

sheldon



smart habitat
for the elderly

Increasing adoption of solutions to improve healthy and active ageing

**A White Paper on Policy Implications
and Recommendations**

COST Action CA16226

Indoor living space improvement: Smart Habitat for the Elderly

Sheld-on

Furniture, Habitat, Active and Healthy Ageing, ICT, Healthcare

Increasing adoption of solutions to improve healthy and active ageing. A White Paper on Policy Implications and Recommendations

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Technical Research Centre
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CETEM

Executive Summary

Rapid demographic change in Europe and globally has led to a larger and increasing population of older people whose needs are not often well addressed. Technological, built environment, and service-based solutions are increasingly being developed to serve older populations, but these products and services have clear shortcomings as adoption rates remain low. Even the most widespread technologies – personal computers, tablets, and smartphones – are not used by around 20-40% of older adults; and the adoption of other tools, such as panic buttons and activity sensors, is considerably lower.¹

COST Action CA16226, “Indoor Living Space Improvement: Smart Habitat for the Elderly” (Sheldon), is a network of professionals and academics seeking to improve the health, well-being, and dignity of older adults. The Action discovered that many tools and solutions for older adults and their caregivers are well made. However, many more products and services seek to address challenges that are not considered important by older adults or their caregivers or simply fall short in their execution. In other cases, solutions are introduced to users without addressing their personal values and concerns, such as fears of making mistakes when using technologies². Many solutions work well from a technological point of view but neglect emotional needs of older adults, for example, by requiring them to wear unattractive panic buttons³. The shortcomings most often seem to be related to misunderstood needs or lack of involvement of older adults and their caregivers in the design process. While the key solution is easily identifiable – end users and other stakeholders should be included and centered in the design

process of any products or services intended for them – designing and implementing robust and inclusive user-centric products and services is still challenging.

This White Paper provides an overview of the barriers to adoption of products and services and provides recommendations to overcome them, making it useful to:

- companies that develop products and services for older adults and their caregivers,
- research communities that study healthy and active aging,
- organizations that offer spaces and services for older adults and their caregivers (e.g., community care, retirement homes, intergenerational centers, etc.),
- policymakers that define relevant policies and guidelines,
- users of solutions for healthy and active aging (older adults and their caregivers), and
- other private organizations that wish to support healthy and active ageing,

The Action suggests that these stakeholders should focus on integrating the needs of older people and their caregivers by:

- introducing potential tools to older adults methodically and with care,
- addressing health promotion in addition to harm reduction,
- connecting older adults to their community to increase social engagement, and
- raising awareness about the issues while they are being addressed.

¹ Link-age, 2021. 2021 Technology Survey Older Adults Age 55-100. linkageconnect.com

² Science Daily, 2018. Why some older people are rejecting digital technologies. sciencedaily.com

³ Miller, T., Pedell, S., Lopez-Lorca, A. A., Mendoza, A., Sterling, L., & Keirman, A. (2015). Emotion-led modelling for people-oriented requirements engineering: the case study of emergency systems. *Journal of Systems and Software*, 105, 54-71. doi.org

Rapidly aging populations face new challenges

Europe's population is aging rapidly, facing age-related physical, psychosocial, and economic challenges. These critical issues are recognized by the World Health Organization (WHO), which aims to improve the quality of life of older people by promoting active and healthy aging. This approach aims to optimize "opportunities for health, participation and security" and "the process of developing and maintaining the functional ability that enables wellbeing in older age".⁴ WHO calls for multidisciplinary efforts that involve various stakeholders, from policymakers to older adults themselves, as active participants in managing their health.

Well-designed built environments, technological solutions, and services have been proposed as key factors in improving the functioning, safety, and wellbeing of older adults.⁵ The built environment is receiving increased attention as the European population spends most of its time indoors, which provides the opportunity and rationale for implementing interventions that promote wellbeing where people live and work. Well-designed environments have the potential to not only meet basic human needs, such as the need for shelter and safety, but also contribute to satisfying higher-level needs, like belonging and esteem, and replacing resources that decline with age and are required to satisfy the needs. These positive effects can be complemented by technological solutions and services that provide additional support for occupants' physical, social, cognitive, and mental functioning. A broad range of needs of older adults and their caregivers can be addressed with a variety of technological solutions, ranging

from technologies that focus on safety, such as flood detectors and wearable alarms, to those that support physical and social activity, such as heart rate monitors and communication systems.

