ICT PSP – Health, Ageing and Inclusion Programme

Home Sweet Home

Health monitoring and sOcial integration environMEnt for Supporting WidE ExTension of independent life at HOME

(Grant Agreement N° 250449)

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Abstract

This document is the Public version of the Final Report of the Home Sweet Home project. It differs from the internal version as it does not include sections about the management of the project. It describes the results of the project, 48 months after the Home Sweet Home's project initiation in March 2010.

Key Word List

Telemedicine, RCT, telemonitoring, eHealth, infrastructure, health care services, provision of health care, assessment of services, call centre.

Executive Summary

The Home Sweet Home objectives (HSH) were to trial a new, economically sustainable home assistance service extending older people's independent living. HSH intended to achieve this by providing a comprehensive set of services supporting older people in their daily activities and allowing carers to remotely assess their ability to stay independent. While systems of this kind inevitably represent an intrusion in older people's private life, HSH included features which could be used by older people themselves to limit to a bare minimum the need for other people to interfere with their private life, unless a clear need was detected by the system. It comprised a wide range of services addressing the health conditions of the older people, as well as the environmental conditions in their homes, and domotics. The project included four pilot sites in Ireland (Louth), Spain (Badalona), Belgium (Antwerp) and Italy (Latina), and the RCT methodology was used to guarantee the rigorousness of the results.

This is the final report of the project and, after a short summary of the main features of the project, it summarises the main findings and results achieved. In the final section, the main lessons learned are reported.

First of all, the initial 36 months duration has been extended to 48 months to cope with some delays introduced during the project start up phase.

As regards the final findings, they can be summarised as follows:

The inclusion of the Home Sweet Home solution into the existing health ecosystems has the potential to transform the landscape in terms of both costs and utility.

Personnel

It is not clear at this stage whether savings in staff time will occur as a result of the introduction of the Home Sweet Home solution, but the staffing mix will undoubtedly evolve. A new layer of actors will be introduced in terms of Call Centre personnel and telehealth triage staff. However this new layer can help to replace the necessity for regular GP, consultant and clinic visits that are costly to both healthcare providers and the older person.

Hospital and residential care costs

The telehealth component of the Home Sweet Home solution will detect early signs of declining conditions and will, therefore, assist medical professionals with early interventions to prevent emergency episodes. Using telecare domotics and assisted living technologies can prolong the time before the need to move to residential care, and reduce the length of time spent convalescing in hospitals. This is particularly relevant considering the average length of hospital stay for people over 65 years is three times longer than people under 65 years.

Quality of Service

Increasingly, evidence has shown that many older people prefer to live in their own homes in preference to residential care. However, quality of care has always been a vital component in this decision. Reducing healthcare budgets are forcing decision makers to consider new and innovative types of care in an effort to maintain current quality. The Home Sweet Home solution is one such innovation, and with the introduction of an added layer of responsibility in terms of the Call Centre, ensures that there is an increase in quality of care.

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1. Introduction

1.1 Purpose of this document

This document contains the final reporting of the Home Sweet Home project.

1.2 Structure of the document

Section 1 is the introductory section of the document

Section 2 contains information about the composition of the Home Sweet Home Consortium and of how it was set up.

Section 3 contains information on the project objectives and gives an overview of the purpose of Home Sweet Home.

Section 4 is about the organisation of the project including a description of the healthcare systems, of the assessment methodology and of an additional task which was performed during the last phase of the project.

Section 5 provides an insight about the impact assessment exercises which were conducted at the end of the project.

Section 6 porivdes some overall information about the dissemination activities which were carried out during the project lifetime.

Sections 7 contains the lessons learned from the project

Section 8 contains the implementation guidelines and recommendations which stem out from the project activities and evaluations.

Section 9 contains the conclusions of the project

1.3 Glossary

CIED	Cardiac Implantable Electronic Device
COPD	Chronic Obstructive Pulmonary Disease
CVD	Cardio Vascular Disease
EHR	Electronic Healthcare Record
EHRS2	European Heart Rhythm Society
HRS	Heart Rhythm Society

ICD	Implantable Cardiac Defibrillator
MAST	Model for Assessment of Telemedicine
PHR	Patient Health Record
RCT	Randomised Controlled Trial
SUTAQ	Service User Technology Acceptability Questionnaire
WSD	Whole System Demonstrator (UK project)

2. Consortium

The Home Sweet Home Consortium covers the entire value chain underpinning the Home Sweet Home business model. It comprises 9 different types of players:

- Social Authorities and Health Authorities. They have the responsibility for the delivery of elderly care and represent the natural buyers of the services that Home Sweet Home intends to deploy.

- Social Services and Healthcare Providers. Depending on the specific context of the various countries, the provision of social and/or health care to elderly people can be undertaken by the Social and Health Authorities themselves or subcontracted to private profit and/or not-for-profit organisations.

- Contact Centre Providers. They provide the Contact Centre function and handle the requests, warnings and alarms generated by the Home Sweet Home system; •

- Technology Suppliers. They supply the technological infrastructure (fixed and mobile units, videoconferencing workstations, sensors, software, etc.) upon which the Home Sweet Home service is built. Health and Social care Professionals. They make use of the HOME SWEET

- HOME service to enhance the efficiency of their interventions, replacing, when possible and advisable, physical with virtual presence through videoconferencing.

- Healthcare insurers. In countries with an insurance based healthcare system such as Belgium, they play an essential role in the healthcare provision value chain because they are mandated to reimburse healthcare expenses to citizens and in some cases ("tier payant" system) they settle bills directly to the healthcare providers. Their role is bound to increase also in countries with a public healthcare system in place because of the clear trend to reduce the range of services provided by the public system under the universal coverage.

- Elderly people and the associations representing them. They are the final beneficiaries of the Home Sweet Home service which has been designed to extend the span of their independent living by delaying and compensating for the initial symptoms of mental and/or physical decline. Elderly people will play the leading role in the trials of the Home Sweet Home service and will be represented in the Consortium through their Associations.

- Business Consultants. They develop the business case and prepare the business plan capitalising on their vast experience in the elderly care market throughout Europe.

The members of the Home Sweet Home Consortium are allocated here below to the various categories listed above.

Health Authorities:
- Departament de Salut de la Generalitat de Catalunya (E)
- Azienda USL di Latina (I)
- Health Service Executive North-Eastern Area (IR)
- Louth County Council (IR)

Social Authorities:
- Zorgbedrijf Antwerpen (B)
- Louth County Council (IR)
- Municipalities of the Latina Province

Social Service Providers:
Zorgbedrijf Antwerpen (B)
Zorgbedrijf De VoorZorg (B)
Badalona Serveis Assistencials (E)
Darco Servizi (I)
Louth County Council (IR)
Municipalities of the Latina Province

Health Care Providers:
ZNA -Hospital Network Antwerpen (B)
Badalona Serveis Assistencials (E)
Departament de Salut de la Generalitat de Catalunya (E)
Azienda USL di Latina (I)
Health Service Executive North-Eastern Area (IR)

Technology Providers:
Digipolis (B)
- Klinisch Psychologe St.-Franciskusziekenhuis (B)
- Health Information Management (HIM) SA (B)
- Telemedicina Rizzoli (I) (subsequently taken over by HIM sa)
- Università La Sapienza – CATTID (I)
- Netwell Centre (IR)

Contact Centre Providers:
- Darco Servizi (I)
- Mutas (B)

Healthcare Insurers:
- Christelijke Mutualiteit Antwerpen (B)

Elderly people representative association:
- AGE -European Older People's Platform (B)

Business Consultants:
- Health Information Management SA (B)

Some of the partners appeared more than once in the list above because they had more than one role in the Project as well as in the deployment of the Home Sweet Home which was expected to start at the end of the Pilot Project funded under the CIP.

