanted. Thermal comfort is another issue.

**FG6:** “One should take care for the comfort of having your hands nicely on a stove, something which cannot be achieved with underfloor heating.”

#### **F. Vision and knowledge**

The theme of vision and knowledge contains a number of factors related to the (pre)conditions for the successful implementation of technology and design features, as well as the provision of adequate care and the creation of a good environment to live in (Table 2). These factors include the education and training of staff, for instance, in the use of new technologies. This also implies that carers need to improve their skills in the field of technology, starting in secondary and tertiary education. Managers are believed to have a supporting role towards care professionals in getting familiar with new technologies. Moreover, technology offers the possibility for remote actions, although this calls for a different mind-set among care professionals.

According to focus group 7, knowledge and skills are among the most important tools a care professional has to have. Protocols may hinder the use of these skills. Obesity and dementia are considered to be two main themes within the future of health care, which also require specific design solutions. The organisation’s vision of health care and the built environment are not synchronous. The vision and mission statement are more prone to change than a building. Small-scale living accommodations are often housed within large-scale facilities. Retrofitting buildings goes together with large costs, and the balance is often lost. Another challenge is formed by the long depreciation period of buildings. Nevertheless, the process of care should be the centre point of the design and development of new buildings.

**FG7:** “The depreciation period is about 50 years, which is an absurd and long period of time. The vision and mission statement has changed a number of times within this time frame. Hence, your building is not paid off, but out of date.”

Evidence-based practice is one of the key-words mentioned by the construction focus group. This vision of shared by four focus groups. Moreover, there should be attention for a vision and mission statement and the overall costs. According to focus group 1, what matters on the work floor is that there is a clear mission statement, within all layers of the organisation, on the use of technology. Technology should not be a goal on its own, but truly an assistive device, which matches the needs when supplying care. Focus group 1 stated that a mistake which is often made is that care professionals understand new technologies including home automation, and that residents do not. Mastering these new technologies is thought to go ever faster, and to be improved substantially in ten years’ time. Even though the familiarity with home automation and monitoring technologies is on the rise, the implementation of these technologies in dementia care will need a lot of attention. The unnoticeable opening and shutting of doors is considered a perfect solution. The automated turning on and off of lights in restrooms is not. This means that an overarching vision statement needs to be formulated for every organisation. When implementing technology at work, the needs of care professionals should be studied and considered in detail instead of being confronted by a technology-push. There is a chance that care professionals will not use the technology, and, in turn, no longer want to use it.

**FG1:** “The staff are not well aware of the possibilities. As a consequence, residents do not get what they want because staff are not familiar with the solutions. So I would like to spend a large part of the budget to training of staff.”

Guidelines, regulations and support, as well as being involved in the implementation of new strategies is mentioned as being an important factor for success. Sustainability, particularly, having a strong corporate vision on this matter, is found important by five focus groups, of which four have a background in technology. Focus group 6 stated that other aspects that designers of building services need to take into account are costs, efficiency and prevention. The scalability of systems can contribute to sustainability, although technologies need to be compatible. Instead of a technology push, carers should be involved in the process of deciding how technology could contribute to their professional tasks, and the design of new solutions, according to focus group 6. Regulations and administration are seen as hindering factors for care professionals. According to focus group 10, care professionals are presently involved in many projects. The participants advised not to include the care professionals in the decision phases of a design process. During the research phase, their views should be considered. The results of these efforts is that care professionals feel more supported by the technology and feel more at ease at work.

**FG10:** “[During discussions with care professionals and residents] they were telling things I did not know at all.”

According to focus group 5, there will always be a group of older people with a high demand for care who need collective facilities. There are some people who are no longer being admitted to a nursing home but create their own way of



living together with friends. The reactions on this statement are mixed, as it is uncertain if older people can always care for each other. One should not underestimate the intensity of caring for another when there are severe complications. A virtual nursing home may be a solution.

**FG5:** “You stay living wherever you want to, but the care is supplied by an overarching structure.”

### **G. Communication**

The theme of communication encompasses a number of factors mentioned by no more than three focus groups (Table 2). This factor relates to the involvement of stakeholders and the way they are provided with information. Being involved is a key factor in this theme, both in daily care routines, as well as in research, and the choice of new technologies. According to focus group 1, care professionals should support relatives and the residents in finding out one’s own strengths. One example is that residents need to be taught how to negotiate with the care organisation about the frequency of getting showered. Family carers and care professionals are not ready for these negotiations. New professions may be needed to bridge this gap.

