Pilot trial and evaluation of the system

Deliverable D4.2

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EXECUTIVE SUMMARY

This report summarizes the research carried out within the pilots of the PELOSHA system carried out in 4 pilot sites – 1 in Poland (Poznań), 1 in Belgium (Hamont) and 2 in Switzerland (Berlingen and Geneva). These pilot test of the system have been the project's attempt at conducting the Beta 1.0 and Beta 1.1 phases of PELOSHA technology tests as planned in deliverable *D4.1. Execution & Evaluation Plan*: *Pilot Test Guidelines - protocol and Instruction*. In this part of testing the consortium wanted to test not only an improved version of the GUI, but also to test the realistic operation for dedicated users - seniors and their caregivers. In addition, they tested the communication between the two dedicated users' applications, as well as the reality of how the system would perform under real conditions of use.

Unfortunately, due to the significant impact of the prolonged state of COVID-19 pandemics, the tests could not be conducted as initially expected. Seniors have been among the population groups most vulnerable to the illness. Due to this institutions such as care homes put emphasis on protecting their residents, limiting possibilities to engage into direct contact with them (foreseen pilot environment in Belgium and Poland). Individuals living on their own have also been reluctant to engage into additional contacts beyond their daily routines (pilot scenario for Switzerland). The situation was changing only in relation to public authorities lifting restrictions. For example, in Poland first contacts with seniors at the partnering care home were possible after 1st of March 2022, i.e. after the Polish authorities lifted the first set of previously enforced COVID-19 related restrictions. All restrictions in Poland were lifted on 28th of March 2022. This limited the possibilities of testing real technology in real life environment and scenarios to only a couple months in the last quarter of the project duration. Moreover, during the pilot test in Poland, the participating care home suffered from COVID-19 infections (to residents and personnel), thus further limiting the possible scope of that pilot as the care home had to be closed for access of other people.

The aim of the study was to test the performance of the PELOSHA system as widely as possible under real conditions, i.e. to detect errors and areas for improvement. This could lead to improvements of the technology and/or their usage scenarios, especially in relation to the Assistant and Caregiver Dashboard applications. By means of numerous questionnaires and observations, attempts were made to answer questions such as: can users use the PELOSHA system? Which functionalities of the system do they find most useful and what do they like best? Which modules are least popular and what causes each group the most problems? Under the conditions that seniors and caregivers currently face, could PELOSHA help seniors become more independent?

The practically achieved time and scope of the test did not give all the answers the project consortium could seek from them. The collected feedback presented herewith does though confirm the good design of the user applications (Assistant and Caregiver Dashboard). The gathered information is also extremely valuable to the potential commercialization of the project results as it suggests that after necessary updates and additional user tests in real conditions, these results should find customers. The recommendation towards updates of the developed solution are proposed in deliverable *D1.3. User feedback findings and updated requirements*.

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ABBREVIATIONS

AAL	Active Assisted Living
AI	artificial intelligence
API	application programming interface
BT	Bluetooth
GDPR	General Data Protection Regulation
GSR	galvanic skin response
GUI	graphical user interface
HW	hardware
ICT	information and communications technology
IPR	intellectual property rights
IT	information technology
LED	light-emitting diode
PELOSHA	Personalizable services for supporting healthy ageing
PPG	photoplethysmogram
TCP/IP	transmission control protocol/internet protocol
TRL	technology readiness level
UI	user interface
UX	user experience
VR	virtual reality
WP	work package

1 INTRODUCTION

When conducting research with such a special group of users, it was important to remember to be appropriately sensitive when dealing with seniors, due to their often very difficult psychophysical state, and to maintain an individual approach to each of them (although the study also included very fit, active and still curious about the world persons). When interviewing seniors, the researchers did not restrict the seniors' time in order to make them more comfortable and answer as many questions as possible, prepared in advance in the research questionnaires. Unfortunately, such a specific group cooperated with the researchers to varying degrees - from expressing the slightest remarks at the address of each device, to completely resigning from participation and having a very reluctant attitude towards the researchers. Thus, not all questionnaires were completed and not all responses were filled out.

Although the reliable research process does not assume any researcher's intervention, some assistance was necessary to conduct the study at all (especially in terms of operating the tablet - pressing buttons, encouraging exploration, asking to add measurements, dealing with errors).

Caregivers showed moderate interest toward the PELOSHA system and the dedicated Caregiver Dashboard application. When caring for the elderly (as employees of care homes, home nurses, informal caregivers), they do not use any special electronic systems to facilitate their duties, apart from technologies such as emergency button or telealarm. Caregivers' tasks focus on performing basic care for seniors related to hygiene, dressing, feeding, and helping them get up, go to bed, walk, and protect them from falls.

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2 RESEARCH

A total of 25 seniors aged from 56 to 97 (average age 81), including 16 women and 9 men, and 15 caregivers, aged between 21-70, participated in the research. Seniors mostly declared higher education (16 people), followed by secondary education (5 people), primary education (3 people) and none (1 person). The study lasted around 2 months, depending on the country, the possibility of conducting studies with users and the availability of the equipment needed for installation. The Beta phases lasted 6 weeks in Poznan (Poland), 3 weeks in Geneva (Switzerland), 6 weeks in Berlingen (Switzerland), and 4 weeks in Hamont (Belgium). The way the study was conducted was not consistent across all the centers involved in the testing, due to individual characteristics of a place. In Poznań, the study was conducted in a private care home. There was a group of people, who are permanently under the care of caregivers or family, unable to operate on their own. In the Berlingen pilot, by contrast, the 6 participants were very physically fit and active in using technology and almost all living independently. In Geneva, the sample was very small, only 3 people, so it is difficult to make broader generalizations. In Hamont, it was a group of mostly independent, senior residents, with high levels of activity, but also receiving daily assistance from caregivers to an some extent. The study included formal caregivers (retirement centers staff), informal caregivers (2 family members taking care of their loved ones) and home nurses.

The pilots used the demonstration installation of the PELOSHA technology prototype described in deliverable *D3.3. Demo of PELOSHA package.*

2. 1 BETA 1.0 PHASE

The conduct of Beta Phases 1.0 and 1.1 was based on the realization of the research plan accepted and described in deliverable D4.1. During the researchers' first meeting with seniors and caregivers, both groups were asked to fill out demographic forms, a questionnaire on health care habits (for the senior and from caregiver's perspective). They were then asked to start using the Assistant application (seniors) and the Caregiver Dashboard (caregivers) and explore freely through the user interface. The researchers then completed a document related to the observation of the first use of the app.

The respondents, who were left with mobile devices (tablets and smartphones) and equipment related to the performance of individual modules, tested the PELOSHA system for no less than a week. After this period, the researchers returned to the center and asked both groups of users for their responses regarding their experiences after using the system.

Both groups were asked to answer a semi-structured interview regarding their overall evaluations of the system, their willingness to use it, and to give suggestions for further development of the PELOSHA system. The researchers also wanted to see, how the respondents have performed within the operation of the modules since they first used the system in the researcher's presence during installation, and whether there has been a learning effect, i.e. whether frequent use of the applications and devices has resulted in some automation, with the effect that users find it easier to use them than at first. The researchers then asked users to express their opinions using 2 questionnaires that formulate ratings into numerical values. The first of the them, the Software Usability Scale, was a very widely used scale for measuring the usability of products and services. The scale is simple and consists of 10 very universal questions. Finally, the second questionnaire asked both groups to rate each of the tested modules on a scale of 1 to 5, where 1 is "not at all useful" and 5 means "very useful."

2.1.1 POZNAN (POLAND) - OVERVIEW OF THE RESULTS

a) Seniors

Demographic questions

The study included 5 residents of the private retirement center in Kobylniki near Poznań, including 3 men and 2 women. The age range of the seniors was 81-94, with an average age of 85.8. Higher education was indicated by 3 people, while 2 had secondary education. Only one person indicated that he lives independently, the others are permanent residents of the center. In addition, 2 people said, that they are only under the care of the center staff, 3 people indicated family members as those who take care of them. One person benefits from the home nurse, who helps him with taking medication, measuring blood pressure and sometimes temperature. None of the seniors use a medical solution to support remaining independent. Seniors mainly use older-type cell phones, such as those that have a single button that is only used to answer the phone. One person indicated owning a smartphone. Seniors use their phones daily or once a week, and described their skills in using these devices as low or lack of skills. Seniors who own a smartphone listed calendar and weather app among the applications they use.