3.   Project objectives

The Home Sweet Home objectives (HSH) were to trial a new, economically sustainable home assistance service extending elders independent living. HSH intended to achieve this by providing a comprehensive set of services supporting elders in their daily activities and allowing carers to remotely assess their ability to stay independent. While systems of this kind inevitably represent an intrusion in the elders' private life, HSH privileged features which could be used by the elders themselves and limited to a bare minimum the need for other people to interfere with their private life unless a clear need was detected by the system. It comprised a wide range of services addressing the health conditions of the older people, as well as the environmental conditions in the homes and the domotics. The project structure included four pilot sites in Ireland (Louth), Spain (Badalona), Belgium (Antwerp) and Italy (Latina), and foresaw the deployment and piloting of the following services:

- Monitoring and Alarm Handling,
- eInclusion,
- Domotic,
- Daily Scheduler,
- Navigation,
- Mental Faculty Maintaining.

The Monitoring and Alarm Handling is based on a DSS which analyses in real time data collected from medical and environmental sensors, fall detectors and geopositioning systems. Standard behavioural patterns are established for individuals and sudden, major changes trigger alarms.

eInclusion is achieved through intuitive videoconferencing based on the familiar TV paradigm and adapted to use by people unfamiliar with IT technology.

Domotics and Daily Scheduler help elders to organise their daily activities and to manage the house in spite of growing physical and mental impairments.

The navigation system takes people who got lost to the closest safe place.

Cognitive training is implemented through interactive games based on cognitive adaptive technology. Complexity of exercises is adjusted to the performance and current mental level of the user.

The Consortium brings together best of the breed partners from Belgium, Ireland, Italy and Spain with a very strong presence of public authorities with budgetary responsibility for health and elderly care, supported by SMEs. HSH will be run according to the clinical trial methodology (randomises study or RCT) to give credibility to the outcome.

More specifically the Project's Objectives have been formulated as follows:

Objective 1: Improving the quality of life of elderly people by extending their independent life (if they so wish), even if they live alone, while providing a level of safety equivalent or better than that enjoyed in elderly homes.

Objective 2:Improving the quality of life of caregivers and relatives by offering both respite from the care routine because part of their workload can be provided by the technology that HOME SWEET HOME deploys and because of the peace of mind that they can enjoy when they are away knowing that their dears are properly looked after.

Objective 3: Improving the social connection of elderly people confined inside the four walls of their flat or house by allowing them to stay in touch visually with their loved ones and the Contact Centre, even when the former live far away, through an intuitive videoconferencing system which is based on the familiar combination of a TV set and of an infrared remote control.

Objective 4: Compensating for growing physical impairments by easy-to-use domotic devices which make it possible to literally "manage the house from an armchair" if elderly people are no more able to move around.

Objective 5: Demonstrating a more efficient business model for care provision, which reduces the cost of social and health care to elderly people, through better targeting of interventions, early detection of situation of risk and deterioration of mental conditions and closer collaboration among organisation providing care to elderly people.

Objective 6: Exploring alternative work flows which compensate for the ever growing shortage of formal caregivers and homecare personnel through the deployment of affordable, reliable and user-friendly technology.

4.   The organisation of the project

4.1   Pilot sites

Four Pilot sites have been selected for trialling the HOME SWEET HOME solution, according to the following rationale:

Antwerp -Belgium

The City of Antwerp through the Senior.comfort@home project has taken the lead among all the European Local Authorities for forward thinking and action in the field of AAL technologies for extending independent living of elderly people. The Antwerp sub-consortium of HOME SWEET HOME includes all the stakeholders and all the service providers which play a role in elderly care. These have a long tradition of collaboration among them and are interested in seeing how ICT can improve the way they work together and help them to develop cross-organisational workflows for assisting elderly people in a more efficient and effective way.

Badalona – Spain

Badalona offers an interesting example of responsibility for social and healthcare services assigned to a same entity and an ideal test bed for IT-based services which address both fields. In the case of Badalona collaboration and coordination of health and social services is not an issue because they are both provided by the same organisation but, even so, HOME SWEET HOME is expected to play a major role in streamlining the elderly assistance process and in increasing the efficiency and the effectiveness of the services offerered to resident senior citizens.

Latina - Italy

Regione Lazio, to which the Latina Province belongs, has shown particular sensitivity towards the issue of extending independent living of elderly people. The Latina Province in particular offers an interesting scenario for AAL projects because of the characteristics of its territory mostly rural with a nice mixture of flat land, mountains and islands. HOME SWEET HOME in the case of Latina represents a logical evolution of the experimentation launched by the Local Health Authority (A.S.L. di Latina) of a new assistance model for frail and non-autonomous individuals which overcomes the concept of service provided "on demand" by shaping the organisation and the management of the services provided to the individual with the aim of meeting the entire set of needs of each individual. Such a model implies a "proactive" approach to assistance and an evaluation of the overall needs of the individual without waiting for these to be formulated in a demand for immediate intervention because an emergency situation has occurred. The experimentation described above is located in one of the Health District belonging to ASL and it is conducted in close collaboration with the municipalities which provide the social part of elderly assistance. As a matter of fact and for reasons qhich will be explained later on in the document, this site has undergone a number of severe difficulties which have reduced its contribution to the statistic elaboration of results.

Louth – Ireland:

Ireland has been particularly active in elderly care and in the integration of health and social services, The HOME SWEET HOME pilot in Ireland builds upon existing initiatives such as the Nestling Project – a collaborative initiative between the local authority, the HSE NE and DkIT and aimed at promoting the fusion of integrated community care models, sustainable environments and technologies to support ageing-in-place and the Transformation Programme aimed "to enable people to live healthier and more fulfilled lives" of which HSE NE hosts the pilot

The Consortium is convinced that the four pilots sites selected for the trials of HOME SWEET HOME were well representative of diversity of situations which can be encountered in the European Union where there is no single model for the provision of elderly care. This, in turn, should have allowed distilling from the HOME SWEET HOME trials, necessarily limited in number, lessons of general validity and formulating implementation guidelines which, with minor adaptations, can be adjusted to local scenarios. The guidelines have been obtained by analysing the experience of the various stakeholders in the different trial sites. Most of these stakeholders are actually part of the project implementation team itself. Those who are not have been interviewed to collect their opinion and understand the Those who are not will be interviewed to collect their opinion and understand the difficulties and problems that they have encountered during the deployment of the services.

4.2   Assessment methodology

The assessment of the HOME SWEET HOME project is based on the Randomized Control Trial (RCT) methodology in which definite outcomes in an intervention group are compared to outcomes in a control group, and which are considered to be the 'gold standard' for measuring the effectiveness of health interventions. RCTs are always prospective and evaluate observations that are collected during the trial with participants that are selected at trial beginning or during the trial. Participants are assigned randomly to an intervention (in this case Home Sweet Home telemonitoring) group and a control group that receives usual care. The control group is evaluated in the same way as the intervention group. Randomisation is performed separately for each trial site by a central operator or institution (in this case the Medical Coordinator) who has no knowledge on the participants identity, but has knowledge of basic participants characteristics such as age, sex and medical diagnoses in order to avoid imbalances between the intervention and the control groups.