Despite their potential, the built environment and technological solutions are often inadequate because they do not address the specific needs of (individual) older people, or they address only basic needs, which can reduce harm, but not higher-level needs, which can encourage positive impacts. One of the main issues is the lack of understanding or consideration of older adults' needs, leading to solutions that older adults cannot or do not want to use. This may additionally strain caregivers who are already struggling. This highlights the importance of human-centered design, which places the needs and input of users and other stakeholders in the center of the design process. With proper design, environmental and technological solutions hold a great promise because they typically do not require a lot of user effort and are relatively easy to deploy on a larger scale, supporting caregivers and providing more efficient and personalized care services.

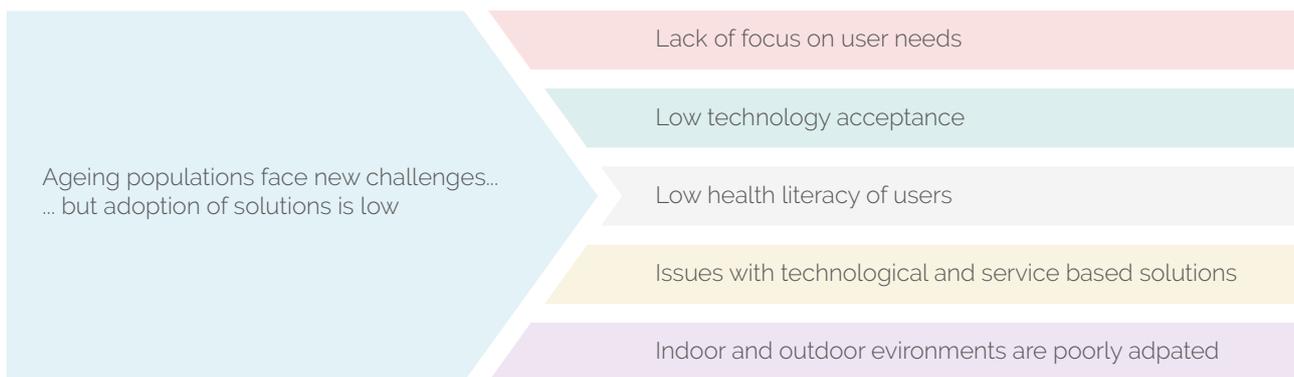
The Smart Habitats for the Elderly COST Action⁵ sought to understand the challenges older adults and their caregivers face and identify the gaps between their needs and the solutions provided for them in terms of smart built environments, technologies, and services. In the Action's review of the existing and emerging solutions, the lack of adoption became apparent. This white paper describes the common

⁴ World Health Organization, 2015. World report on ageing and health. apps.who.int

⁵ COST Action "Smart habitat for an independent elderly life". (n.d.). sheld-on.eu

challenges faced and suggests solutions that will increase the adoption of technical, built, and service-based solutions that can address the

needs of older adults and improve their wellbeing, privacy, and dignity.



The pathway to change is through inclusive and human-centered design

Many of the shortcomings in the design-build-use process stem from an inadequate understanding of user needs (and how to satisfy them) and the exclusion of users from the design process. Involving users and other stakeholders in the design processes is only a part of the solution as it ignores the production and adoption phases of the product or service life cycle. Rethinking and relearning approaches to design, production, and use – including support for different groups – is necessary to improve the wellbeing of older adults and their caregivers and ensure that the solutions developed for them are relevant, meet their needs, and are used enough to have an impact. The largest impact will be achieved with a personalized approach to various dimensions of healthy and active aging.⁶

Changes to professional practice, higher education and vocational training, policy, and standards must be introduced across disci-

plines to better address the needs of older adults and their caregivers. The adoption of technical and built environment solutions can only be increased through a systematic approach that includes users and understands their needs.