Questions about senior' health care habits

Seniors are rather satisfied with their current state of health, except for individual problems, e.g. thrombosis or orthopedic problems, and when asked about their desire of keeping actual stare or improve it, they answered that they would like to improve it, i.e. mainly to cure the problems in their particular cases, like memory problems, trouble with getting out of bed, recovery feeling in the fingers of the hand, thrombosis. However, these are problems over which people of their age have very limited influence, so most of them did not answer what they were doing to improve. The respondent with the problem of paresis in the fingers indicated more frequent and intensive rehabilitation of this part of the body. Dressing independently was indicated as the most difficult, as an activity that requires a lot of effort. Seniors do not undertake many activities at home - some expressed appreciation for being able to walk on their own feet at all. Seniors try to be in motion – they are very aware of the fact that it is necessary for their health, so they try to be in motion, even slightly forced. The most popular activity among them is walking, the seniors also participate twice a week in gymnastics/exercises conducted by a rehabilitation therapist employed by the senior house. Their health condition does not allow them to do more and varied activities. As for taking measurements, seniors check their blood pressure and sugar levels. These measurements are very rarely taken by themselves, it is a task that belongs to the caregivers and the elderly have no need to take them more often and to have them under control themselves. Sleep quality was rated as good by the respondents, in addition to problems with getting up frequently related to prostate hypertrophy, some seniors sometimes have difficulty just falling asleep. They claimed that sometimes the reason is the retirement center conditions themselves, i.e., going to bed too early, roommates' discussions in the hallway. The frequency of medical visits was rated as regular, and the seniors are also under medical care at their center. Important to them is "good contact with the doctor," which can be understood as the manifestation of general interest in the health of patients and the availability of quality specialists. All seniors rate contact with their family as regular, relatives contact them by phone, and they are also visited. If the family lives close by, they visit the elderly family member more often, if they live far away, personal contacts are less frequent. Seniors had no comments on the frequency of contact with the family, and when asked about the type of support they receive, the following was mentioned: deliveries of seasonal fruits, help with medical appointments, conversation.

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Observation of using the Pelosha system for the first time

i)   Dashboard content and changing modules

Respondents were asked to walk through different parts of the user interface, and they didn't really show the initiative to explore the app on their own. They followed the researchers' instructions. One respondent was visually impaired and refused to test the interface due to eye problems. Other respondents pointed out that the font used for content was too small in their opinion. The respondents understood that there were various parameters such as temperature, weight, air quality presented in this view and they could check them. Changing the preview tiles of a particular module proved to be a problem, the respondents did not figure out how to do it on their own - in the end, 2 people understood this function and 2 did not.

ii)   Reminders module

The module in its purpose was understandable, the respondents knew that these were reminders they received from the caregiver to do something on their own. Obstacles included letters that were too small and a button area on the tablet that was too little - these factors worsened comfort when testing the app.

iii)   Health module

In addition to problems with the text, seniors had also no feel and general intuition for pressing the touchscreen, making in consequence some functionalities unresponsive. Buttons such as "temperature"/"pressure"/"weight" were extremely small for them. Another problem was the two "add measurement" buttons on the next screen, because one referred to measurement via Bluetooth-connected devices, and the other to manual addition. The same button names were confusing to users. Respondents were asked to take measurements on their own and only managed with the help of the researcher, but the purpose of the app was clearly understood. The user interface and the touchscreen device itself proved to be the biggest barrier.

iv)   Air quality module

The module was rated as useful. The respondents understood that the application displays parameters such as temperature, humidity, air quality both indoors and outdoors.

v)   Stay in touch module

The numbers next to the button areas were not clear enough, one person indicated that this button might confuse him, while another respondent declared that he would be able to learn which one is for what. There was a problem with the pressing strength of the button, as it must be large enough for the button to react.

The researchers did not test the Training module with seniors, because it had not yet been installed at the center at the time.

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Tests completed after Beta 1.0 test and ending this phase

Software usability scale

The average score achieved with this tool was 26.7/100 points, which means that users perceived the system as not useful (a product or service is considered useful when the total score is above 68 points). This score was averaged based on results from 3 questionnaires.

Questions for the appreciation of each functionality by users

Table 1 presents averaged ratings of users who rated each module (their utility and helpfulness and whether they were liked by the respondents) on a scale of 1 to 5, where 1 is "not useful at all" and 5 is "very useful". The sum of all ratings for a module was divided by the number of responding seniors (4), thus getting the average rating of all participants.

Table 1 Evaluation of seniors in Kobylniki on the usefulness of modules in the Assistant application.

Module name	Average subjective evaluation
Health module	2
Reminders	1,33
Stay in touch	3,33
Air quality	2,33
Training	not used

Semi-structured interview

Seniors did not use the system at the time it was left to them. One senior used only the devices: thermometer, scale, Stay in touch button, but not the interface for operation on the tablet. The main problem was again that seniors cannot operate such a device. They have very serious limitations both physically and cognitively which make using technology extremely hard for some of them. Test persons declare also, that they don't want to use Pelosha after the study. One senior would like to use only the devices - thermometer and scales. Seniors could possibly recommend PELOSHA only to someone who can operate a tablet.

Researchers observation

Seniors had no difficulty using the dashboard panel (except for changing the quick view) and this view was clear to them. Only one respondent was able to indicate where he can find reminders from the caregiver. Adding measurements appeared to be needed and even liked by the elderly, but buttons for adding a new measurement were not clearly described. The users were able to enter the Air Quality module and read the

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information from it. One was also able to return to the dashboard view. One respondent was particularly keen on the Stay in touch button, which he used all the time, although, in researchers opinion, more for fun than out of any real need of a caregiver. Not all seniors noticed the "+add measurement" button to add a one on the tablet in the Health module. Confusingly, on a further screen, there were two buttons for adding a measurement – senior did not understand that one was for entering the measurement value manually, and the other for sending the measurement result automatically. He also did not know what he needed the information about the CO_2 level in the room for. The user was happy to use devices such as scales or thermometer, but unfortunately showed no willingness to operate the tablet. Here, as with the other respondent, the technical aspect of operating the tablet itself was problematic. His clicks were either too long or too short which made the user interface unresponsive.

Summary. Seniors at the care home are not fluent in technology, and most of them are unable to use it themselves. The observations were disrupted by the researcher's help, instructions and commands, but without this, the users would not have learned either how the seniors use the app or what they think of it. One test person liked the application and the idea very much, however, he had problems with the operation too. These were probably due to his lack of experience in using touchscreen devices - he did not know how to click, as well as his vision problems - the letters and buttons were too small for him. While he was instructed by the researcher he was able to cope with the tasks, but on his own he could not repeat without help. Operating on the tablet is the most serious barrier.

"Well to tell the truth, a brilliant solution, we will see how it works out. Won't there be some mistakes due to the incompetence of the operator. I will definitely need help to handle it, because I won't make it all. That's what I'm able to handle [referring to the Stay in touch module], but the rest... Especially since it's several things at once and this can be confused with this, that with that. This is where I wouldn't be confident."

b) Caregivers

Demographic questions

Four female caregivers between the ages of 35 and 54, (average age 48), including two of Ukrainian nationality, participated in the study. Three indicated a secondary education, and one a higher education. The activities in which they help their residents at the center are mainly: dressing, taking medications, assisting with toileting, feeding, changing. All caregivers use a smartphone daily, 2 also use a computer and tablet. Caregivers mostly use social media: Facebook, Messenger, Wiber.

Questions about caregivers' work

In questions about the work of the caregivers, the researchers wanted to determine what the caregivers think is the biggest challenge in their work, how they encourage seniors to take up physical activity, take care of their health, what kind of help the seniors need most often, and how the caregivers' work is organized.

All caregivers working at the center take care of all seniors, and this is currently 28 people. Among the most difficult tasks were caring for people lying down, lifting, and providing mental support to the elderly. Caregivers are not concerned with encouraging physical activity, explaining that it is not their responsibility; some seniors want to be active and do not need to be encouraged, but some cannot be persuaded. Caregivers remind seniors to drink water regularly (there is a problem of dehydration), control medications, measure blood pressure and temperature. Seniors most often need support in washing, dressing, feeding, cleaning, laundry, mental support, administering insulin, measuring sugar, toileting, getting up and lying down.