The Home Sweet Home trial followed international guidelines for RCTs which have been defined in the following publication:

- The revised CONSORT statement for reporting randomised trials: explanation and elaboration. Altman et al, Annals of Internal Medicine 134: 663 (2001).

Since these guidelines have a major focus on pharmacological trials, a recent extension was published for better coverage of the needs of non-pharmacological trials, such as the Home Sweet Home one:

- Extending the CONSORT statement to randomised trials of non-pharmacologic treatment: explanation and elaboration. Boutron et al, Annals of Internal Medicine 148:295 (2008).

Both publications were followed in the design of the Home Sweet Home trials and in the definition of the clinical impact indicators.

The Home Sweet Home assessment is centred around the goal of measuring the real impact of the monitoring, cognitive training and eInclusion services on the quality of life of elderly people, the cost of social and health care delivered to them, and on a number of social indicators.

The primary and the secondary outcomes to be measured during the trials have been selected from the following list of indicators:

- Number of falls.
- Number of femur fractures.
- Number of temporary transfers to elderly or nursing homes for respite care.
- Number of permanent transfers to elderly or nursing homes.
- Number of hospitalisation episodes.
- Average length of stay in hospital.
- Number of consultations with GPs and specialists.
- Number of accesses to Emergency Rooms.
- Health related quality of life as assessed by the SF-36 questionnaire, at the beginning, at midterm and at the end of the trial period.
- Depression as measured by HADS.
- Survival.

Measurements for elderly people belonging to the Study Group have been retrieved by authorised users having the right to know at any time by accessing the Portal where data are securely stored.

In addition periodic reports have also been generated automatically. The same however is not true for elderly people belonging to the Control Group. Taking measurements for them is a time-consuming exercise requiring home visits by healthcare professionals and this could disrupt the daily routine of these people in compensation of no real benefits from participating in the trails other than the conscience to do something useful for the elderly people of tomorrow.

For this reasons, measurement taking for comparison between the two groups has been kept to the minimum compatible with the quality of the results and has been conducted at start, halfway and at the end of the trials. Satisfaction with the use of the service for all the other categories of users has been assessed using questionnaires specifically designed for each category of users because of the different interests that these categories have.

In order to eliminate the influence of other factors on the results of the pilots, the trials have been organised as a randomised study, where elderly people meeting the criteria for being part of the trials have been randomly allocated to a Study Group (those receiving the actual HOME SWEET HOME service) or a Control Group (those not receiving the HOME SWEET HOME service but used for comparison purposes).

Although this method can be seen as cumbersome for a project which is not by its nature a clinical trial, rigorousness in the assessment of the impact is absolutely essential to bridge a gap in the literature of studies measuring outcome of monitoring, cognitive training and eInclusion services combined together and with non-technology based services. Data on the outcome form the core of the business case for the long-term viability and the large-scale deployment of the service.

As a result of the above the project's impact has been evaluated in the following predefine areas (in brackets the corresponding deliverable):

- Clinical & Quality of Life impact (D3.8, including D3.9)
- Social Impact (D3.10)
- Economic Impact (D3.11)
- User Satisfaction(D3.12)

The findings for each one of these areas are reported in the next section.

4.3 Clinical protocol and preparation for trials in the four Pilot sites

4.3.1 Clinical protocol and preparation for trials - Antwerp

4.3.1.1 Ethical approval

The ethical approval was set up on 24th November 2010.

It was prepared in cooperation between Zorgbedrijf, Digipolis, ZNA, CMA and Voorzorg.

4.3.1.2 Recruitment of the users and random allocation to the intervention or control group

In Antwerp, recruitment of candidates started in the service flats of Zorgbedrijf. In five centres we gave a very extensive demonstration of what the project could mean to a participant. All the devices were shown, and people could ask questions. After that, all interested candidates could subscribe to collaborate in the project.

As we did not find enough candidates at Zorgbedrijf, some participants from Voorzorg and CMA also signed on.

After these subscriptions, the therapists visited the candidates to check the inclusion criteria and to determine the result on the Edmonton Frailty Scale (EFS). At that point, the informed consent was signed.

A few candidates, who had previously subscribed, did not want to continue anymore when they were visited for inclusion. Some were not supported by their family. In Antwerp, we also had the disadvantage that no GP was involved, as they did not want to cooperate in this project.

Another disadvantage was that the potential candidates did not know us at the start of the project. There was no relationship, no trust, the older people still had to get to know us. So there was a lot of doubt, many questions to answer, and many people who did not want to join the project.

This is why the recruitment period took longer than expected. We started the information sessions in 2010, and repeated them until we had found enough people willing to participate.

After participants had been included and signed the informed consent form, their data was sent anonymously to the Medical Coordinator who randomised them into intervention and control group.

This procedure of randomisation was carried out five times in 2011, in five groups, until all the participants were randomised. This happened because we did not find 60 candidates on the same time. It took a period of 5-6 months before we had all participants randomised. The results are stored in a google doc file shared with the project team. At the end of 2011 we had all our candidates.

Unfortunately several randomised participants dropped out immediately after randomisation because they were not included in the group they preferred. Some of them preferred the intervention group, but were included in the control group, and vice versa. This is why in the end we had randomised more than 60 candidates. The drop outs were replaced by new recruits while we were giving the demo sessions looking for new participants.

4.3.1.3 Informed consent form signature

Every participant has signed the Informed consent after the **inclusion criteria** were checked:
- Aged 65 years or over?
- Living at home or in the community, i.e. not in a nursing home, acute or sub-acute clinical or care setting?
- Scoring 'mildly frail' or 'moderately frail' in Edmonton Frail Scale (EFS)?

And **exclusion criteria**:
- Willing to participate (e.g. signing informed consent form)?
- Participant's living situation suitable for independent living? (E.g. in case of a full time caregiver: NO inclusion).
- Physically, mentally or otherwise adequately able to use and / or operate HSH devices / instruments?
- Able to administer self-assessment measurements (e.g. monitoring vital signs; questionnaires)?

- Not having a significant impairment of language comprehension or expression (e.g. aphasia)?
- Not enduring active medical illness with a significant shortened life expectancy (< 6 months), based on mortality prognosis?
- Not living without access to ISDN or ADSL service?
- Not living with another HSH participant in the same home?

4.3.2   Clinical protocol and preparation for trials - Badalona

4.3.2.1 Ethical approval

The Ethical Board that accepted the HSH project as a pragmatic trial for the BSA pilot site was the Clinical Investigations Ethical Committee (from Hospital Fundació Germans Trias i Pujol de Badalona).

Contacts with the Ethical Board of the Hospital Fundació Germans Trias I Pujol for approval of the HSH trials were initiated in April 2010, with a final meeting held on 27th August 2010.The trial was officially approved on 20th September 2010.

4.3.2.2 Recruitment of the users and random allocation to the intervention or control group

Badalona Serveis Assistencials offers health services to more than 400.000 people of the city of Badalona and the neighbouring towns of Montgat and Tiana. It is important to highlight that the setting of the Badalona pilot site is people living in a city environment with most of the population having a medium – low socio-economic profile.