According to focus group 2, architects too often have an ‘ego’. The contractor mainly has a focus on functionality. The needs of residents and care professionals remain out of sight. Therefore, care professionals should be involved in the design of nursing homes and the actual furnishing of the rooms. Architects should have more elaborate knowledge of end-users and the care processes. Apart from a functional programme, the participants call for an additional emotional programme. The principal should find a fitting and skilled architect and installer.

“The care process should be leading when designing and constructing, not just how fancy the building looks.”

“The thing that strikes me most is that every time a new construction project is started within a nursing home organisation, a new team is arranged for the job. This is astonishing as the same mistakes are made over and over again.”

When making new sets of rules and methods, care professionals and residents should be involved. Today, mainly the managers and directors have a say in this, according to the participants. Involving care professionals may also lead to innovations being implemented, as they are familiar with the problems from the work floor. Particularly assistive devices and home modifications are important for care professionals, including floors which are easily accessible for people using wheelchairs, or machines for putting on pressure stockings.

“The physical burden for care professionals should be minimized as much as possible.”

Digital means of communication are mentioned by stakeholders with a background in healthcare as a way to support care. According to focus group 2, ICT can help limit the amount of paper, and help to find information faster, and supply information on personal preferences of residents. The use of Twitter and Facebook are seen as good ways for care professionals to be in touch with relatives, although there need to be fitting rules for the implementation. Pop-up screens can be used as prompts, containing information of these personal preferences.

“If Mr. Vanderbilt wants to have his afternoon tea at 4 o’ clock, and then there is a pop-up screen.”

A back office should be able to assist workers in case of emergency situations. Focus group 2 mentioned the need for sufficient technical support to make technology function properly. Part of these tasks should be fulfilled by care professionals, although not all of them would like to work with technology because of reluctance or lack of knowledge.

Intake interviews should be introduced as a way to have new residents fit in better. Having a thorough intake interview should be at the start of every new admission, according to focus group 2. The information of these intake interviews should be presented in a smart manner, for instance, via a smartphone, tablet of screen near one’s front door when a care professional uses a tag for identification. According to focus group 4, digital systems should be tuned to one another, for instance, administration, planning and management of staff. Most of these systems are not linked though.

**FG4:** “The problem is that particularly ICT has never been regarded as an important factor by healthcare professionals. If you invest in quality ICT services, all sorts of problems will be gone in the end.”

According to focus group 5, arrangements can be made with care professionals over personal desires of the residents. If a resident would like their light be switched off by carers at night, this should be an option. Again, tablet technologies can help professionals in keeping their appointments and arrangements, but education and communication are essential.

**FG5:** “The carers do need some training, many of them are digitally uncertain at present.”

### **H. Maintenance and operation**

The theme of maintenance and operation is the traditional realm of facility managers and cleaning staff (Table 2). The most important factor is the need for hygienic conditions (hygiene), which is mentioned by three of the healthcare groups and three of the technology groups. Cleaning is related to hygiene, as is the control of *Legionella* in water systems. The disposal of materials, incontinence materials in particular, is another factor. Focus group 2 mentioned self-cleaning toilets and deodorisers as a way to improve the hygienic conditions.

**FG2:** “One should try to find a good balance between the hygiene mafia and the cosiness of the 1930s/1940s with rugs and small lights. My mother always said: ‘this house is clean enough to be healthy and dirty enough to be happy’.”

According to focus group 3, there are different ideas and opinions about the cleaning procedures. There are suggestions to diversify: some people get help in cleaning and others do not. It should be a choice residents can make themselves. Cleaning yourself or having it done by someone else is a part of a home-like feeling. This choice should be made only for the private rooms and not for the common living rooms.

According to focus group 8, the focus of any cleaning and hygiene protocol should be on the sanitary equipment in bathrooms. Textile carpets in a nursing home are considered to be unpractical from the perspective of cleaning. The personal belongings of persons, particularly small items, are also a hindrance to cleaning. Glass cabinets are seen as a solution. Bringing your own furniture can also be problematic from the perspective of cleaning, but residents (or relatives) may also be stimulated to contribute to the act of cleaning. Residents with a private room are in many cases already assisting in cleaning, particularly female residents who engage in traditional role taking. Male residents engage in other tasks which are considered more masculine. Most of the complaints related to cleaning come from relatives, not from residents themselves. According to focus group 9, there is a considerable rate of flow in residency in nursing homes. The average duration of residence ranges from 3 to 5 years. It takes a lot of effort and time to clean out private rooms and refurbish them. Thinking about term maintenance is indispensable. Increasing the frequency of cleaning contributes to higher costs, but the participants see room for negotiations with residents for the intensity and frequency of cleaning. There is room for the creation of sort of *a la carte* care: when certain items or services are more expensive, residents should pay themselves.