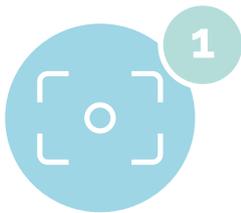
Members of the Sheldon COST Action have reviewed the existing and emerging technologies from both industry and academia.⁷ This work revealed that high-quality solutions to support the health, wellbeing, and dignity of older adults and their caregivers do exist, but that many solutions are not well adapted to their specific needs, or that the transition from design to production and use is limited. The Action then investigated the causes for the gaps between needs and solutions to identify recommendations to close the gaps.

⁶ Baraković, S., Baraković Husić, J., van Hoof, J., Krejcar, O., Maresova, P., Akhtar, Z., & Melero, F. J. (2020). Quality of life framework for personalised ageing: A systematic review of ICT solutions. *International journal of environmental research and public health*, 17(8), 2940. doi.org

⁷ SHELDON, 2018. State of the Art Report for Smart Habitat for Older Persons. sheld-on.eu

Unaddressed challenges, inadequate solutions, and common barriers

Lack of focus on needs



It can be difficult to use [an automated telephone menu] when you have arthritis ⁸

Many existing solutions are far from optimal, and many challenges remain unaddressed. This largely originates from overlooking and failing to understand the needs of older people and their caregivers. Their needs are rarely considered, even in general terms, let alone as they change with time, context, culture and individual characteristics and conditions. When needs are considered, only certain needs, such as safety, are often recognized, while others, such as belonging and esteem, are overlooked. This can lead to loneliness and low wellbeing for older adults and work overload and stress for caregivers. In many cases, not enough attention is paid to the needs because building designers and solution providers do not recognize the necessity to consider them or do not want to invest enough time or resources to understand them.

Low technology acceptance



[Cellular phones are] a distraction ⁸

Older adults and their caregivers are often unwilling to accept or even test the existing technological solutions. One of the reasons for low technology adoption is directly related to technology developers overlooking user needs, resulting in solutions that are not adequately adapted to older adults and their caregivers. Technologies can be deficient in many areas, from inadequate user interfaces to the lack of interoperability, making them significantly less convenient and useful. Many tools have sufficient functionalities but neglect the emotional requirements of users, which should be explicitly addressed.⁹ Low technology adoption may also result from the improper introduction of products and inadequate user training, which may leave users feeling uninterested in the solution or unqualified to use it. They may perceive technologies as not useful, too difficult to use or learn, or too expensive; they may be concerned about their privacy. Providing appropriate long-term technical and social support can be critical for older adults encountering and using new technologies.

⁸ Mitzner, T. L., Boron, J. B., Fausset, C. B., Adams, A. E., Charness, N., Czaja, S. J., ... & Sharit, J. (2010). Older adults talk technology: Technology usage and attitudes. *Computers in human behavior*, 26(6), 1710-1721. doi.org

⁹ Taveter, K., Sterling, L., Pedell, S., Burrows, R., & Taveter, E. M. (2019). A method for eliciting and representing emotional requirements: Two case studies in e-healthcare. In 2019 IEEE 27th International Requirements Engineering Conference Workshops (REW) (pp. 100-105). IEEE. doi.org

Low health literacy



*I know I'm looking for this connection, but I don't know what it's called, I don't know what the things are, and so there is no ... terminology, you know ... um.*¹⁰

Older adults may lack the knowledge and experience to use health-related services and make appropriate health-related decisions. Due to cognitive and sensory impairments and inexperience with technology, they are often unable to find, understand, use, or remember health-promoting information and solutions that are not adapted to their needs. This can further deteriorate their wellbeing and functioning, making it even less likely that they will find and understand health-related information.

Poorly adapted indoor and outdoor environments



*I've been in a wheelchair temporarily, which made it clear that you cannot do without accessible public buildings*¹¹

Indoor and outdoor environments are often poorly adapted to older adults. Indoor environments are generally designed for healthy and well-functioning people, while people with physical or cognitive impairments often struggle with everyday activities, such as reaching cabinets and opening food containers. Even activities as simple as crossing a room can be risky in many indoor spaces due to features such as poor lighting, loose carpets, or slippery floors. This shows that indoor environments sometimes do not even meet the minimum standards to allow older people to live independently and safely (especially those with mobility issues), and are still far from stimulating positive changes, such as maintaining cognitive abilities and promoting healthy sleep, sufficient activity, and social interaction.