To start the recruitment from such a big group we decided to select only those people that were 1) living alone and 2) over 65 years old. At this point, the eligible sample was up to 985 people.

In the next step for selection, we decided to search the target population that fit the inclusion and exclusion criteria, but limited to people living in the two main primary care areas of the city. Doing it in this way we achieved:

- Same people distribution, as the primary care areas had all population groups.
- Closer people distribution that led to an easier installation and monitoring phase.
- Centralised centres to contact primary care staff (nurses, social workers and practitioners) that helped with the adherence to the project.

At this point we had a smaller sample of 109 eligible candidates. We then performed a round of randomised phone calls to give a general description of the project and to ask 9 of the 11 questions of the Edmonton Frailty Scale, the essential scale for the inclusion criteria, followed by two home visits to those who met inclusion and exclusion criteria. Contact steps:

- First telephone contact: Project presentation and contact details, Exclusion criteria, EFS (except clock test & walking test); arranging a home visit (relative informed).

- First home visit: Exclusion criteria, EFS clock test and walking test. Inclusion criteria. If possible Informed Consent Form signed.

- Second home visit: Informed Consent Form signature, (visit with relative had to be arranged).

At this stage, 20 participants had been selected that we could include in the first centralised randomisation process. We had to search in a third primary care area to find the next 10 participants, randomised in the second centralised randomisation process.

4.3.2.3 Informed consent form signature

The signature of the Informed Consent Form had to be preceded by the adaptation / translation of the general Consent Form to Spanish and Catalan.

The signature could be done in some cases in the second home visit, always with the presence of a relative. If this was not possible, the signature was done when the platform was deployed in the house, before the start of the trial.

All participants, both control and intervention group participants, signed the informed consent form after being told about the conditions, requirements and rights they assumed when accepting participation.

4.3.3 Clinical protocol and preparation for trials - Louth

4.3.3.1 Ethical approval

Ethical approval was applied for by Rodd Bond of the Netwell Centre through the HSE and DkIT research ethics boards in August 2010 and confirmation was received in February 2011.

4.3.3.2 Recruitment of the users and random allocation to the intervention or control group

In Louth, candidate selection was chosen from three approved lists:

1. HSE community care list: this is a list of all clients in receipt of home help services within the Louth Local Health region.

2. LCC housing list: this is a list of all clients residing in local authority housing.

3. Netwell network list: this is a list of vulnerable older people in County Louth who had interacted with the Netwell Centre (and in particular the Cultaca service) since 2006.

The Public Health Nurse (PHN) or the medical co-ordinator and the research team visited each individual older person to assess their interest in the project and to allow participants to discuss the implications further with their families. From this a list of 228 potential participants was drawn up.

A second visit was organised from this list to assess each participant using the prescribed Home Sweet Home inclusion and exclusion criteria. Results from the Edmonton Frailty Scale excluded a large percentage from the HSE and LCC lists –

the HSE candidates being generally too frail and the LCC candidates being not sufficiently frail enough. Those who met the inclusion criteria were then asked to sign a consent form.

Each candidate identified their General Practitioner and a letter was sent to each GP informing them of their clients' choice to participate in the Home Sweet Home project and inviting them to get involved also.

Participants were randomised in three different groups as they were recruited in March, July and August 2011. The participants were immediately informed as to which group they were allocated to, and the implications. Participants were then given further time to reconsider their decision. A total of five participants dropped out at this stage, and hence the final randomisation in August 2011 was required to reach 60 candidates.

The Intervention Group were invited to view the test laboratory facility in DkIT in July 2011 with their families. Demonstrations were held showing how each device operated and how contact was made with the call centre.

4.3.3.3 Informed consent form signature

All participants, whether in the intervention or control group, signed the informed consent form at the outset of the project.

4.3.4 Clinical protocol and preparation for trials - Latina

4.3.4.1 Ethical approval

The ethical approval was given in March 2011.

It was prepared by ASL Latina and specifically with the contribution of Monti Lepini District Direction.

4.3.4.2 Recruitment of the users and random allocation to the intervention or control group

Potential participants were selected starting from a list prepared by GPs in the Monti Lepini area, where the trial was started. Taking into account the inclusion criteria set out in the CT documents, GPs selected from their patient lists those that were suitable for the trial.

Using this list, staff from ASL Latina visited each one in order to verify the adherence of candidates to the inclusion and exclusion criteria for the trial. In these visits, the project was explained to the patients, and any questions from them or their relatives were answered in order to give them a full understanding of the project aims, and the implications of their participation.

After the inclusion and exclusion criteria had been verification, and the patient had confirmed their participation, the informed consent form was signed, and he/she was included in the trial. Their data was then sent anonymously to the Medical Coordinator who randomised them into intervention and control group.

This procedure of recruitment and randomisation was carried out three times in 2011, in three groups, until all the participants were randomised. This happened because we were not able to find all the candidates at the same time. It took a period of 5-6 months before we had all participants randomised. At the end of 2011 all candidates were recruited.

63 patients were randomised, but before the study start there were three drop outs in the control group, and two in the intervention group. The final numbers were 58: 30 in the intervention group and 28 in the control group.

During the trial to date, we have had one patient who passed away; currently there are 29 in the intervention group, and 28 in the control group.

4.3.4.3 Informed consent form signature

Every participant has signed the informed consent form once the inclusion and exclusion criteria were checked:

4.4 Equipment installed

All sites provided both medical devices, including blood pressure meters, weight scales, glucometers, and oxygen saturation meters, and environmental devices, including smoke detectors, water detectors, motion detectors, and temperature monitors.

Other devices included the Mambo personal alarm, and ello! videoconferencing system, though this was not widely installed.

Although home automation equipment was tested, it proved difficult to install it, either because it would not work with the windows, doors and radiators in participants homes, or because the physical modifications necessary were not acceptable.

4.5 An additional, unforeseen task performed: the Qualitative Analysis

One of the remarks following one of our project reviews consisted in gathering qualitative information about the HSH users and their feeling about the project. Therefore a qualitative analysis was set up and together with the support of the Advisory Board and Age we have produced a publication on the outcome of a small qualitative study that took place within the Home Sweet Home user group. The study aimed at shedding the light to barriers and enablers for the acceptance of new technologies that where introduced to help older persons live autonomously and manage better their health. It is written from the perspective of older persons who use technologies in their everyday living and it is addressed to all the stakeholders who are involved in the development and deployment of such solutions : researchers, service providers, industry and SME's, public authorities, health and social care professionals, informal caregivers, insurers and mutualities and older persons themselves. Instead of discussing elements specific only to the

project, the publication is drafted in a way that can be useful to various similar settings and sets of services.

First some information about Home Sweet Home and the study is provided. Then the results of the study are summarized as answers to the questions : who are older persons and what matters to them? In the end, recommendations for future research and practice are given, before presenting the case studies, which were analysed in order to reach conclusions and lessons learned.

5. Impact assessment in the predefined areas

In this section an abstract of the impact assessment for each one of the areas defined at the end of the previous chapter is provided.