**FG8:** “Let people join in. They are often used to clean the own home, well, let them give a helping hand in cleaning if they want to.”

**FG8:** “It is the women in particular. The men often don’t want to get aside, they prefer remaining in their chairs.”

There are different levels of expectation with regard to cleaning, such as from the perspective of the owner of the building. ‘Cleaning-awareness’ in design is an important feature for principals of new nursing home construction projects.

**FG8:** “Facility workers should be included in the design process, such as in the preliminary design stage, with full mandate and commitment.”

According to focus group 7, there are many materials available for the interior design and selection of furniture that are easy to clean. This puts an end to the endless compromising between a chair which is either comfortable or easy to clean. When designing nursing homes, involving producers of floors and materials should be involved in order to make balanced design decisions which relate to maintenance and cleaning, according to focus group 4. This is already starting to take place, and strategic partnerships are being made. Working together, particularly sharing learning points and bad practices is considered a positive development.

**FG4:** “Which complicates the deal is that you are going to build with partners who have their own interests.”

It is evident that certain choices need to be made in the field of materialization. There are numerous examples of design pieces of furniture which is very functional and has a great choice of materials for upholstery. There are only a small number of players active on this market. The fear of making the wrong choices may influence care organisations in their choices. The physical level is not considered in sufficient detail, whereas the factors that are one step up the hierarchy dominate processes.

**FG9** “Even though the interior design can be done quite warm and with a great atmosphere with the possibilities at hand, this is quite a challenge. Large manufacturers want to sell in great quantities and small-scale approaches may be disadvantageous to their production processes.”

Focus groups 9 and 7 of technology mentioned the need for team maintenance and the depreciation period of building in relation to the design and operation of a nursing home. Having clear floor plans, smart home technologies and automation, and a proper risk analysis are smaller factors within this theme. In focus group 9, the question is raised whether you should place a control system on top of a control system, of whether one should accept certain risks. One should not ignore that there are certain risks, and come up with measures and processes to work around it.

**FG9:** “One should make a thorough risk analysis, and if a certain risk remains, one should accept it or try to make it go.”

Focus group 10 discusses that, in relation to maintenance and control, there are many important factors. Many of these factors revolve around costs, although the considerations are made based on importance.

**FG10:** “Facility management are worried about energy costs. The construction of a new building is paid from another budget than the energy bills.”

It is yet unclear how much can be saved on cleaning costs, and this hampers the discussions and decisions that are to be made in many organizations. Making a business case with all components in it should be able to provide insight. Business cases can be outdated the moment politics comes up with new regulations.

## IV. DISCUSSION

### A. Relevant themes for the three groups of stakeholders

The eight themes identified in this study dealt with the needs of three groups of stakeholders. The most frequent themes related to the perspective of the residents are in the category ‘personhood and well-being’. Having a private room was considered to be

equally important as being able to decorate the room with personal belongings. In addition, privacy is an important factor. People should be able to withdraw in a private room, and receive and meet relatives and friends in this room. A sense of autonomy is another aspect which according to the participants contributes to a sense of home and a sense of freedom. Being able to keep and take care of a pet is considered to be a contributing factor to well-being.

The most frequent themes related to the perspective of the care professional are different from those of the perspective of the resident. The groups most frequently mentioned technologies and ICT as the most important factor. The support thereof is mainly related to non-care tasks as doing the administration and for tasks that have no direct benefit to the residents as support of night shifts. Tablet technology is also mentioned as an emerging tool for the support of care professionals, for instance, in relation to communication. There was a difference between healthcare and technology. The technological groups did not mention the monitoring of vital functions, whereas the participants of healthcare discussed it three times. The participants of healthcare discussed the importance of having sufficient workspace around the bed of the resident. This is considered a problem in current nursing homes.

