Smart technology at home: a multidisciplinary challenge

Helianthe S. M. Kort, and Joost van Hoof, *Members, ISG*

***Abstract*—The majority of older adults in the Netherlands live at home (90%) with or without assistive technology or care support. Most older adults choose to live at home in their well-known neighbourhood. With the progress of the biological ageing process, the chance of getting chronically ill increases. The 'older adult' as an entity does not exist and older people are not a homogenous group. Therefore, in the Technology@Home programme the design of dwellings was differentiated for lifestyle and type of impairment. The mock-up dwellings planned within the programme are: (i) the comfort, safety and low vision home (CSL); (ii) the dementia home; and (iii) the COPD and mobility home. The programme was executed by a consortium consisting of the professional association of installers, their professional education fund, a regional innovation fund and the Research Group of Demand-Driven Care of the Faculty of Health Care of Hogeschool Utrecht. Some lessons learnt are: a collective goal is not the same as having collective interests; continuity in project management is essential; developing knowledge is not the same as dissemination of knowledge; and transformation from vertical professional-orientated solutions to horizontal consumer-orientated solutions are all challenges in achieving a multidisciplinary approach of technology at home.**

I. Introduction

In the Netherlands the population aged 65 years and over will increase from 15% in 2007 to 17% in 2013 [1]. Most older adults live at home (90%) with or without the use of assistive technology or care support. Most older adults also choose to live at home in their well-known neighbourhood [2]. With the progress of the biological ageing process, the chance of getting chronically ill increases. Having a chronically disease does not mean that a person feels ill, but the accompanying impairments go together with limitations in daily living and in social participation. Frail older citizens usually have one or more chronic diseases. This phenomenon is called co-morbidity or multi-morbidity. When getting older, senior citizens first experience limitations in doing domestic work such as ironing and cleaning windows. Later, limitations in mobility and having restrictions to personal care occur due to biological ageing. Senior citizens often tend to ask for assistance for the experienced limitations in domestic and personal care when it's too late [3]. In the Netherlands the demand for care will increase approximately by 2% each year [4]. In addition, less professional carers are available to give support and counselling to care clients [4]. The potential care demand of older adults increases the most for care at home when compared with the demand for residential care. The increase demand for care in relation to the shrinking number of working professional cares and availability of family carers could not be solved by a higher supply of carers only. Ageing-in-place with support of smart technologies at home is seen as a solution for the increasing demand for care. In order to achieve smart technological living environments, a multidisciplinary approach is needed. Apart from the health care sector, the building services' industry is involved too.

The large group of older adults is very diverse, and not, as is often believed, a homogenous group. Therefore, in the Technology@Home programme [5], the design of dwellings for the ageing population was differentiated for lifestyle and type of impairment. The mock-up dwellings planned are: (i) the comfort, safety and low vision home (CSL); (ii) the dementia home; and (iii) the COPD and mobility home. The project was executed by a consortium consisting of the professional association of installers, their professional education fund, a regional innovation fund and the Research Group of Demand-Driven Care of the Faculty of Health Care of Hogeschool Utrecht (HCHU). The mock-ups could be used as a real-life learning environment, in which: (i) professionals could see and receive instructions about possibilities for smart technologies at home; (ii) older citizens could experience technology-supported living; (iii) carers could get acquainted to a large range of technological possibilities; and (iv) students could be made enthusiastic about smart technologies. In addition, based on the experience of various visitors, research would be done to examine whether smart technologies at home may contribute to a delay in the demand for care. In this paper we focus on the multidisciplinary approach within the chain cooperation.

II. Methodology

The Technology@Home programme consisted of two subprojects, namely: (i) practice-based research and (ii) transfer of knowledge and education. The general goal of the programme was to initiate changes within the building services' sector and to enhance technological innovations within the care sector. The underlying goal was to delay the demand for professional care at home or the demand for residential care.

A. Literature search and focus sessions

The development of the design of the planned mock-up dwellings was based on literature research and practice-

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H. S. M. Kort is with the Research Centre for Innovations in Health Care, Hogeschool Utrecht, University of Applied Sciences, Bolognalaan 101, 3584 CJ Utrecht, the Netherlands, as well as Vilans, Catharijnesingel 47, 3511 GC Utrecht, the Netherlands (phone: +31 30 2585342; fax: +31 30 2540608; e-mail: helianthe.kort@hu.nl).