Outdoors, older adults can be cut off from their local community because there are no services or infrastructure to be active, socialize, and rest, making it difficult for them to be physically and socially active. Older adults may also lack connections to the broader community, as they may struggle to commute due to crowded and inaccessible public transportation.

¹⁰ Wang, S., Bolling, K., Mao, W., Reichstadt, J., Jeste, D., Kim, H.-C., & Nebeker, C. (2019). Technology to Support Aging in Place: Older Adults' Perspectives. *Healthcare*, 7(2). [dx.doi.org](https://doi.org/10.3390/healthcare7020191)

¹¹ Ravi, K. E., Fields, N. L., & Dabelko-Schoeny, H. (2021). Outdoor spaces and buildings, transportation, and environmental justice: A qualitative interpretive meta-synthesis of two age-friendly domains. *Journal of Transport & Health*, 20, 100977. [doi.org](https://doi.org/10.1016/j.jth.2021.100977)

Promising technologies with critical issues

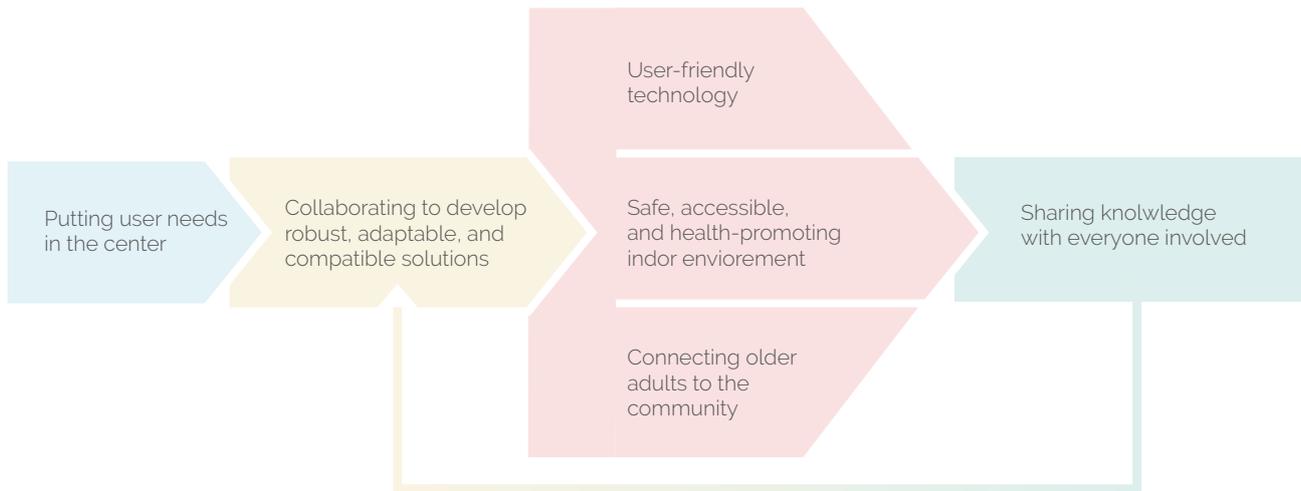


There is just so much stuff... it's too many gadgets. ⁸

Ambient assisted living (AAL) monitoring systems are composed of sensor networks, processing elements, and actuators that analyze and control the environment and its occupants to extract knowledge and detect events (e.g., unusual behaviors), trigger alarms, or support activities of daily living. AAL products and services have great potential to support older people and their caregivers, but they have deficiencies in many key areas. They can be considered intrusive by some users, and personal data han-

dling does not always meet the requirements of the General Data Protection Regulation. The tools are often expensive, have limited availability across a fragmented market, and are not made according to a uniform standard, making it harder for commercial solutions to be adopted widely. The large number of solutions with different purposes and functions and the rapidly changing field make it difficult for potential users to learn about the existing solutions and how these may suit their needs.