There are a number of themes related to the perspective of the maintenance. There needs to be attention for hygiene in a nursing home, according to the majority of focus groups. Main focus should be on cleaning of sanitary equipment and floors. Items mentioned are self-cleaning toilets, masking of odours, and centralized collection points for used incontinence materials. Although residents are stimulated to bring personal belongings, this also gives rise to questions about cleaning. Rugs and small items can hinder the cleaning process, and working together with relatives in order to clean a private room is considered to be a desired solution. A nursing home should ideally be equipped with climate control systems. This item is also mentioned in relation to residents and caregivers. Such systems include controls for temperature, ventilation and lighting. The importance of daylight is also stressed by the groups. Sustainability is an item most frequently mentioned in the technological focus groups.

The outcomes of the ten monodisciplinary focus groups showed a number of similarities, mainly in relation to the aforementioned aspects of privacy and having a private room. The communal living room is an important place for meeting fellow residents and for getting together with relatives and friends. All ten focus groups stress the need of assistive technologies, including home automation, tablet computers, and robotics. In relation to the built environment, aspects of safety and security are mentioned most often, including fire safety, the prevention of wandering behaviour and the prevention of *Legionella*. There are also a number of differences between the focus groups with participants with a background in healthcare versus technology, mainly in the field of maintenance. Factors as risk analyses, efficiency, process control, building services, energy management and maintenance of buildings are only mentioned by technological focus group participants. It is only within the healthcare focus groups, that aspects such as the monitoring of vital functions were mentioned. Hygiene is an important theme, but the disposal of used incontinence material is only described by healthcare focus groups.

### **B. Focus groups: strengths and weaknesses**

This study encompassed ten simultaneous focus group sessions with monodisciplinary selections of participants. Within the scientific literature, having focus group sessions with end-users or other stakeholders is a widely-used method in healthcare and design [10-12,16-18]. In this study, residents were not included as participants of the focus group sessions. Nevertheless, both groups put most focus on the resident. One could argue if the participants adequately reflect the needs of residents, which has been discussed before by van Hoof et al. [2] and Heylighen and Bianchin [19]. Including professional stakeholders working in a nursing home seems to be less arduous a task as engaging in design processes with older residents themselves, particularly those with psychogeriatric health problems [6]. Including this group of stakeholders would have gone together with certain challenges, which are related to focussing attention and distinguishing between the importance or relevance of information [18]. In our study, there were 95 participants, who are all actively involved in professional practice. This scale of having 10 focus groups work on the theme is unique and not seen before. This study is the first of its kind to explore the separate needs of three groups of end-users through the eyes of different professional stakeholders. Therefore, differences in perceptions of what end-users actually need come to the fore. These differences reflect the way participants in this study perceive the needs of others. Another weakness of the study is that the second question was not discussed in the focus group session by Group 8. The third question was not answered on paper by Group 1. Given the richness of data, and the fact that nine other focus groups dealt with the topics, may indicate that new data and insights may not have been missed. In the discussion, a large number of themes have emerged, but these themes and factors were not discussed in great depth. This may be due to the limited time available, or the fact that so many themes were worthwhile mentioning.

The focus groups revealed a mixed set of end-user needs, their personal and professional values and a set of building- and technology-related solutions and innovations. This was made possible through the dual character of the methodology applied. The combination of filling out forms and discussing allows the participants to express and clarify their thoughts in an open and unconstrained manner (triangulation). By having participants fill out forms on an individual basis allowed them to share their personal views, even though some of these were not included in the discussion part of the sessions. This way of working contributed to the richness of data and themes of this study. In addition, there was a broad diversity of disciplines among the participants, which further contributed to the richness of data. The discussions themselves provided means to question stereotypical thinking and assumptions about what stakeholders need, and revealed differences between practices of various nursing home organizations. The organizations' cultures can have a significant impact on the way stakeholder needs are met in practice. Focus groups can help sharpen participants' thinking on issues, and help to create a common new vision by combining

opinions and beliefs. The focus group sessions did not lead to a concrete set of recommendations or a concrete programming list, which is one of the limitations of this study. Instead, the outcome of the sessions was a set of themes that need to be addressed when programming and designing a nursing home.

### C. Implications for practice and future research

All groups of stakeholders put the resident first, and stated that a nursing home is first and foremost a place to live, and not a place where care is provided. Such statements are confirmed by research by Van Steenwinkel et al. [20]. All the knowledge expressed by the participants shows a positive attitude towards the design and operation of nursing homes. In practice, however, it seems that all the knowledge and good intentions are not combined and realized in actual projects. The focus group sessions show that participants with a background in healthcare and in technology/architecture think alike on major themes. The differences between them can be explained that they operate within the boundaries of their own domains. A positive result of the sessions is that the emerging themes in the three areas are largely complementary.