5.1 Clinical & Quality of Life impact

In the Home Sweet Home trials, the Home Sweet Home services are intended to have a positive impact on both the clinical aspects of treating chronic conditions (diabetes, COPD, and cardio-vascular diseases) and on the health-related quality of life of elderly people.

The four trial sites used two questionnaires, SF-36 and HADS, to evaluate changes in participants, together with a number of other questionnaires; a number of clinical indicators were also collected.

The results of the clinical impact assessment may quite possibly have been affected by the quite high level of drop-outs, probably as a result of the inclusion criteria including only frail citizens as measured by Edmonton Frail Scale (EFS).

While many of the tests administered have not shown any significant difference between the control and intervention groups, there does appear to be an improvement in the SF-36 MCS (Mental Component Summary) score for the intervention group, as compared to the control group. This is somewhat weaker than in the Dreaming project, but shows basically the same pattern. Thus, findings again show a positive effect in mental health and well-being.

5.2 Social Impact

Social Impact Assessment (SIA) is the process to estimate in advance the impacts on the day-to-day quality of life of persons and communities whose environment is affected by a proposed project.

HSH has the objective to evaluate whether providing integrated care assistance substantially prolongs the time that older people can live independently at home, thereby producing clinical benefits to its users and economic benefits to the health and social care authorities.

The project has selected the following main domains for the assessment:

- Individual: socialisation, leisure and free time, physical activity and sport, job and requests, travelling and transport.
- Family: security, communication, burden, saving resources, the relative independent life viability.
- Community: community offer of services, community social features, social services in community.

Questionnaires were compiled to complete a comprehensive assessment of the project outcomes in the social arena. They were used to capture and analyse changes in social indicators by contrasting the baseline situation with the situation following the HSH intervention, and by comparing the measures in the Intervention Group with the Control Group.

The main results and conclusion are:

- Within the personal domain, participants clearly did not feel that relationships with people around them had deteriorated. In the other areas, the intervention group was perhaps marginally more positive than the control group, but this could not be considered significant. And the great majority of participants felt HSH technology made no difference to the areas considered.

- For the family domain, the intervention group felt their level of security had improved more than the control group, together with the capacity of independent living. Otherwise the results were either neutral, or not negative. While the majority of participants felt HSH technology made no difference to the areas considered, at least some felt it had promoted security and independent living, consistent with the other results.

- In the community domain, the only area to show agreement was the need for more services to support independent home living, though Antwerp did not see this need, possibly because participants were already living in special residential apartments. Again, while the majority of participants felt HSH technology made no difference to the areas considered, at least some felt it would promoted independent living, and to a lesser extent information and communication.

5.3 Economic Impact

The project has identified a number of indicators to assess the economic impact of the HOME SWEET HOME (HSH) Services.

HSH expects to find tangible and intangible benefits, but evaluating the economic impact of the latter has been excluded; the quality of life impact indicators and possible improvements are addressed in other deliverables.

The economic factors can generally be divided into three levels:
- user (savings / costs);
- organisation (public, private, profit, non-profit); and
- global (national/regional/local (municipal)).

In this study, we have focused on the user level, though we are convinced that improvements for individuals benefit global societal interests too.

In terms of economic impact:

- Since the data did not show any reduction in use of these healthcare resources by participants in the intervention group, no economic benefit from this source arose.

- Since no significant changes to workflow were identified, no economic benefit from this source arose.

However, some of the sites intend to analyse the impact of the potential changes to workflow that introducing HSH services could enable.

The results above are in sharp contrast with those obtained for DREAMING a couple of years earlier. This cannot be due to the difference in the basket of services provided because in HSH this is even more comprehensive than that deployed in DREAMING.

Therefore, the difference can only be due to the different inclusion criteria used in HSH (age and frailty) compared to DREAMING (age and chronic conditions). In other words, the results indicate that, once an older person has reached the level of "mildly frail" or "moderately frail" according to the Edmonton Frail Scale, his/her level of frailty is such that the support the technology can give is not sufficient to influence the use of health and social care resources.

The outcome of HSH suggests that, to achieve sustainability when deploying ICT-based services for older people, age and existence of chronic conditions should be used to identify people to whom the services are offered. On the other hand, moderate or higher degrees of frailty according to the Edmonton Frail Scale should be considered reasons for excluding people from the deployment. Mild frailty is probably a grey area where further analysis of data is required to determine if it is worth including these people in the deployment.

5.4 User and Health Care Professionals Satisfaction & Acceptance

There was a good response to the acceptance questionnaire from participants, with 52 questionnaires completed, 17 from Antwerp, 9 from Badalona, and 26 from Louth.

On the whole, the feedback from patients was positive.

- Most participants used the equipment weekly or daily, and were satisfied with the system as a whole.

- Participants in Badalona appeared to have slightly more problems with the Mambo and environmental sensors, while Antwerp users had a little more difficulty with the health sensors. However, participants in Louth definitely found the games less useful than elsewhere.

- On the other hand, participants in Badalona agreed more strongly than the other sites that the equipment improved their quality of life, and with Louth that it increased their self esteem.

- Most participants in all sites agreed that had a stronger sense of security, and also reported a minimal impact on their everyday routine and social life.

Despite the overall positive response, participants are not prepared to pay for the HSH equipment and/or services.

41 relatives completed the questionnaire, 17 from Antwerp and 24 from Louth.

It is probable that the satisfaction of relatives was affected by two points:

- First, the majority of relatives used the equipment either never, or only rarely. As a result, there was a high percentage of "neutral" responses.

- Second, because the participants in Antwerp were drawn from accommodation specifically designed for older citizens, relatives in Antwerp felt less need for the support provided by HSH services, and thus perceived less benefit, than relatives of participants in Louth.

In common with the participants, relatives are not prepared to pay for the HSH equipment and/or services.

29 HCPs completed the questionnaire, 21 from Antwerp, one from Badalona, and seven from Louth.

With regard to HCPs, a majority also used the equipment either never, or only rarely, especially in Antwerp. This will most probably have affected their responses. Nevertheless, despite the fact that HCPs in Louth were rather more negative about the equipment itself than their colleagues in Antwerp, they were slightly more positive about its impact on patient care and their own job.

6. Dissemination activities

Dissemination activities have been very intense across the project lifetime, and have been reported in detail in the annual progress reports and WP2 deliverables. Only some relevant highlights are reported here.