Strategies to overcome barriers, best practices, and recommendations



Putting needs in the center by including users in the development of solutions



Considering user needs is a fundamental feature of human-centered design — a framework that can be implemented using many freely available resources.¹²

Human-centered design begins with a comprehensive understanding of user needs, including how needs (and resources available to satisfy them) change over time, in different contexts, and among different groups of people. The design process considers the user holistically: how the solution fits the user's habits, activities, and lifestyle; how the user learns to use the solu-

tion; and what the user experiences and feels when using it. Solution prototypes are tested and refined in an iterative process that stops only when everyone involved is satisfied with the developed solution. The resulting solutions are typically intuitive, simple, and easy to use, as well as flexible and customizable to be able to meet basic and higher-level needs of end users. This approach to design works best when all stakeholders, including users, work together closely throughout all stages—from exploring issues and solutions to implementing, testing, and refining them.¹³

¹² U.S. General Services Administration, Usability.gov. (n.d.). usability.gov

¹³ AAL Programme. (n.d.). AAL Guidelines for Ethics, Data Privacy and Security. aal-europe.eu

Introducing products and services to users methodically

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Introducing tools to users is a phase in which potential users can form strong and lasting opinions that will influence their future use of the technology. The introduction process should be carefully planned and adapted to the target audience, and relevant guidelines should be consulted during preparation.^{14,15} When introduced, the ease of use and benefits of any solution, including its emotional benefits, should be emphasized. Examples of existing successes and happy users could provide a much-needed

motivational boost to potential new users. Training should start with the basics and progress slowly so that users feel competent and engaged at all stages. Information for older adults should be presented in simple terms with adaptations like large fonts, and visual aids, such as illustrations or videos, to clarify the message. Product and service providers should be encouraged to offer and emphasize long-term technical support that is accessible to older adults, either in person or by phone. Family and peers should be involved in training to provide both technical and emotional support.

Collaborating to develop simple, robust, adaptable, and compatible tools

 03

To ensure an easier transition of developed solutions into practice, technology-related research and development projects should collaborate more with industry during early innovation phases. Tools should be suited to the diverse characteristics and preferences of users and be resistant against unintentional misuse. Product providers should focus on producing simpler and more affordable devices and developing standards that make solutions accessible and interoperable. The whole field would benefit immensely from a unified search platform that categorizes and describes the existing solutions in one place. This would enable 1) policy makers to create standards for

accessibility, adaptability, and interoperability, 2) users to find and obtain appropriate solutions, 3) solution providers to learn about the user needs and how to connect their work to the existing solutions, and 4) researchers to test the effectiveness of the latest developments.

Increased collaboration between actors from different areas like technology, construction, urban planning, health and social care, and citizens for joint production of action plans, policies, and frameworks will lead to smart, healthy, and inclusive environments and solutions in the future.¹⁶

¹⁴ Lee, C., & Coughlin, J. F., 2015. PERSPECTIVE: Older adults' adoption of technology: an integrated approach to identifying determinants and barriers. *Journal of Product Innovation Management*, 32(5), 747-759. doi.org

¹⁵ LeRouge, C., Van Slyke, C., Seale, D., & Wright, K., 2014. Baby boomers' adoption of consumer health technologies: survey on readiness and barriers. *Journal of medical Internet research*, 16(9), e200. doi.org

¹⁶ European Commission: Thematic Network on Smart Healthy Age Friendly Environments 2018 ec.europa.eu

Reducing caregiver burden



Caregivers' burden should be addressed by providing access and resources to use various technologies to help them care for older adults.

Remote monitoring technologies can provide caregivers with a rich source of information, such as data on older adults' physical activity, current location, and sleep

patterns, or the data on air quality of their living space. Simple communication devices, such as panic buttons, would decrease the need for caregivers to constantly observe older adults, and contribute to independence and dignity of older adults. These and other solutions could help caregivers manage their time and effort more effectively, decrease their stress levels, and provide more personalized care.

Adapting the indoor environment

Indoor environments should be designed to meet people's needs. The principles of universal design¹⁷ and accessibility standards¹⁸ can serve as a starting point for building designers to make buildings safe, accessible, and functional for all users. As the first step, everyday activities should be made simple and easy to perform, even for people with significant physical or cognitive limitations. The second step is creating environments that encourage positive change, such as healthy eating and relaxation. This can be achieved in part by adhering to green



building certification systems that emphasize health, such as WELL¹⁹, which addresses multiple aspects of wellbeing, including thermal comfort, social functioning, and mental

wellbeing. Building on these foundations, designers should move towards recognizing and addressing the specific needs of older people and their caregivers by following the principles of human-centered design.