J. van Hoof is with the Research Centre for Innovations in Health Care, Hogeschool Utrecht, University of Applied Sciences, Bolognalaan 101, 3584 CJ Utrecht, the Netherlands (e-mail: joost.vanhoof@hu.nl).

based knowledge from the researchers, SMEs participants from the building services' sector and members of a focus group from the health care sector. The literature research included covered both health care as technological literature; Science Direct, IEEE databases, and PubMed, as well as various Dutch handbooks of accessibility of buildings and the Dutch Building Code. The literature search focused on five care profiles of client systems, which correspond with the planned mock-up dwellings. The first concept of the design of the dwellings was first presented to, and discussed with, a focus group. The focus group consisted of representatives of the Netherlands Asthma Foundation, the Netherlands Alzheimer's Foundation, and various foundations for the aged and ageing and experts on accessibility with a focus on the disabled. After receiving their feedback, the designs for the mock-up dwellings were adjusted to meet the feedback. These revised designs were then presented and discussed with SMEs participants within the programme. Their comments were also used to adjust the initial designs. Final adjustments were made after consulting the focus group for a second time.

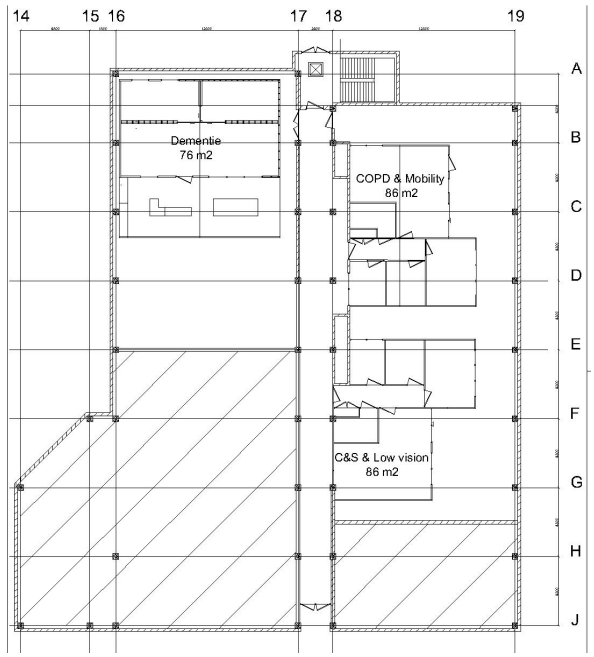

Fig. 1. Plan of the small community of the three dwellings.

B. *Practice-based research*

In this subproject the central question was: how can clients maintain independence at home and maintain their well-being as much as possible? In order to answer these questions the consortium started with building the demonstration of a small community. In addition, a helpdesk is set up. The demo offers the opportunity to citizens, students, teachers, professional carers, housing corporations, care- and education organisations, and last but not least installers to see and experience the smart technology as installed in the dwellings that can be used for ageing-in-place. The sessions with the focus group were not only used for feedback on the design, but were also used to gain more understanding about the needs and desires of the represented client groups. Potential visitors would be able to evaluate the mock-up by filling out questionnaires.

C. *Knowledge transfer and education*

In this subproject the goal was to disseminate knowledge and instruments with which installers can contribute to the realisation of ageing-in-place. This was done in several ways. One was by sending all interested persons an electronic newsletter. The research team was available for answering questions from the SMEs about developing smart technological products or services for ageing-in-place. Moreover, students from the Faculty of Health Care and the Faculty of Technology of Hogeschool Utrecht participated in literature search and designing the different spaces of the mock-up dwellings. The results were presented to the participating SMEs as a part of getting their Bachelor theses. All results are available on the webpage http://www.technologiethuisnu.nl (which is in Dutch only).

D. *Interests and Preconditions*

Each initiator within the consortium described the personal interests and preconditions for participating in the programme (Table 1).

Table 1: Survey of interests and preconditions of the consortium members.

Initiator	Interests	Precondition
HCHU	Gaining expertise on care and smart technology; development of student competence in this area.	Common views in process to achieve results and products planned.
Professional education fund of installers	Realisation of innovation in care and technology	Results and products should be available within 30 months
Professional association of installers	Knowledge transfer to installers and other relevant stake holders such as housing corporations	Support of members from each practice section
Regional innovation fund	Stimulate SMEs to innovate in the field of care and technology	Results and products should be easy to access

III. Results

The initiators in the consortium worked out their vision of smart technologies at home. Their visions were transcribed into a project plan by a feedback group. One of the items of the plan was building a demo of a small community (Fig.1).

The group of initiators in the consortium was later transformed into a steering committee to obtain structural consultation.

The programme resulted in validated practiced-based

knowledge about the use of smart technologies at home for ageing-in-place. In addition, more understanding was gained about how potential dwellers such as persons with

Fig. 2. Comfort, safety and Low vision dwelling, view of the living room, photographer Max Koninkx, The Netherlands Association of Universities of Applied Sciences (HBO-Raad).

dementia or with COPD perceive the special design features of the dwellings. Results were disseminated via different channels for local policy agenda. Results were also used as input for the development of new curricula in the multidisciplinary field of care and technology.

A. *The CSL Dwelling*

The CSL dwelling is the only mock-up realised to date (Fig. 2). For older citizens (55+, sufficient level of income) the CSL dwelling seems to be a 'normal' dwelling, since the smart technology is placed out of sight. Among the technologies installed, are automated curtains, a low-energy ventilation system, automated doors that can be controlled from the living room and master bed room, night orientation lights (to safely go to the bathroom at night), and an 'on-off-switch' for the dwelling.