The variety of themes and factors is remarkably large, ranging from financing, *Legionella*, having an attractive entrance, risk analysis, clustering of maintenance and operations, climate control, cleaning, well-being of residents, and so on. Future research should focus on specific themes and subthemes. There should be more room and time for finding nuances in the current themes, and room for discussing best and bad practices.

Overall, the nursing home of the future should try to include the needs of the main stakeholders during the design and operation phases, which was also concluded by van Hoof et al. [1,2], and should put the resident in the centre of attention. Residents should have a high degree of autonomy which is facilitated by the staff and the building's infrastructure. There should be room for privacy. These factors should improve the perceived freedom of the residents and their quality of life. Residents should have a say in the way their private rooms are decorated and furnished, and there should be sufficient room for their personal belongings. Involvement of professionals and residents is another factor which is crucial in raising acceptance of new technologies and design solutions.

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### CAPTIONS, FIGURES AND TABLES



Figure 1. Process of filling out the forms prior to the discussion part of the focus group session.

Table 1. List of sessions and the characteristics of the participants

	Group leaders and assistants	Background	Characteristics of participants	Mean number of years of work experience [years;months]
Healthcare	1 PG, LV	Healthcare 1	n=10 (9 females, 1 male)	10;0
	2 MM, MW	Policy makers	n=7 (6 females, 1 male)	3;6
	3 MN, TW	Education and research	n=9 (7 females, 2 males)	5;5
	4 LZV, LOW	Healthcare 2	n=8 (2 females, 6 males)	10;2
	5 AD, CDH	Healthcare 3	n=9 (5 females, 4 males)	12;4
Technology and architecture	6 SP, TR	Building services	n=8 (2 females, 6 males)	3;7
	7 EW, BP	Assistive aids and beds	n=9 (3 females, 6 males)	4;7
	8 JH, CVL, JW	Construction, real estate and maintenance	n=12 (5 females, 7 males)	6;7
	9 CV, CH	ICT and home automation	n=11 (1 female, 10 males)	6;5
	10. AE, NP	Architecture and interior design	n=12 (7 females, 5 males)	8;7
	Total: 10 leaders, 11 assistants	5 groups healthcare, 5 groups technology/architecture	n=95 (47 females, 48 males)	7;2

Table 2. All emerging themes and subthemes from the forms (f) and transcripts (t). Themes appearing in both forms and transcripts are marked italic

Main themes	Subthemes	Healthcare	Technology
Personhood and well-being	<i>Personal belongings</i> <i>Privacy</i> <i>Autonomy</i> <i>Private room/space</i> <i>Sense of home</i> <i>Own furniture</i> <i>Freedom</i> <i>Pets</i> <i>Freedom of movement</i> <i>Trust</i> <i>Quality of life</i>  <i>Independence</i> <i>Hospitality</i> <i>Sexuality</i> <i>Involvement</i> <i>Different lifestyles/cultures</i> <i>Activities</i> <i>Respect</i> <i>Comfort</i> <i>Well-being/welfare</i> <i>Freedom of choice</i> <i>Attention</i> <i>Possibilities to exercise</i>	(1f, 2ft, 3ft, 4ft, 5f) (1f, 2f, 3ft, 4f, 5t) (2f, 2f, 3ft, 4f, 5f) (2ft, 3ft, 4f, 5f) (-) (1f) (4f) (3f, 4f, 5f) (4t) (-) (4t, 5ft)  (-) (-) (4t) (-) (3t) (2f, 3f) (2f, 5f) (3f, 4f) (-) (-) (2f) (-)	(6f, 8ft, 9ft, 10ft) (6ft, 7f, 8f, 9t, 10f) (6ft, 7f, 8f, 9f, 10f) (9ft, 10f) (6ft, 7t) (7f, 9f, 10t) (6ft, 8t, 10f) (8ft, 9f) (-) (6t, 9f) (-)  (10f) (9t) (-) (6t) (8t) (9f) (8f) (10f) (6f, 8f, 9f) (10f) (8f) (-)
Relatives and interaction	<i>Partner is allowed to live-in</i> <i>No visiting hours</i> <i>Overnight staying</i> <i>Private space for receiving visitors</i> <i>Social network</i>  <i>Fellow residents</i> <i>Right of say</i>	(-) (-) (1t, 4ft) (3t) (-)  (2t) (-)	(9ft) (9ft) (10f) (-) (8f, 10t)  (8t, 9t) (7f)
Care technology	<i>Assistive/supportive technologies</i> <i>Home automation</i> <i>Robotics</i> <i>ICT</i> <i>Tablet computers</i> <i>Monitoring</i> <i>Camera surveillance</i>  <i>Apps for healthcare</i> <i>Electronic resident file</i> <i>Assistive technologies for transfers</i> <i>Monitoring of vital functions</i> <i>Wandering detection</i> <i>Dynamic lighting</i> <i>Mimicking day and night rhythm</i>	(1ft, 2ft, 3ft, 4ft, 5f) (1t, 3ft, 5f) (1t, 2f, 3ft, 5t) (4t) (1f, 2f, 3ft, 4t, 5ft) (2t, 3t) (4t, 5f)  (-) (1f, 4f) (5f) (2f, 3f, 4f) (5f) (-) (2f)	(6ft, 7ft, 8f, 9ft, 10ft) (6f, 7ft, 10ft) (7t) (8f, 9f) (7ft, 9ft) (-) (9f, 10f)  (9t) (9f) (-) (-) (9f, 10f) (9f, 10f) (-)
Safety and security	<i>Safety and security</i> <i>Fire alarm systems</i> <i>Legionella prevention</i>  <i>Security</i>	(2t, 3f, 4ft, 5f) (4t, 5ft) (4t, 5ft)  (4t)	(7f, 8ft, 9f) (8f) (9f)  (-)