The dissemination activities have been designed based on a thorough stakeholders' analysis which is depicted in the following picture:
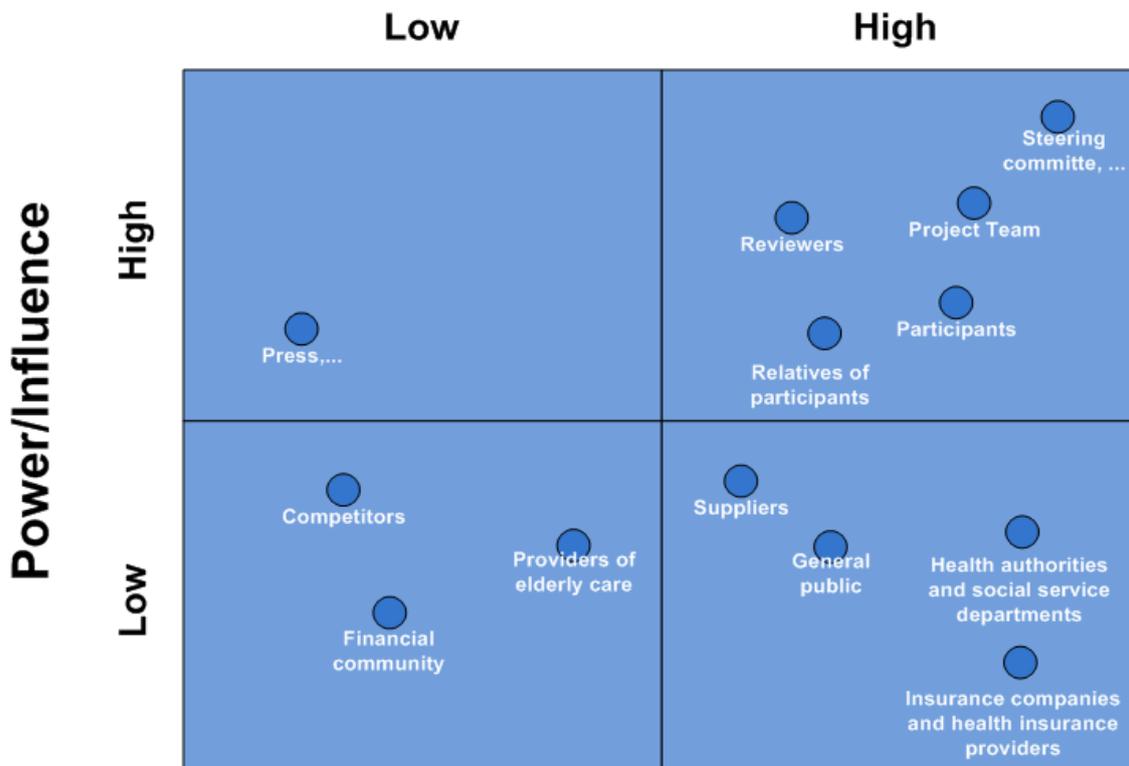
All the subsequent activities have been carried out according to the categorisation of stakeholders deriving from this scheme.

It must be noted that the retention strategy, aimed at reducing the number of dropouts, has been based on the upper right quadrant of this picture, and in particular on taking care of the relationships with older people and their relatives,

The first activity has been the development and start up of the project Website which is still operational and will be kept online at least until the end of 2015 at: http://www.homesweethome-project.be/

Also in terms of communication tools the project leaflet has been produced and updated.

The Home sweet Home project has been presented at a very high number of public events such as conferences and workshops, and the foreseen number of **events has been organised by the project team itself**, namely:

- Press conference held March 2010 in Antwerp by Zorgbedrijf and Digipolis with several publications in local and specialised media;

- Midterm Workshop - The HSH Midterm Workshop was held on the 17th of January 2013 at the premises of the'AGÈNCIA D'INFORMACIÓ', Avaluacio I Qualitat en Salut Premises : Roc Boronat 81-95.

- Final Conference - The Final conference of the HSH project was held in Barcelona on16 January 2014 and it was called:

  ENABLERS FOR SUCCESS - E4S CONFERENCE (ICT support to Active and Healthy Aging: Paving the way from pilot to the Market)

Video on HSH

- In May 2012 a number of videos were developed in order to inform our stakeholders about HSH:
  - A day in the life of some of our participants (we followed some of our participants during a day in order to show the public about HSH, how it is being used, what it means, …);
  - A video about the project with short interviews with team members and users;
  - A short video per item in order to present the means and use;
  - A short video about the installation

- The videos were released in May-June 2012 after being translated into Italian, English and Spanish.

- These videos were displayed and published on:
  - HSH Website;
  - YouTube;
  - Websites of the HSH partners;
  - Facebook pages;
  - Linked-in pages;
  - Shown in several occasions as, e.g. at the Midterm Workshop

7. Lessons learned

7.1 Introduction

This section details the experiences of the four pilot sites over the course of the Home Sweet Home project, and lists the challenges encountered and the potential solutions in order to guide similar projects in the future.

7.2 Target population

The Home Sweet Home project planned to deploy the full range of devices and services to all participants at the outset. This required the introduction of exclusion criteria that, while useful when researching the use of some devices, precluded a section of the general population liable to gain the most from other devices.

The prime example of this is the navigation system attached to the Mambo unit. Designed to guide participants who are confused or lost, this tool would be most beneficial to older people who suffer from cognitive impairment. However, a specific exclusion criterion in the Home Sweet Home project was dementia, due to the requirement to be able to take medical measurements and complete questionnaires.

Initial criteria in terms of trial participation should be reviewed and aligned with the solution being tested, for example:

- Telecare domotics and the Mambo navigational portal may be useful solutions for participants with cognitive impairment issues.

- Homematic devices may be most useful for participants with severe physical impairment. Inclusion criteria should allow for participants who have high frailty scores if the deployment of Homematic solutions is possible.

- Other considerations, such as education and socio economic levels, should be tested in order to inform the future marketing strategy.

7.3 National rules and legislation

In order to understand the value of the service going forward, it is important to fully consider the implications of national rules and laws that must be taken into account, for example:

- In Belgium the fire brigade is not obliged to respond to a call from the Call Centre, for example if a smoke detector alarm is registered. Some fire brigades will react to the call; others will not.

- With the advent of the Cloud, care must be taken that using this does not breach data privacy rules (e.g. when medical data must not cross national borders) and that the encryption systems necessary are robust enough to prevent hacking.

- Differences in national reimbursement systems influence the success of the system. For example, how GPs are compensated, is telehealth monitoring recognised as a reimbursable service, do health insurance companies provide health plans that can include monitoring and self management.

- Public procurement regulations must be observed.

7.4   Organisational issues

7.4.1   Service segmentation

While every person has individual requirements when it comes to tele-monitoring, it will be helpful for any organisation looking to deploy these types of services to define the typologies or segmentation of the potential users. For example:

- Domotic devices may be suitable for very frail persons, or persons with early stages of dementia.

- Vital sign monitors may be difficult for very frail persons or those with dementia, but would certainly be suitable for persons with a chronic health condition.

- The setting (rural v. urban) may also be relevant in terms of broadband coverage and telephony.

- The digital divide problem should be taken into account when deploying tele-monitoring services to a cohort comprised of those who are not particularly IT literate. Where the target population has no or little familiarity with technological devices, a specific training phase should be considered in addition to closer assistance during the service implementation phase.

7.4.2   Service reimbursement

It is vital that the appropriate healthcare professionals are involved in the tele-monitoring of vital health signs. This can create problems when these healthcare professionals are only reimbursed when face-to-face consultations take place.

In these healthcare systems, it is vital that this issue is addressed and solved before contemplating deployment of tele-monitoring of health parameters.

7.4.3   Health and social care coordination

It is important to coordinate effort between health and social care providers. While not all participants using tele-monitoring will be receiving care from both, many will, and opportunities for improving care delivery more economically will be lost without such coordination.

7.5 Connectivity

7.5.1 Broadband coverage

In some more remote, rural areas, broadband coverage can be poor, with low bandwidth and speed, or non-existent. This clearly has an impact on whether or not tele-monitoring services can be deployed successfully, although alternatives (e.g. UMTS, 4G) may be an option, subject to cost implications.

In addition, even where the broadband service is sufficient, installation lead times can be long. While this impacts on how quickly tele-monitoring services can be implemented for an individual older person, it should not have longer term consequences.