The personal alarming system is connected to appliances in the home. For instance, when the resident loses consciousness while cooking but quickly presses the alarm button, the systems the kitchen are switched off, including the cooker top. In cases of emergency, there is also a voice-based connection to a care centre. Moreover, there is an extra large meter cupboard that provides sufficient space for (additional) technical installations. Apart from these technological systems, the dwelling provides sufficient space for walker/wheelchair accessibility, and has windows that a easily operable by levers.

B. *The other dwellings*

A second dwelling is designed for people with COPD and/or mobility problems. This dwelling is currently under construction under supervision of the professional education fund of installers. In this mock-up the emphasis is on building services that provide good indoor air quality that can be distantly monitored. A third dwelling in the small society mock-up is designed for people with dementia and their spouses. Among the characteristics of this dwelling are the open plan layout and sliding doors to maximise visual access, and short (direct) walking distances within the dwelling [6,7]. The design of the dwelling is such that it stimulates and supports the person with dementia to perform daily activities. In addition, the caring spouse has a good view of the activities of the partner with dementia, but is also able to withdraw her/himself from the burden of care.

C. *The multidisciplinary approach*

The multidisciplinary approach started with the vision of the initiators about "what should it be?". Next a think thank focused on "how do we realize this?". Subsequently, a consultative group translated the visions in to projects of the programme. The different bodies were transformed into a steering committee; different project teams and a focus group. The steering committee aimed at performing the programme within the giving budget and time, whereas in the project teams the focus was on the creative process of getting things done.

Results are: (i) a change in lateral thinking in the HCHU; (ii) students are enthusiastic to have made a useful contribution; whereas (iii) installers expected the use of more innovative technologies. The true innovation lies in the combination of use of available technologies for certain lifestyles, or to compensate impairments. Installers, researchers and policy makers all had a different view about when results should be available. The installers had a short-term planning, in the sense that they wanted to implement the results within one year into product assortment, whereas policy makers had a medium-term planning for to translate the available results in to local policy. The researchers however, had a long-term planning, because they wanted to make results available after publication in scientific journals. All these different expectations resulted in a conflict of interests, although all partners knew the differences from the start, and had the ambition to realise the mutual goals of the programme.

IV. Lessons Learnt

A. *The multidisciplinary approach*

Lessons learnt about the multidisciplinary approach are: (i) a mutual goal is not the same as having mutual interests; (ii) working on a multidisciplinary theme does not automatically mean working multidisciplinary; (iii) enhancement of knowledge is not the same as knowledge dissemination. In addition, scientific knowledge is not accessible and easy to comprehend for practice-based professionals as installers or care professionals. Finally, the researcher or designer does not always have the ownership of the products.

B. *The organisation*

Lessons learnt for the organisation of a multidisciplinary programme are: continuity in project management is essential; when starting and during the programme all participants should have faith and patience in each other. One thing that is helpful is to have unity in language and avoid the use of professional terminology, since partners felt insecure when terminology was not understood. Furthermore, all partners should be represented in the steering committee with the appropriate authority, because

otherwise essential decisions are delayed and there is a risk of loss of information. Partners should start to build a mutual network to enhance the implementation of the results. Finally, results and experience gained within the programme should be translated into education activities in a separate programme.

C. *Dissemination of results*

For an effective dissemination of the results the lessons learnt are: that transformations from vertical professional-orientated solutions to horizontal consumer-orientated solutions are all challenges in achieving a multidisciplinary approach of implementing technology at home. Students should have a sufficient amount of time and opportunities to experience doing research. Their experience can be used as an inducement for other stakeholders in the field of smart technologies and care to explore activities such as education about ageing-in -place or the development of products for ageing-in-place. Students namely do not use professional terminology because of their limited experience of their discipline. Students are aimed at seeking a solution for the problem presented. They use their creativity and are not yet engaged with nuances. Research on smart technologies at home is a multidisciplinary challenge. Working in a multidisciplinary setting however, is an interesting and a valuable experience.

V. Conclusion

The programme Technology@Home worked as a catalyst in the field of smart technologies and care. However, the intended ambition for having products and instruments for ageing-in-place was not completely achieved. Although initiators of the programmes started with a mutual goal and had the same ambition, conflicts of interest disturbed the processes started. Dilemmas between working together to meet the ambitions and competition occurred. Sharing knowledge is also seen in the light of first getting acquainted with each other before sufficient trust emerges. Therefore, it is necessary to have one and the same chain director without (personal) interests, who deals with each other's interests and preconditions. Learning about how to effectively work in a multidisciplinary setting on a multidisciplinary theme is necessary to overcome the so-called 'pilotitis' in the field of smart technologies at home.

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