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Caregivers organize their work by completing workbooks, have a scope of tasks to be completed on a given day, and divide work among themselves.

Observation of using the Pelosha platform for the first time

Caregivers had no problem using the interface of the Caregiver Dashboard application. They were asked to navigate through the different modules, they had no questions, the information there was clear to them and navigating the app was easy to understand. However, they did not notice the notifications while in the middle of the application. A new notification was only signaled by a change in the digit at the notification bell, which the caregivers themselves did not notice. As some of the employees were from Ukraine, Polish language in the application was also a barrier.

Tests completed after Beta 1.0 test and ending this phase

Questions for the appreciation of each functionality by users

Table 2 presents the ratings coming from averaging the values that 2 caregivers chose to subjectively evaluate each individual module.

Table 2 Evaluation of caregivers in Kobylniki on the usefulness of modules in the Caregiver Dasboard application.

Module name	Average subjective evaluation
Night activity	2,5
Health module	1,5
Notifications	2,5
Stay in touch	2,5
Air quality	2,5
Reminders	1

Night activity. In caregivers opinion, this feature would be especially useful if it would notify caregivers right away that, for example, the senior has turned on the TV. So far, it looks like the caregivers are listening to see if there is a noise. The app could do this for them, only the notifications would have to work better.

Health module. For caregivers this module is not useful, because they have an another way (analog) of saving measurements, e.g. they measure residents' blood pressure twice a day, but using one blood pressure monitor and write down the results in a notebook. Using a tablet for this purpose would prolong the process for them.

Reminders. Caregivers prefer to approach and "notify" the senior in person, rather than sending a reminder via an app, which may be ignored/overlooked, or the sound of an incoming reminder may startle the senior.

In caregivers opinion, **notifications** do not serve their purpose because they cannot be heard (the sound accompanies the notification when the app is not only closed, but also not running in the background) and caregivers don't want to carry the phone with them because it bothers them or they are afraid of getting wet while bathing residents, for example.

The **Stay in touch** module would be very useful if it would visually differentiate the buttons more and add a voice confirmation that a particular message has been sent to the caregivers. Plus the caregivers would have to learn to carry the phone with them, and the notifications would be clearer (audibly and communicatively).

Information from the **Air Quality** module would be much needed, but again, notifications would have to work better.

Semi-structured interview

Caregivers admitted that due to lack of time and the confusion caused by COVID-19's subsequent closure of the retirement center, they did not use the PELOSHA system regularly. Among the problems encountered, they mentioned that, notifications are not heard or seen. They suggested, that notifications could be more clearly voiced and communicated, while in the Stay in touch module, the different parts of the button should be visually distinguished from each other to make them more accessible to seniors; it would also be good for seniors to receive a voice confirmation that a particular message has been sent when they press the button. Caregivers would not want to use the system after the survey. Respondents felt that if the system was limited to automatically recorded notifications, such as Night Activity, Air Quality and the Stay in touch module, (only these features are easy to implement in a place like a senior's home) then they might recommend the system to a someone.

This is a quote from one of the caregivers, that perhaps gives a better understanding of the distance of this group which they had to the system:

"The respondent didn't use the solution because she was afraid she would wet or break the phone (e.g., while residents were bathing). In her opinion, this solution does not work for such a target group as the residents of the Kobylniki Senior Home, because they are largely people with very limited cognitive and manual abilities. She said that residents who received the tablet and the other meters hid them in cabinets, not allowing anyone to touch them - they treated them as their own possessions to be put away, but which they did not use. Occasional people (such as one female senior, who reacted most enthusiastically to the app and had the greatest technological skills) measured their own temperature or blood pressure, but wrote the results down in their own notebooks - without using the tablet."

Summary. Caregivers were very sceptical about the use of the Caregiver Dashboard app and that seniors living in the center would properly and regularly use the Assistant app. For some caregivers coming from Ukraine, the Polish language in the app was also a problem. In terms of obfuscation skills, the caregivers had no problems. The work of caregivers is more about handling physiological needs, performing physical activities that seniors are no longer able to do themselves, rather than psychological support and encouraging them to take care of their health.

2.1.2 HAMONT (BELGIUM) - OVERVIEW OF THE RESULTS

a) Seniors

Demographic questions

Four residents of the service flats of the Sint-Jan Berchmans center for the elderly (3 women and 1 man) participated in the study. The age range of the seniors was 84-97, with an average age of 89.5. Higher education was indicated by 3 people, while 1 person had primary education. Two people indicated living alone, while the other two are living with a spouse. In addition, all respondents answered that they are cared for by others - it should be added at this point that site choses for the pilot at Sint-Jan Berchmans is a complex of assisted living facilities, where seniors live relatively independently, using outside help when needed; they can also use the day care home located on the premises. All seniors, therefore, benefit from in-home services, such as visits of a nurse and a cleaning person. They receive help with morning toileting, dressing, and do not have to cook. In terms of medical solutions, seniors use devices available in apartments: emergency button, electronic keys, smoke detector. Seniors use smartphones (3 responses), a tablet (1 response), a cell phone without a touchscreen (1 person). Seniors use phones daily or once a week, and they described their skills in using these devices as low or lack of skills. Seniors who own a smartphone listed camera, skype, games among the applications they use.

Questions about senior' health care habits

Seniors said they are generally satisfied with their current state of health. They indicated cycling and walking as their favourite physical activities, which make them feel good. They undertake these activities possibly every day or once a week, and are also aware that they should be active every day to keep this state. All seniors specified that they sleep well, 1 person would like to be able to fall asleep more easily. As for taking measurements, seniors do not take the measurements themselves - they are taken by a doctor who visits them every few weeks (3-6 weeks), and then all the measurements are taken. All seniors rate contact with their families as frequent or very frequent, including visits, since some family members live near the center. When asked about the type of support they receive, they mentioned: shopping, conversation, and psychological support.

Observation of using the Pelosha system for the first time

i) Dashboard content and changing modules

Respondents were asked to walk through different parts of the user interface, and showed little initiative to explore the application on their own. For the respondents, pre-configuration of the devices (at which the researcher helped) proved to be a serious barrier and the time and effort put into this resulted in discouragement to take part in the study in almost all respondents. One person was seriously discouraged after the earlier setup and no longer wanted to test the Assistant application's user interface or use the system. The main view of the dashboard itself was not any problem and was understandable. Quickly changing from one measurement view to another via a tile was not considered a useful feature, and some did not even want to change the tile view after such a long and difficult setup process in which they managed to set everything to the right state.

ii)   Reminders module

Seniors did not understand the point of this module - they asked why they should use it if they can and (do) write reminders in the calendar. They were all very puzzled by this feature, although they may not have understood correctly how it works.

iii)   Health module

The click area was too small for seniors, such as when measuring blood pressure, although the process itself and the display of results went well. When entering the pulse manually, the app stopped working properly. When using the thermometer, one respondent said, that he thought that taking a measurement should be easy, but it turned out not to be - turning it on and then starting the scan was difficult itself, but especially holding the thermometer right in front of the head and then pressing the appropriate button was uncomfortable. One test person refused taking measurements, because she trusts only her doctor. In another case, it turned out that the blood pressure monitor that came with the system was more complicated than the one that respondent has, so she did not want to learn how to use the new device. Moreover, she showed no interest in having all her measurements in one place, the concept itself did not seem attractive to her. Some seniors are afraid to step on the scales themselves for fear of the possibility of falling. The devices didn't always work, did not always transmit measurements to the app, and there were errors, which, combined with the impatience often present among seniors, led to an overall negative attitude toward the Pelosha system.

iv)   Air Quality module

Seniors have their own habits, which cannot be easily influenced by showing them the benefits of new solutions. An example is checking the temperature outside with a traditional thermometer outside the window, so seniors did not see the need to turn on the tablet to check the temperature with the Air Quality module. Turning on the tablet for this purpose would involve unnecessary effort for them, when they can simply walk to the window. This was the opinion expressed by one of the respondents. Two others who also tested the module were similarly reluctant to use the tablet itself to learn about air quality, humidity levels - but they approached the very idea of air quality control with enthusiasm and felt they would need such functionality.