Connecting older adults to the community



Loneliness and low wellbeing of older adults could be improved with different approaches that promote social engagement and physical activity by connecting older

adults with their communities. This connection could be established and strengthened through

age-friendly trails, rest areas, open and green spaces, community meeting areas, virtual meeting places, accessible local events, and mobile applications that facilitate navigating those spaces and events. Public transport should be made more accessible, affordable, socially focused, and convenient.

¹⁷Centre for Excellence in Universal Design (CEUD). (n.d.). universaldesign.ie

¹⁸European Committee for Standardization (CEN) (n.d.). standards.iteh.ai

¹⁹International WELL Building Institute (IWBI). WELL Building Standard (WELL). (n.d.). ellcertified.com

Sharing knowledge with all involved parties



Skills and knowledge about aging, caring for older adults, and the healthcare systems surrounding them should be accessible and more widely available. Higher education and professional training programs should incorporate the latest knowledge and best practices to ensure that new and existing employees have access to the most relevant skills. Likewise, older adults and their caregivers would

benefit from learning about health-related information, services, and products that could improve their functioning and wellbeing.

Existing and upcoming online courses, projects, and platforms already provide information on a variety of relevant topics.²⁰

²⁰cf. ESSENSE. (n.d.). moodle.essense-project.eu; DESign for all methods to cREate age-friendly housing. (n.d.). projectdesire.eu; Age-Platform Europe. (n.d.). age-platform.eu; PHArA-ON (n.d.). pharaon.eu

Overall recommendations



Appreciate physical, social, emotional, and spiritual needs of older adults and their caregivers and involve them in all phases of the design process of solutions and environments intended for them.

. Human-centered design based on the needs of older adults and their caregivers must become the backbone of the design of every built environment and technological tool. Emotional requirements for these environments and tools must be explicitly elicited and represented.²¹



Introduce products and services to users with care.

The introduction of solutions to older adults and their caregivers should emphasize physical, emotional, social, financial, and other benefits of using the tool. The initial

training should start with the basics and progress slowly to make new users feel engaged and competent. Long-term technical support should be offered, and the social network of users can be invited to provide additional support.

Pay attention to the caregiver burden. Informal and formal caregivers struggle with work overload and stress. Resources should be devoted to easing their burden by connecting them with relevant resources and solutions that can help them with daily tasks and provide ease of mind.



Create safe and accessible indoor environments that promote wellbeing. The principles of universal design and accessibility standards should be the foundation of all indoor spaces to make them safe and accessible. Indoor environ-



ments should also promote positive changes, such as physical and social activities, and address the unique needs of specific building occupants.

Connect older adults to the local community.

Older adults can be engaged in their communities and society in a variety of ways: physical and virtual meeting places can strengthen the connection with family and friends; mobile applications can connect older adults with local events and volunteers; outdoor infrastructure can be improved to provide age-friendly trails, rest areas, and open spaces; community meeting



places and local events can provide additional opportunities for socializing; affordable and convenient public transportation can connect older adults with the broader community.

²¹ Mooses, K., Camacho, M., Cavallo, F., Burnard, M. D., Dantas, C., D'Onofrio, G., ... & Taveter, K. (2022). Involving Older Adults During COVID-19 Restrictions in Developing an Ecosystem Supporting Active Aging: Overview of Alternative Elicitation Methods and Common Requirements From Five European Countries. *Frontiers in Psychology*, 13, 818706. doi.org



Spread important information.

Older adults and their caregivers would benefit from learning more about health-related information, services, and products. Students and professionals need access to new skills and knowledge in higher education and professional training programs.

Cooperation across disciplines and sectors is needed to support the active and healthy lifestyles necessary to increase the wellbeing and dignity of older adults and their caregivers worldwide. Only by creating a common language can we achieve greater outcomes for everyone involved.

The Sheldon COST Action calls on leaders in industry, policy, health care, and the community to be part of a transformation in solution design by supporting strong policies and practices that increase the wellbeing and dignity of older adults and their caregivers through inclusive and user-centered design.



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