	Trusted care professionals Cleanliness Choice of materials	(2f, 3f) (-) (5f)	(8f) (9f) (-)
Interior design, architecture, built environment	<i>Communal areas</i> <i>Light</i> <i>Climate (control)</i>  Daylight Cleaning-based design Logistics of a building Garden / green environment Private bathroom Attractive entrance Sufficient (work)space Design with(out) thresholds Lighting Emergency power generation Flexible construction methods Hard flooring Acoustics Climate control at room level Air changes and circulation Heating Ventilation Look and feel of a building	(2f, 3ft, 4f) (2ft, 3ft, 4ft) (2f, 3f, 4ft, 5t)  (-) (-) (5t) (2f, 4f) (2f) (-) (1f, 2f, 5f) (-) (5f) (-) (-) (5f) (3f) (-) (-) (5f) (3f) (-) (-) (-)	(6f, 10t) (8t, 10t) (6ft, 8ft, 9f, 10ft)  (8t) (8t) (-) (-) (-) (10f) (-) (8f) (9f) (9f) (9f) (-) (10f) (-) (10f) (9f) (9f) (10f)
Vision and knowledge	<i>Education of staff</i> <i>Vision of care organisation</i> <i>Costs</i>  Virtual nursing home Uniformity Guidelines Support from the organisation Being involved in implementation Being involved in development Sustainability Regulations Evidence-based practice	(1ft, 3t, 5t) (-) (-)  (5t) (4t) (3f) (-) (2f) (-) (4f) (4f) (-)	(7f) (7ft) (8f, 10t)  (-) (-) (-) (9f) (-) (10f) (6f, 7f, 8f, 9f) (-) (7f)
Communication	Early involvement of facility managers Wishes of residents Involvement of care professionals Involvement of residents Including staff in research Intake Communication Back office Buzzers/alarm calls Sharing of knowledge Digital communication	(-) (5t) (5t) (5t) (-) (2t) (4f, 5f) (2f, 4f) (2f) (-) (4f)	(8t) (-) (-) (-) (10t) (9t) (9f) (-) (-) (7f) (-)
Maintenance and operation	<i>Depreciation period of a building</i> <i>Term maintenance plan</i> <i>Legionella (control)</i> <i>Hygiene</i>	(-) (-) (4t, 5ft) (2ft, 3f, 4f)	(7ft) (9ft) (-) (8ft, 9f, 10f)

	<i>Cleaning</i>	(5f)	(10f)
	Risk analysis	(-)	(9t)
	Ambient intelligence/smart homes	(-)	(6f)
	Clear floor plan	(-)	(6f)
	Control systems	(5f)	(6f)
	Prevention	(-)	(6f)
	Efficiency	(-)	(6f)
	Clustering maintenance and control	(-)	(7f)
	Maintenance	(-)	(9f)
	Energy (savings/control)	(-)	(10f)
	Disposal of incontinence materials	(2f, 4f)	(-)
	Cleaning of building and materials	(2f)	(6f, 7f)
	Automated disposal of waste	(3f)	(-)
	Cleaning (general)	(4f)	(-)
	Cleaning protocol	(-)	(8f)