v)   Stay in touch module

The respondents were pleased with the simple button and were well-disposed to the concept of a contact button, while the person with the onset of dementia did not fully understand the difference between the Stay in touch button and the emergency call button, which residents already have. One senior was afraid to use the button and preferred to wait for a caregiver to come in person to communicate an issue. Two respondents used the button and the caregiver actually came. One of them admitted that it was a very good way of communication. The respondents liked the simplicity of this solution and the fact that they do not have to use a tablet.

vi)   Training module

The seniors were quite negative about this module and 2 of them were afraid to test it. Although the messages were rated as rather understandable, the login procedure remains somewhat cumbersome, again, this causes unrest for the user. Exercises should be better tailored to seniors so they do not hurt themselves - the level of exercise was designed generally, for a fairly fit person. There should also be some sort of interlock, preventing people from doing too much exercise in a day, as one respondent admitted that he would lose control if he actually started exercising with the exercise station. The user field for login is too small compared to the font size. They did not know if it was possible to leave the app and how to skip an exercise, which is important for seniors. The camera cannot be moved during exercise,

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otherwise the trainer may disappear or be placed in the wrong place on the screen. This also happens sometimes when the camera is not moved (for no obvious reason).The detected image does not always match the end-user. No translation for "after training" in Dutch. The correct translation of man is not 'mannetje' but 'man'. The looks of the virtual trainer are important to motivate the elderly, so seniors would prefer exercise with the feeling that the trainer is 'one of them', so making the trainer an older woman or man is a good idea. Level and step are in different tool bars. The history of previous training might be useful, but now, generally this module is confusing and complicated for elderly. There would also need to be an option to select the level and step during the start procedure. Also indicate the level and step of the last exercise. Music started to be irritating quickly so it is better to be able change it whenever a user wants. There were no units in the measurement display (percentage, points). The displayed Accuracy values are wrong - when one just stand still or move a little bit, the accuracy is higher than when this person really dd the exercise. At a certain point she left, then, at the end of the exercise, she saw a communicate: 'You did a good job'. Time of all these exercises should be redefined. The visual and written instructions do not match (in Dutch).

Tests completed after Beta 1.0 test and ending this phase

Software usability scale

The average score achieved with this tool was 22.5/100 points, which means that users considered the system pretty unusable (a product or service is considered usable when the total score exceeds 68).

Questions for the appreciation of each functionality by users

Below are the average ratings of users who rated individual modules (their usefulness, whether they liked them) on a scale from 1 to 5. The sum of all ratings for a given module was divided by the number of responding seniors (4), thus obtaining the average rating of all participants. The results are presented in Table 3.

Table 3 Evaluation of seniors in Hamont on the usefulness of modules in the Assistant application.

Module name	Average subjective evaluation
Health module	2,75
Notifications	2,75
Stay in touch	4,75
Air quality	4,25
Training	2,5

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Semi-structured interview

Seniors avoided using the tablet and were more willing to test the included devices. They liked the Stay in touch and Air Quality modules the most. Although residents have a so-called emergency call, they believe that an additional form of contact would not be unnecessary and they could call someone with a wider range of needs. Regarding the Air Quality module, Belgian seniors' statements often included concern about indoor air quality, and this is a parameter they would like to have under control. They are not interested in checking the temperature, but more in CO2 levels. All the seniors, regardless of their involvement in the survey, confirmed that the most cumbersome thing about the PELOSHA idea is checking everything on the tablet.

"I have not used the system every day. I have my own tablet and I do play games on that every day. I haven't needed the system exactly either. I did think about it, but then I didn't really know why I would use it. My thermometer is on the cabinet, so I know how warm it is. "

"I didn't like that tablet, but that button is easy. I had a problem and I pressed the button and a day later a caregiver called me back. That was a good system, yes, very nice! That temperature stuff is actually very nice to know, but I did not find it easy to have to put the tablet on. It would be interesting if I could always just read that somewhere."

Summary. Respondents became prejudiced against the system from the beginning of their experience with it after going through a very complicated configuration of the software and the system, which made it unattractive from their perspective since it requires certain technical skills. Despite the fact, that the seniors themselves mostly use touchscreen devices on a daily basis and have some basic skills as to how to use a smartphone, they refused to explore the application in depth. However, the respondents could not imagine the benefits they would gain from using such a system, as they are accustomed to the solutions they already use (taking measurements by a doctor, checking the temperature with a window thermometer, saving reminders in the calendar). Much of the seniors' reluctance was centered around the use of a tablet, which they felt was unnecessary to operate. Most positively received were the Air Quality and Stay in touch modules, which seniors said were useful.

b) Caregivers

Demographic questions

Eight caregivers between the ages of 21 and 55, all with a higher education, participated in the study. The activities they help their residents at service flats are mainly: responding when the emergency button is pressed, usually when the senior falls over or feels unwell. Typically, seniors need support ranging from the very basic (washing and dressing) to more specific, like wound care, compression stockings, medication, blood pressure measurements. All caregivers use a smartphone daily; responses also indicated computer and tablet use. All caregivers use the same care program on the tablet and different apps on their phones for private use: WhatsApp, weather, the newspaper, health app, calendar.

Questions about caregivers' work

Caregivers currently take care of 37 service flats for which we make the emergency calls, that is 41 residents. Caregivers combine this work with taking care of the residents of the retirement center. Twenty five residents who are in need of everyday help live there. The impatience of the elderly, who want help to be given to them first, and the burden of care, which is sometimes very heavy, were cited as the biggest challenges in

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caregiving. The elderly in the service flats are still very independent. The difficulty with these seniors is that they are more likely to ask for help too late than too early. In addition, the calls are sometimes difficult because a caregiver has to leave residents in the rest home understaffed for a while. Caregivers claimed, that they do not know the residents of the service flats very well, because they only come when these seniors are in need. Caregivers admit that it is not necessary to encourage residents of assisted living to become active, as they are still mostly functional and take care of this sphere themselves. Nor do they themselves encourage seniors to take care of their health, in which case it is limited to regular medical visits, during which the senior learns about his or her results and the doctor's recommendations. Caregivers organize their work exclusively from the senior's home, as they only respond to calls in assisted living facilities on an ad hoc basis.

Questions about senior's health care habits

The residents of the flats still live alone, so their health is still okay. There is some concern about one resident being confused, with another resident it seems that caring for his wife is becoming too heavy and caregivers are trying to support seniors in such cases. These seniors are doing well and can live alone with minor adjustments. Seniors who are residents of assisted living are still active, not only for reasons of taking care of their bodies, but also for reasons of keeping social contacts, such as going on bike rides together. Caregivers noted that seniors are often reluctant to take measurements of their health parameters on their own, because they are afraid of getting them wrong or misinterpreting them. They also do not know what to do if a measurement is incorrect: they panic when their blood pressure is too low or too high. According to caregivers, seniors do not want to worry about it, as long as nothing serious happens to them. Caregivers have no knowledge of the quality of their residents' sleep; if they do not report problems in this regard, caregivers assume that everything is fine. Many seniors get help from a caregiver in the morning and this is sufficient. If more help is needed, then they suggest considering a move to a retirement center.