Some broadband providers apply a cap on usage in order to reduce costs to the consumer under certain tariffs. It is important to be aware if this cap is set at a suitable limit for the participant's home, bearing in mind other devices using the home broadband connection.

7.5.2 VOIP

The Consortium has discovered that some broadband suppliers restrict the use of VOIP. (This appears to be linked to whether the broadband supplier also supplies normal telephony services.)

This prevents the use of videoconferencing, but is also dependant on the choice of broadband tariff.

7.6 Equipment related issues

7.6.1 Batteries

Battery life is an issue for any battery operated devices that need to be installed to provide HSH type services. Anyone wishing to implement these services should explore this issue thoroughly with their device suppliers.

7.6.2 Equipment reliability

The field of tele-monitoring equipment is rapidly developing, with new devices coming to market all the time. While these new devices may have enhanced functionality, their long term reliability has no track record.

Procurement needs to take this into account, either through selecting suppliers with a good demonstrable track record in their other equipment, or through the contract terms that are included, e.g. Mean time between failures (MTBF).

In any case, all devices should be tested thoroughly before use in the project (e.g. BPM, temperature and glucometres) with adequate supplier guarantees in place.

All pilot sites in the Home Sweet Home project felt it was a necessary to have a dedicated maintenance staff member on the team in order to visit participants and make minor repair to equipment – rebalance scales, change batteries, move smoke detectors, reboot InTouches etc.

7.6.3 Device selection

It is important to tailor the selection of devices to the needs of the older person. In particular, there is no value in providing devices for which the older person sees no purpose or benefit, although the Project did find that this view could change after experiencing the devices.

The ultimate goal should be to move to a position where the devices are integrated into the normal way of living. For example the functionality of the Mambo should be incorporated into the functionality of a standard mobile phone.

7.6.4 Medical devices

The choice of medical devices provided was based on participants' pathologies. However the functionality of some of these devices was questionable, e.g. the blood pressure monitor can be difficult to apply to the upper arm for older people with dexterity problems or obesity, and with the ECG device, it can be difficult to obtain an accurate reading.

An additional consideration to observe is the battery life between charges.

7.6.5 Domotic devices

The water leak detector must be positioned carefully, as it can be dangerous to place it loose on the floor – the user could trip over it, or hurt him/herself by stepping on the pins. One solution may be to stick it to a wall in the bathroom, but still touching the ground.

Smoke detectors must also be positioned carefully, especially in small apartments, to reduce false alarms to a minimum. In addition, consideration must be given to how the user can disarm the detector in the case of a false alarm. Standing on a chair to do this may not be safe for an older person. One solution might be to include a switch (with wifi) to turn off the audible alarm and avoid the risk to the person and the device.

Unfortunately, the Homematic devices were not suitable for installation in the study groups' homes.

- Winmatic and keymatic devices require holes to be made in windows and doors respectively, which may not be acceptable to persons, either because they are renting properties, or because they do not want to damage the windows and doors.

- Winmatic does not work with sash (vertical sliding) windows.

- Climatic devices cannot be fitted to some radiators, and are not suitable for electric storage heaters at all.

In this case, alternative solutions will be needed. For doors, one option is an online door with badge system that can be opened from distance. The Antwerp site observed a very positive response from older people in relation to operating a badge system. It also should be noted that at a certain age it can become difficult to unlock a door using the key – a badge, therefore, is a very good alternative.

7.6.6 Platform independence

Increasingly, there is a need to consider platform independence especially in relation to the InTouch central unit, as potential users may choose to use their own interface devices with which they are more familiar (e.g. iPad, tablet, PC, smartphone, etc.). While this may reduce the investment in hardware, it may increase the complexity of the software environment.

7.6.7 User Interface

It is not important for participants to be aware of the intricacies of the solution design nor the back office portal. Interfaces need to be simply designed using coloured buttons on an uncluttered page.

The *ello!* solution proved very complicated with participants. While the Consortium is in agreement with the merits of the concept, the e*llo!* interface needs to be reconsidered before a successful deployment is possible, especially given other possible alternatives available off the shelf.

7.7 Operational issues

7.7.1 Alarms & alarm protocols

7.7.1.1 Temperature

The pilot sites are based in regions with vastly different average temperatures. For this reason, a generic alarm management policy is not always valid. For example, low temperatures are not a danger in the coastal areas of Mediterranean countries, while high temperatures are not a concern in Northern European countries.

Also, temperatures can be lower than normal at night without needing to generate an alarm.

7.7.1.2 Other

The portal is not capable of receiving automatic alarms from the Mambo device and keyfob when their batteries are low. This represents a reliability gap with the system.

When monitoring vital health parameters, it is important to set thresholds and limits appropriately. E.g. a higher blood pressure is only relevant when it is consistent over a period of time, or if it is excessively high (Type 1 and Type 2 alarms). Individual measurements should be interpreted with caution and in conjunction with

parameters agreed with health professionals. Alarm protocols must be defined to take this into account.

7.7.2 System functionality

The Daily Scheduler should have the ability for the older person and his/her relatives and friends to add/amend events on the schedule.

Another possible improvement would be the addition of more games in existing formats, such as Solitaire and Sudoku. These have the advantage that there are no language or cultural issues associated with them.

There is a requirement for the inTouch to be on the home screen mode when taking readings or else they are not recorded. Also, if readings are not confirmed by the participant, then they are not received by the portal and therefore no alert is triggered.

In order for the Call Centre to have a greater understanding of the needs of the older person, it would help if the portal had a section where operators could read some general information on the participant – living alone with a pet, diagnosed with mild dementia, recently returned from a hospital stay. The levels of access to this information would need to be determined in conjunction with national guidelines.

The navigation system on the mambo portal is a good concept in terms of assistance to older people with cognitive impairment. However, the pilot sites encountered a some areas that would need improvement:

- The map updates at a slower than expected speed and is dependent on cloud cover.
- The directions given are in an unfriendly / jargon filled manner, e.g. "move north for 150 metres then turn northeast on the R142".
- The directions given give no consideration to the safety of the individual – there were instances during the lab test that the portal was asking the participant to cross a busy highway.

7.7.3 Mambo

Mobile alarm should be more reliable and user friendly:

- The Mambo will disconnect when a long conversation takes place.
- The Mambo holder is not easy to use: cables are too easily disconnected; the weight of the device often loosens them.
- Some users see the Mambo as a duplication of their mobile phone.
- There is no alarm for low battery either on the device or on the portal, and the device will shut down when out of power without any warning.

7.7.4 Training & technical support

Both the participant and his/her family need to be trained appropriately to improve technology acceptance. This training should be adapted to the needs of the participant, and may need several visits and revisits. Understandably, pilot sites need to be aware of the resource implications where intensive training is required.

Literature, in terms of user manuals and training manuals will need to be kept and updated as necessary.

The requirements for ongoing technical support should not be underestimated, particularly in the first few months after installation.

7.7.5 Participant Management

It is a good idea to organise a consultation meeting with the participant, friends, family, healthcare professionals and other stakeholders beforehand in order to provide complete information on the equipment solution. But the older person must not feel they are patronised or under external pressure to adopt the technology. In this regard, expectations are managed especially in relation to technological glitches. Whenever a participant decides to stop using tele-monitoring services, the reasons should be determined and analysed to identify any weaknesses in service provision, training, device functionality etc.