Observation of using the Pelosha system for the first time

   i)   Dashboard content and changing modules

The view of the dashboard was clear and simple for caregivers. Attention was drawn to the need to remove all notifications at once.

   ii)   Reminders module

Caregivers did find it useful to be able to let their seniors know if they would be coming later or not, however, they do wonder how many of them would read this. Seniors should already hear the tablet 'ping' and then open the tablet to see. They estimate that this is too many actions. It is useful for the caregiver to be able to plan something in the senior's agenda. Seniors engage in many activities and often leave the house, for example, to visit family. This module would be useful if the caregiver had a synchronized calendar with the senior's current calendar.

   iii)   Health module

Caregivers are convinced that few seniors at their center would actually use this module, as they predict that seniors would have too many worries about taking measurements correctly, as well as properly interpreting the values obtained. This would be easy for the residential care center, instead of the service flats. It would save a lot of time if they could take a blood pressure and have these results automatically entered into the care plan.

iv)   Air Quality module

The results of using this module were surprising to caregivers, as they admitted that by controlling CO2 levels indoors, they became more attentive to levels above the norm. They were shocked at how quickly a healthy level CO2 is rising. Using the device has permanently changed their behaviour when they are indoors in a larger group of people, and they now always open a window. While the decision about CO2 levels in an apartment is, of course, up to the senior citizen individually, elderly probably still underestimate the role of ventilating a room and restoring CO2 levels to proper values.

v)   Training module

Caregivers are of the opinion that residents will not be too willing to participate in this kind of exercise because they already exercise a lot. According to caregivers, using an exercise station may be too complicated for seniors. Caregivers find it graphically unattractive and there are many better-looking (though perhaps less precise) solutions on the market that more easily encourage movement and having fun.

vi)   Stay in touch module

Respondents felt it was a useful module for them - "it helps us not to receive calls at annoying moments, but we can call back ourselves when it suits us." Its purpose in this case was separated from emergency calls, so caregivers also knew that they were not being called about any serious situation.

Tests completed after Beta 1.0 test and ending this phase

Software usability scale

Caregivers provided one "collective" score in this survey, which is 72.5 out of 100 points, meaning that they consider the system to be moderately useful (if a product or service scores above 68, it is considered useful on this scale).

Questions for the appreciation of each functionality by users

The caregivers provided "collective" results in this study, so there is no individual data and an average for them, only a generalized assessment of the caregivers from this center. These are summarized in Table 4.

Semi-structured interview

In a semi-structured interview, caregivers admitted that they used the app every day during this phase. They liked receiving notifications, but receiving too many at one time made it difficult to handle them. They also would like to be able to delete all the notifications they read at one time. The Stay in touch module and the idea behind it was also considered the most useful, as "you no longer get calls when they need something (nothing urgent). You can choose when to call them back."

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Table 4 Evaluation of caregivers in Hamont on the usefulness of modules in the Caregiver Dashboard application.

Module name	Average subjective evaluation
Night activity	2
Health module	4
Notifications	4
Stay in touch	5
Air quality	3

Summary. The caregivers at Hamont work in a special way, as they take care of both the seniors' home and answer to the needs of assisted living residents. They don't know seniors living in service flats very well, as they are still fairly independent people who don't require much care. Caregivers appreciated the Stay in touch module the most, as an alternative form of communication with these residents. This group also liked the Air Quality module very much, thanks to which they even changed their previous habits.

2.1.3   GENEVA (SWITZERLAND) - OVERVIEW OF THE RESULTS

A small number of people participated in this survey (3 seniors and 3 caregivers), so the group is not representative. There were also many incomplete questionnaires collected here.

   a)   Seniors

Demographic questions

The study involved 3 seniors from Geneva, including 2 women and 1 man. The age range of the seniors was 72-86, with an average age of 76 years old. Higher education was indicated by all 3 people, same as independent living. All seniors are looked after by family members, and 2 also by caregivers. Home nurse visits are used by 2 people. Seniors here also benefit from solutions as telealarm and 2h2care (European programme). Seniors use a variety of devices: cell phones, 2 people have smartphones, as well as a computer and a tablet. They use these devices on a daily or weekly basis, but do not feel skilled in using these devices. One senior who owns a smartphone, among the apps he uses listed a kitchen recipes application and WhatsApp.

Questions about senior' health care habits

Seniors rate their health moderately, but rather good (some serious but single problems). Usually they want to keep their current state of health, and to achieve this they mention: do more physical activity, perform physically engaging activities: walking, gardening. The most difficult thing for them is to move around independently, take a bath on their own, do their own errands on their own (shopping, taking public transportation). Their most common activity is walking, sometimes gymnastics and gardening. They usually

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have the opportunity to engage in these activities unless the weather is not good. All seniors check blood pressure and a home nurse is checking glucose, one person is checking temperature, oxygen saturation in blood, weight. They are taking these measurements daily or once a week. Seniors have trouble with sleeping - falling asleep takes a long time and they often wake up at 4-5 am to use the toilet. Some seniors take medications and drink herbal teas to sleep better. A nurse visits them regularly, but doctor only if needed. The friendly relationship and attention from the nurse and access to specialists were noted as important in medical care. Contact with family phone calls is regular, but due to the COVID-19, one person has not seen family for 2 years. Another senior meets her children every 2 weeks, so it much depends on a person. They feel that the frequency of this contact is generally sufficient, but they wish seeing their relatives a little more. The support they receive from loved ones is mental support, one person is receiving care from the loved ones.

Observation of using the Pelosha system for the first time

Two test persons confused the module where they can check their body temperature with the module for checking the outside temperature. Seniors were generally not comfortable with the tablet. Setting up the device ran into problems - one senior did not understand at first the concept of a "roulette" used to select his date of birth from those available on the screen, where you have to scroll your finger across the screen to select year. The senior was not used to choose numbers on a touchscreen keyboard. Another one had trouble returning to the home screen after taking a measurement. The seniors were not intuitive about such a program, which made them feel like they had to enter a lot of information and make many clicks, which discouraged them from using PELOSHA. In the end, 2 seniors tested only Health module and Air Quality, one also Night Activity.

Tests completed after Beta 1.0 test and ending this phase

Software usability scale

Respondents put the usability of the PELOSHA system at 67.5/100, therefore recognizing that the system is on the border of being considered usable (but does not formally meet the criteria).

Questions for the appreciation of each functionality by users

Table 5 shows the average ratings of users who rated individual modules (their usefulness, whether they liked them) on a scale from 1 to 5. The sum of all ratings for a given module was divided by the number of responding seniors (3), thus obtaining the average rating of all participants .

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Table 5 Evaluation of seniors in Geneva on the usefulness of modules in the Assistant application.

Module name	Average subjective evaluation
Health module	2
Notifications	4
Stay in touch	1
Air quality	1
Training	2,3
Reminders	not used

Semi-structured interview

Two seniors said, they used the system daily and 1 person admitted that she did not. All of the seniors admitted that the Health module was the most useful to them, 1 person also indicated Air Quality, however, in another question, which 2 seniors did not answer, 1 person indicated that Air Quality was the least useful module. When asked about the problems they encountered, 1 of the seniors had no problem with the operation of the included medical devices, thought they were simple, while he had some valuable comments on the other functionalities: *it is worth adding a more detailed explanation on the application that you have to step on the scale directly (don't press once to turn it on like many electronic scales) and step off when it is displayed step off*. He suggested also making a better instruction how to take a blood pressure.. When it comes to Air Quality module, he liked to see measurements every 20 minutes. This was better than his current sensor. He also liked to see the history. He had to change the place of the outdoor sensor, and put it in the shade, otherwise it had temperatures much too high to reflect reality. For the humidity, he thinks he cannot do much to change it. This person also suggested making a distinction for interior temperature when it is summer or winter. For the moment, having 23 degrees inside is acceptable because outside it is 30 degrees but in winter it would be too hot and it would be necessary to lower the heating. He proposed to modify the alerts for the temperature according to the outside temperature, if it is hot outside then 23 degrees is normal but if it is cold outside then it is too high. Add alerts for the senior if it is too hot in the summer in the home to tell him to think of lowering his blinds during the day and open the window all night. He was concerned about the CO2 level at night. He had levels during the day around 400ppm and at night once he closed the windows it went up to 800ppm or even 1000ppm. He did not understand why, because his house is always ventilated. There appeared also an opinion, that the system contains too much equipment (which must be remembered to be charged), and the operation of the application itself was not simple. The developers could consider adding an oximeter to the health module, because when this senior does not feel well his first reflex is to take his temperature to see if he has an infection and then the oximeter to see if his oxygen level is above 90. This was the only senior who loved the fact that the system was designed for a tablet, because he can take it with him everywhere, he can also put it on the table to have the information at hand at home, he even bought a protective cover that can also be used as a stand. This person also appreciated that the system was free, to be able to take the health measures whenever he wanted as many times as he wanted. The system takes the right measurements, he was able to compare with systems he already had (Air quality module, and scale) and the measurements were the same.

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Being asked about their experience of using the tablet during the survey, 2 seniors admitted that it was easy, 1 senior had no feeling for the tablet. It was also suggested, that after measuring, the user would like to return to a screen with a summary of measurements (Health module). However, seniors would not want to use the PELOSHA system after the survey - they unequivocally stated that it was not useful, nor would they recommend it to their friends, due to the complexity (especially the tablet).

b) Caregivers

Demographic questions

The three caregivers who participated in the study were between 56 and 70 years old, (average age 62), including 2 women and 1 man. One person was a home nurse, while the other 2 participants were family members of the 2 seniors (wife and son). All persons indicated higher education. 2 persons take care of 1 senior and 1 person take care of 20-30 people. The activities they help their mentees with are: toilet, health checks, medication preparation, general care, palliative care. All caregivers use smartphones and computers daily, 2 of them also indicated using tablets. They rate their ability to use these devices as skilled or very skilled. The apps they use are WhatsApp, Facebook, nursing software, Signal.

Questions about caregivers' work

The main difference in this small group of caregivers was that two people only care for their immediate family member, while a home nurse claims to care for about 20-30 people as part of her job. Among the biggest challenges, respondents included: home support and being too caring. They encourage seniors to be physically active by walking together with them. Like in previous places, caregivers do not feel they have to encourage seniors to take care of their health:

"No, if there's no problem. Otherwise, it can become anxiety-provoking for the patient. They will call as soon as there is a measure a little high or low. They will quickly worry at the slightest deviation when it is not necessarily serious. They just don't have to be too big."

A home nurse admitted, that seniors who are under her care declare, that they are not too happy with their health, because in other case they would not call her. Some, when they feel worse, immediately call the emergency, and it is simply a challenge for them to stay at home. If seniors are still able to walk, they willingly and often walk. Instead, they don't take measurements themselves; they wait until she (the home nurse) shows up at their home. The quality of sleeping depends on single seniors.

Observation of using the Pelosha system for the first time

The caregivers did not notice that they had to create an account first in order to log in; instead, they all started filling in their identification information in the login panel and they saw a register button after a while. It might be worth considering a better way to present and differentiate between "Already registered" / and "New user" login and registration to users. Caregivers also reported a problem of not being able to see the measurement history on their phones. They would like to see the results and also interesting to be able to share the complete history with the doctor.

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Tests completed after Beta 1.0 test and ending this phase

Software usability scale

Respondents determined the usefulness of the PELOSHA system at 76.25/100, thus finding the system useful. Unfortunately, this result was averaged through the responses of only 2 respondents, as 1 caregiver did not complete this form.

Questions for the appreciation of each functionality by users

The caregivers provided "collective" results in this study, so there is no individual data and an average for them, only a generalized assessment of the caregivers from this center. These are presented in Table 6.

Table 6 Evaluation of caregivers in Geneva on the usefulness of modules in the Assistant application.

Module name	Average subjective evaluation
Night activity	1,5
Health module	5
Notifications	5
Stay in touch	not used
Air quality	3
Reminders	3

Semi-structured interview

A home nurse did not use the system because her senior did not use it, 1 caregiver did not use it because lack of time, and 1 used it every day and received Air Quality notifications. Too few users participated in the study to be able to clearly answer the question of which module caregivers needed most. One caregiver said that the Air Quality and messages sent to the senior would be most needed modules for him. In contrast, the other, when asked which module was least important, answered:

"The Air Quality module. She finds it a gadget and not useful for her. It can be useful for the caregiver to see the temperature inside during a heat wave for example."

In terms of the app's operation, no serious problems were reported that prevented any task from being performed. Caregivers shared a few suggestions, about giving up the tablet and consider switching to a smartwatch, displaying messages and notifications as soon as the senior opens the application on the tablet to make sure he or she reads them. Caregivers, on the other hand, would like to be able to choose when to receive notifications for each user. For example, for those who are to be watched, be able to receive a notification every time he has returned a health measure and not only when there are extremes. It would be really nice to have control under the notifications. They also really missing the measurement history on smartphones and being able to easily send it to the doctor. When asked about her willingness to use the

PELOSHA system later, only home nurse said yes, however, she knows that most of her patients would be unable to handle Assistant application. For example, she was sure that her patient (in the PELOSHA research) would use it easily because she is comfortable with new technologies (she has a smartphone, iPad, laptop), but then this senior had some kind of blockage and disinterest to use it. So she thinks it would be even worse for seniors who are not comfortable with tablets. All the caregivers believe that in its current form, the system is too complicated for this generation of seniors. There appeared also an opinion, that there were too many notifications and one caregiver admitted, that she wouldn't know what to do if it turns out the CO2 standard is too high.

Summary. The caregivers in Geneva have mostly not used the system, nor do most believe that the seniors would be able to operate all the devices and the tablet, however, one caregiver was very passionate about suggesting many ideas that he believes would improve the system, as the idea behind the app is, in his opinion, very good. The individuals themselves did not have any technical problems (other than confusion about logging in and registering), but they were missing a few functionalities in their interface (such as the history of measurements and the ability to send them to the doctor).

2.1.4   BERLINGEN (SWITZERLAND) - OVERVIEW OF THE RESULTS

   a)   Seniors

Demographic questions

The study included 6 seniors from Berlingen, including 4 men and 2 women. The age range of the seniors was 56-81, with an average age of 65.5 years old. Higher education was indicated by 5 people, 1 person described education as secondary. Only one person indicated that he does not live independently, but with his wife. The remaining 5 respondents declared living independently. The same seniors indicated that no one takes care of them. Home services are used by 1 person (home cleaning service). None of the seniors uses a medical solution to support independence. Seniors use technology extensively: all declare daily use of smartphones and computers, 5 people use a tablet, 3 people declared in the questionnaire also, that they use a smartwatch, and 5 people also use cell phones. Seniors feel confident using these devices: 1 person described his skills as neutral, 3 people rated them at the skilled level, and 1 person rated them at the very skilled level. Respondents use a variety of mobile applications: WhatsApp, Microsoft Word and Powerpoint, Spotify, calendar, bank app, train timetable, newspaper online, maps, Flora incognita, bird-NET.

Questions about senior' health care habits

The majority (5 people) of respondents indicate that they are satisfied with their current state of health. Four would like to keep the current status (respondents indicated that to keep it, the following would be necessary: cognitive and physical exercises, social contacts, eat less, limit sweets) and 2 would prefer to improve it (for which, in their opinion, more physical exercises and stress reduction would be necessary) and respondents declare that they have already taken steps to achieve their goals and they even have noticed positive effects of their actions. The most difficult thing, according to seniors, to stay in good health is time and discipline. Seniors in Berlingen are very active ones - they indicated walking, biking, hiking, skiing, swimming as their favourite activities. This group is attracted to natural values - they appreciate being in the nature, they like to realize that they can do it (be active, fit, walk in the mountains), and think it is refreshing, some seniors answered also that they like walking because it provides relaxation, beautiful views, nice weather, moving away from sweets. Most of the respondents declare that they have the opportunity to enjoy

such activities regularly, they also strive to be active all year round. Seniors take measurements very individually, some every day, others once a week, once a month, there was also an answer from one senior who does not take measurements at all - it depends on the individual person and their health. In addition to blood pressure, it is also important for them to control their weight. All declared the absence of sleep problems. Similar differences as in measurements appeared in the responses regarding the regularity of doctor and nurse visits. The most common answers were irregularly, such as once a year, or when especially necessary. Seniors most expect advice, no pain, protection, knowing the results and being calmed, good consulting, answers to questions concerning their health. Contact with family was interchangeably described as regular or daily and is satisfactory to seniors. When asked about the extent of support received from family, there were 2 extreme answers: none (not needed) or full support (anything that would become needed).

<u>Observation of using the Pelosha system for the first time</u>

Dashboard content and changing modules, Reminders, Stay in touch, Training were not used by the seniors. Finally, not all of the seniors who completed surveys on health care habits also participated in testing the system.

i)   Health module

All the test-persons in the Berlingen used Health module on their own. Blood pressure monitor and thermometer worked very well. Blood pressure monitoring is quite easy, the same with body temperature. The results of the measurements showed up in the Health module, but did not appear in the views of the Assistant application itself. Bluetooth connection between the devices and the tablet got lost twice. By disconnecting and reconnecting the devices it was fixed. The scales did not connect by Bluetooth to the Health app in the Pelosha system. Even after changing the scales, the new one had the same problem. The scales instructions are a bit unclear. The message in English should be changed to the language of the specific service user. One respondent described the Health module as useful.

ii)   Notifications module

Certain notifications were too many and were simply not practical in given situations: if the temperature is high in the summer, high temperatures inside and outside are expected – and in Switzerland, air conditioning is very seldom installed in apartments. Reminding very old people to open the window more often is of good use.

iii)   Air Quality module

One test person who tested the system found it really useful, but met some technical problems due to connection: after changing the gateway at the beginning of his testing, everything worked without problems until he ended testing. The gateway was connected by LAN-cable to the internet, that worked much better than by SIM-card and W-LAN. Another person claimed, that CO_2 measurements are fine to open the window more frequently is helpful in many respects – one cannot smell or perceive carbondioxide nor know if its concentration is high or not, but symbols for outdoor measurements in user interface were not clear. In the senior's apartment, one had to use the Sim card of the gateway, it was not possible to plug in an ethernet-cable. Therefore the tests ended when the SIM card was empty (unexpected quickly). Also, prepaid SIM-cards without a mobile contract are not recommendable: if it is not possible to install the gateway by LAN-cable, such a mobile contract should be recommended. After changing the gateway and after a technical call in Belgium, the module worked perfectly. Indoor and outdoor temperature were shown on the tablet until the end of the testing phase. This test person was the only one who could use his own tablet, a new Samsung model. All the other test persons had tablets

older than 1 year or Apple models. One test person had a barometer of his own at the side of the PELOSHA devices: he thought they were not of great use to him. One respondent was indifferent to this functionality: "irrelevant for me." However, she admitted that notifications for older people to open their windows when CO_2 or/and temperature in the room are quite high make a lot of sense.

Tests completed after Beta 1.0 test and ending this phase

Software usability scale

Respondents put the usability of the PELOSHA system at 84/100, thus finding the system useful. This score was averaged based on the responses of the 4 respondents who completed the questionnaire. These were the highest usability ratings in all the surveys conducted.

Questions for the appreciation of each functionality by users

Table 7 presents the average ratings of users who rated individual modules (their usefulness, whether they liked them) on a scale from 1 to 5. The sum of all ratings for a given module was divided by the number of responding seniors (4), thus obtaining the average rating of all participants.

Table 7 Evaluation of seniors in Berlingen on the usefulness of modules in the Assistant application.

Module name	Caption 2
Night activity	not used
Health module	4,25
Notifications	3,3
Stay in touch	not used
Air quality	2,75
Reminders	not used

Summary. In Berlingen seniors seem just being happy people, cheerful and content with their lives, which they are still actively leading. Almost all of them are advanced in using technology. The main problem they had was the installation of the devices, but software seemed not to be a problem for them. There were also not many voices in this group against using the tablet. However, this is a group that is still independent and does not use care services, so they did not use some of the functionalities also offered in conjunction with the caregiver application.

b) Caregivers

In Berlingen, all test persons were absolutely independent. Hence, in this pilot site caregivers were not participating in the test.

2.2 BETA 1.1 PHASE

The Beta 1.1 phase was attempted exclusively in Poland, at the care home in Kobylniki near Poznan. Unfortunately, the conditions and disposition of the elderly did not allow this phase to be conducted to the extent previously planned (1 full month of use of the system by the users), and therefore the previously assumed research tools were not used either. The abandoned tools included WHOQOL-OLD, Short Physical Performance Battery, WHOQOL-BREF, SF-36.

2.2.1 POZNAN (POLAND) - OVERVIEW OF THE RESULTS

a) Seniors

Demographic questions

The study involved 7 female seniors from care home in Kobylniki near Poznan. The age range of the seniors was 83-94, with an average age of 87. Higher education was indicated by 2 people, while 2 had secondary education, 2 people declared primary education, 1 person none. The seniors are permanent residents of the care home and none of them live independently. In addition, 2 people indicated that the people who take care of them are the house staff, 5 people indicated family members as those who take care of them. They do not use home services, however, 1 person declared using 2 years ago an interactive robot designed by students that could play cards and read books. None of the seniors use a medical solution to support remaining independent. Seniors mainly use older-type cell phones (6/7 people). One person indicated owning a smartphone. Seniors use phones every day or once a week, and described their ability to use these devices as medium (2 responses) low (1 response) or none (4 responses). Seniors who own a smartphone use a calendar, weather and crossword puzzles among their applications.

Questions about senior' health care habits

Seniors rate their health condition differently, but mostly as "good," indicating that their well-being depends on the day. They would like to improve it relatively, point to the role of physical activity and rehabilitation, while they realize that this does not improve their condition, but only delays its deterioration. All of the seniors taking part in gymnastics led by a rehabilitation therapist twice a week, adapted to their abilities. They do not write their favourite activities. Measurements are taken entirely by caregivers. Most of them sleep well; if there are problems, it is with falling asleep. Seniors rarely visit doctors, rather when something ails them, they point out that it is important to have good contact with a doctor who has the right approach to them. They maintain contact with their families (mainly children), which they mostly rate as frequent.

Observation of using the Pelosha system for the first time

Following the observations made during the Beta 1.0 phase, the researchers decided to test the Pelosha system with only an improved version of Stay in touch module. This was an implementation of the scenario that did not require usage of tablet by the senior. The revised button included a colour cue, the name of the message, and an icon depicting the choice graphically. The button itself was further divided into 4 parts, the pressing of which would inform and summon the caregiver about using the toilet, feeling pain, asking for help with getting up, willingness to leave the room. Moreover, this time, the researchers no longer asked the residents to use the tablet or other modules.

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i)   Stay in touch (improved version)

The respondents had no problem recognizing the purpose of the various buttons, plus the visually impaired person was definitely helped by the colour cue. One person had a problem to press the button (too weak pressure of the device). Respondents understood the purpose of the button and liked it more than the previous one.

Tests performed during the next meeting with the researchers

Software usability scale

Respondents rated the usability of the Stay in touch button (improved version) at 82.5/100, thus finding the button itself simple and useful to them. This score was averaged based on the responses of the 5 respondents who completed the questionnaire.

Questions for the appreciation of each functionality by users

Respondents were asked to evaluate the usefulness of the Stay in touch module button – the results are summarized in Table 8.

Table 8 Evaluation of seniors in Kobylniki on the usefulness of improved Stay in touch button.

Module name	Average subjective evaluation
Stay in touch (improved)	3,4

Semi-structured interview

Within days of the Stay in touch button being installed in a senior's home, some users admitted that they did not feel the needs specified by it, and therefore did not call a caregiver. A questionnaire study was conducted, but only on the use of the Stay in touch button in a simplified version. It should be noted, however, that at some point the seniors became too tired of the researchers' visits and conducting interviews and completing forms, and became annoyed at seeing the researchers once again. Four people used Stay in touch at least once (including, however, by accident), while two did not use the button even once. Unfortunately, only one respondent admitted that pressing the button caused a caregiver to actually come and help (in this case with the toilet). Those who pressed the button without a result of the arrival of a caregiver, were discouraged by this and did not press the button later.

"I think it's always useful, because if you even call on that general ringtone, and it wouldn't work, because it varies, you can use it. It's always some other form of contact."

Summary. Simplicity is the key factor that defines the interest of elderly people with some physical and cognitive limitations in operating devices. Not coincidentally, most residents of the home use a simplified cell phone - they do so, because it is simple. Seniors avoid solutions that might involve too much complexity,

because they often don't believe they would be able to master its operation, and they would also be afraid of breaking expensive electronic equipment, even if the solutions might benefit their health or well-being. Residents who took part in this phase of the study, responded positively to the new version of the button, which contained more clear instructions to avoid making a mistake. However, even if the use of the Stay in touch button becomes more frequent, there is still the question of caregivers responding to these requests.

b) Caregivers

The director of the facility reported that at this stage the caregivers do not want to use this solution, because carrying the phone with them is inconvenient, it does not work especially when bathing seniors. Wearing a waist bag with the phone is also inconvenient and caregivers did not put them on. Besides, the application had its limitations - notifications were only noticeable when a caregiver opened the app. When the phone was off, notifications could not be heard. Caregivers do not have a convenient work environment to open the app every moment and then to check if a notification has arrived. In addition, they received a lot of notifications not strictly related to the seniors status, but system notifications, which was confusing, maybe even annoying: "the caregivers don't respond to these notifications because they're too busy to interrupt what they're doing, take the phone out of the bag, turn it on, go into the app and then into messages." Unfortunately, it was not possible to talk to any of the caregivers working at the center on the planned day - they were too busy and refused to be interviewed.

Summary. Caregivers in the care home were very irregular in reading notifications and responding to them, because they usually are too busy helping seniors with activities such as washing, dressing and feeding and they did not have time to look at notifications and then respond to them on an ongoing basis. However, if caregivers do not respond to requests sent through the module, seniors become discouraged and stop using it. Other features of the app were not found attractive, although it should be mentioned that individual caregivers in general were not interested in testing any facilities or solutions.

3 Research summary

Research on the PELOSHA system has been conducted in very different locations that are difficult to compare to each other, as are their residents. The results yielded more differences than similarities, and evaluations of the various components of the system cannot be so easily compared among the participating users. Elderly who took part in this research varied in age (a 40-year difference between the youngest and oldest participating senior), health status (some still play sports and drive a car, while others are happy to still be able to walk at all), degree of independence (from completely independent individuals to those who have not lived independently for many years and are dependent on the care of others to function) and the degree of mastery of technology (from people who freely use mobile apps to pursue their interests or plan a trip to those who use a one-button phone solely to answer calls). With such extreme differences, drawing common conclusions does not provide a reliable picture of reality.

It is also difficult to properly answer the question of where respondents coped with the system better and where they coped a little worse, due to significant differences in the number of seniors who took part in the survey. In addition, many questionnaires were left unfilled, so that the surveys themselves were incomplete. Many research assumptions were not met due to the fact that, for the most part, users did not use the system or used it very selectively.

3.1 Seniors research summary

The majority of respondents say they are satisfied with their current state of health, although this varies widely among the seniors taking part in the survey. They also declare that they sleep well - the only problem that arises, and is common to residents of all centers, is trouble sleeping. Almost all also maintain constant, and frequent, contact with their families. It is not always direct, in the form of personal visits, but seniors declare that they always have it by phone.

Seniors are afraid to try new things because they fear they either will not master them or they might mess them up. Combined with the impatience that seniors often have, they prefer to either avoid new experiences and solutions in their lives (especially with technology, which has become more prevalent in adulthood), or they get discouraged very quickly when they fail. Technical problems (especially the setup stage, if the senior went through it) discouraged the elderly so effectively from the very beginning of the PELOSHA experience that some of them refused to participate in the later stage.

Many seniors do not take measurements at all or their caregiver takes them - there are definitely fewer of those who take measurements of pressure, temperature and other measurements. Caregivers admit that it is often the case that older people do not want to take measurements on their own because they do not want to worry about bad results, nor do they know how to interpret the results if they are incorrect and may panic unnecessarily. All seniors have a similar opinion on what is important for them in medical care - "good contact" with a doctor and access to specialists.

The most common problems were that font size being too small and the interface elements being too small for pressing on the touchscreen. All the seniors, regardless of their involvement in the survey, confirmed that the most cumbersome thing about the PELOSHA idea is checking everything on the tablet.

The most-liked and most-used modules by seniors are Stay in touch and Air Quality, due to the CO2 parameter, which seniors wanted to know and maintain at a healthy level. They are not interested in checking the temperature or humidity, but more in CO2 levels. The Health module, despite high ratings, did not enjoy such recognition in verbal declarations. Although it was understandable to seniors, and seniors liked to take

measurements with it, it turned out to be quite complicated, with all its devices that were difficult to connect at first, and then use it to finally find your results in the application. Problems encountered by this module include unclear instructions related to the scales and a complicated method of correct measurement. Problems with connecting the scale itself to the application, inconvenient use of the tablet, waste of time if you only want to measure the temperature and not keep a graph of body temperature measurements for some time - then starting the tablet seems to be an unnecessary effort for a senior. Unclear adding measurements in GUI - two "add measurement" buttons are not highlighted enough against each other and they do not inform which measurement is manual and which is automatic. Several seniors would like this module to be supplemented with a pulse oximeter and a blood oxygenation value.

A few seniors did show a lively enthusiasm for the PELOSHA system (or individual functionalities, such as the Stay in touch button). They were people who really wanted to use this solution because they saw the value for themselves and had an idea of the benefits that could possibly be achieved for themselves through such a system (e.g. better contact with the a caregiver).

3.2 CAREGIVERS RESEARCH SUMMARY

Besides minor inconveniences, using the app as a program was not difficult for caregivers, regardless of where the study was conducted. Caregivers were mostly younger than the seniors, on average by one generation, and are therefore more proficient in technology and the use of mobile devices, which are almost 100% a daily experience for them. Caregivers in all countries support seniors in very similar ways. Caregivers (if they are not family members) are not interested in many of the options currently offered by the Caregiver Dashboard: checking the progress in physical activity, whether the sleep quality of seniors is appropriate, whether they regularly visit a doctor and take measurements relevant to their health. They are interested in communicating with seniors if they have to do something themselves - in situations when seniors need them (feeling unwell, help with hygiene, getting dressed, falling).

Notifications, which are the main method of communication between caregivers and seniors, could work much better if they were more refined. Using them will not work in every case, such as in a care home, where there are a lot of seniors who need constant care and few caregivers who are busy all the time. Perhaps it would be beneficial to allow caregivers to personalize notifications, to be able to turn them off, and to specify which specific information they want to receive and how - by sound and vibration or only in graphic form. This would also avoid receiving unwanted notifications that overwhelm the user. In terms of communication between the two groups, the Stay in touch module certainly stands. Even in a place where a somewhat similar solution (emergency button) already functions, caregivers imagined specific situations when it would be needed. Much less attention and positive feedback was received in this regard by the Reminders module, which was tested to a limited extent, and even if it was, users did not like the very idea of the caregiver sending. Rather, the module was judged to be too demanding when seniors and caregivers are able to call each other, talk directly or write something on the calendar.

Due to the fact that seniors, in principle, did not report any problems with sleep (apart from problems with falling asleep), the Night Activity module was not very popular with the caregivers and they did not pay much attention to it.

Caregivers often expressed the opinion that the seniors they care for would not be able to master the Assistant application or the use of the system itself with their devices. They also presented frequent discouragement to a greater or lesser degree. Caregivers say the PELOSHA system requires appropriate changes if it is to be practically used.

4 CONCLUSIONS

The tests conducted within the pilots focused the potential customer segments in respective countries – institutional care in Poland and Belgium, and individuals living independently in Switzerland. Due to impact of COVID-19 pandemics the project consortium could not conduct pilot tests as expected in DoW, at the time of midterm review and in the execution plan described in deliverable D4.1. The small scale tests nevertheless provided important insights and encouragement towards further pursuing of changing the developed technology into a product offer.

The design of user interfaces within Assistant and Caregiver Dashboard must be assumed as good. The general usability scores suggested the system as a whole is usable in all user groups except one. The group that found the system unusable were the residents of the participating care home in Poland, which are dependant seniors aged around 90 without much experience with technology, generally unable to use tablets as such. A different approach to deliver functionality for this group is needed. One important Assistant usage notes is that onboarding should be done without direct participation of seniors.

As far as individual modules are concerned the most positive reviews were received by the Air Quality and Stay in touch modules. This encourages focusing on these modules as the first modules to offer to potential users and customers. Health module seems to be needed, though relevant improvement must be made to it so that using it is easier and (potentially) without the need to use the tablet during measurements. The Night Activity, Training and Reminders modules were the least tested, so it is difficult to draw general conclusions based on single uses, described more extensively during Beta 1.0. Nevertheless, a scenario for care homes to monitor usage of electric devices inside residents' rooms/flats exists.

Since the primarily targeted customer segment are institutions providing care to seniors, it was particularly encouraging that among the caregivers participating in the tests enthusiast of the PELOSHA technology could be found. That suggest a potential in finding early adopters of the PELOSHA offer, so important to the business success of the project results according to deliverable *D5.4. Market analysis and business models*.