Frustration can also be a caused where multiple calls are being received from the Call Centre either through faulty alarms or inappropriate alarm parameters. (But this is not always true: some participants liked to chat to Call centre staff!) Some participants expressed an interest in having an option button on the InTouch for "Feeling OK / No Intervention Required" in order to avoid unnecessary calls from the Call Centre where the participant is feeling fine or the alert is triggered in error. Flexibility in this approach would need to be considered in cases where the participant is suffering from cognitive impairment.

The pilot sites also found it useful for a team member to contact participants at regular intervals in order to ascertain their feelings with respect to the monitoring and follow up responses. This was useful to feedback to the Contact Centre and an initial identifier of participant frustration.

7.7.6 Summer holidays affecting participants

In certain cultures, both Mediterranean and Nordic, older people often take extended holidays. In the Mediterranean cultures, these tend to be in the summer, to be with their families, which may take place at some distance from their normal place of residence. For the Nordic countries, these extended holidays are in the winter, often relocating to warmer countries or staying with extended family.

This has implications for the use of tele-monitoring, in particular using medical devices. I.e., during this extended holiday, tele-monitoring will not normally be possible, so if necessary, the older person needs to make alternative arrangements through their normal GP protocols.

However, the domotic and movement detectors can still play a useful role in monitoring the home of the older person during their absence (i.e. detecting intruders, fires, etc.), though it is necessary that the older person accurately informs the Contact Centre about their planned absence (giving exact dates of absence and new contact details).

7.8   Display devices

7.8.1   Power surges knocking out InTouch units

Although in general the InTouch units have proved resilient to power failures and accidental unplugging from the mains supply, this is not always the case.

At this stage, the Consortium are not clear whether this is due to the nature of the cause of the power failure (e.g. lightning strikes causing power surges), or the power network itself being susceptible to power surges, either when the power fails, or when it is restored.

This issue can be solved either through the use of UPS or an extension lead with built in surge protection.

7.8.2   InTouch units turned off

Sometimes the InTouch units are turned off by users. In this case, further training & information is needed about the requirement to keep the units turned on at all times, especially to maintain the internet connection.

The effect of the InTouch being powered down can be disruptive, e.g. multiple messages are received from inTouch with previous readings from devices, but the date and time recorded is when the InTouch is powered back up again, and not the date and time that the measurement was actually taken.

The Irish site found that repeated power intrusions can lead to broadband connectivity failures. In order to mitigate against this, the Irish site introduced a CronJob that power-cycles all devices and reconnects them to the internet at 3.00am every night.

7.9   User Acceptance

The Home Sweet Home project produced results showing a majority of users were interacting with the technology solution. However, there were a few reservations drawn from the qualitative analysis that were interesting; these should be addressed to ensure successful widespread deployment.

For example, there was a negative correlation between technology acceptance and the type and quality of existing support and environment. This was mostly seen in the Antwerp pilot site, where the technology was installed in serviced accommodation. Some of the users responded that they felt the solution was only

duplicating existing services and would be of greater use to people living in their own homes in the community.

There was also a feeling from some participants that they were taking part in the project for solely altruistic reasons. This presents a possible barrier for full deployment because altruism is not transferrable to real life situations. In order to ensure more effective results and conclusions, it is important for participants to understand the potential benefits to themselves in addition to society as a whole.

Every effort should be made to reduce the amount of wiring that is needed in the user's home. This can create real resistance to acceptance of these systems. However, the increasing prevalence of Bluetooth, wifi etc. is making this more and more possible.

8. Implementation guidelines and recommendations

8.1 Introduction

This section presents a set of guidelines for other countries or regions who would be interested in deploying the Home Sweet Home platform or a similar service on a wider scale. This information has been provided in Deliverable D4.7 but it is being reported here because it represents one of the most important outmeos of the project.

The approach to implementing a Home Sweet Home type solution should be viewed from both the participant / customer perspective and the region's existing healthcare system. There is an inherent belief that using technology to assist older people to live independently is more cost effective due to the reduction in use of healthcare resources and facilities; however, the qualitative analysis from the Home Sweet Home project would suggest that older people still prefer interaction with other people and not with a computer interface.

Clearly healthcare systems will be motivated by cost reductions and other ad hoc efficiencies to use the Home Sweet Home solution, but what motivations exist for the end user? Maslow's Hierarchy of Needs can be considered a fair representation of a persons' needs and motivations up to the point of retirement, where the need to better oneself is diminished or eliminated. After this point the triangle is inverted (see below). In early retirement, the esteem need and the need to belong are satisfied through membership of clubs or committees and through volunteering. Later, in the final years of life, individuals' needs revert to safety in the home and finally the basic physiological needs of food and rest – the satisfaction of needs mostly associated with long term care. Long term care is costly to society, and can be very disruptive to the individual. The Home Sweet Home solution can address the social and safety needs of older people, thus delaying the necessity to transfer to long term care.
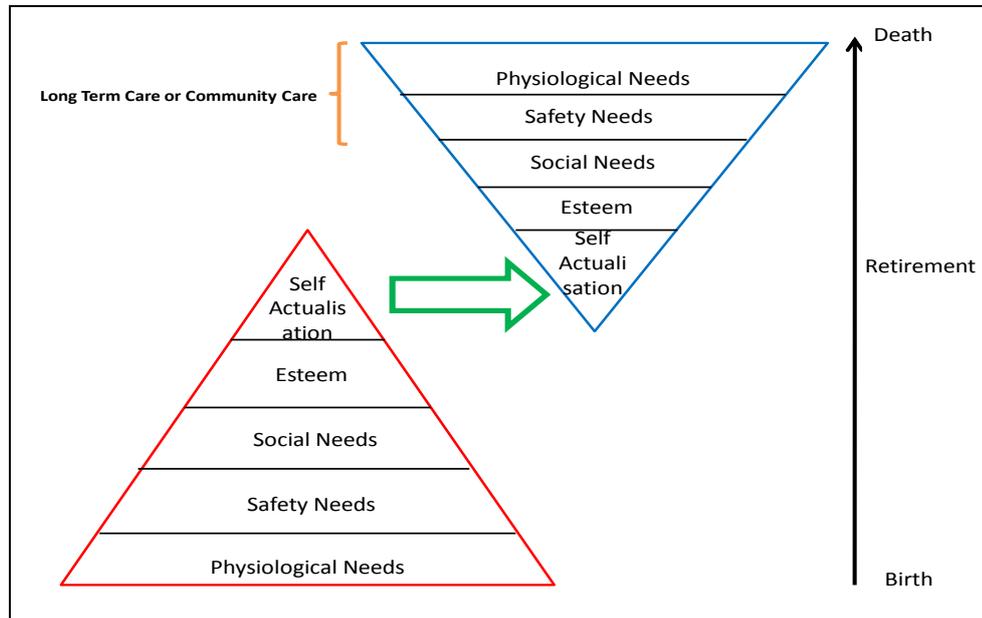
Figure 1: Maslow's Hierarchy of Needs

8.2 Customer Selection

The Home Sweet Home solution pilot was tested on older people over 65 years, who showed no signs of cognitive impairment and who scored within the mildly frail range of the Edmonton Frailty Scale. However, it should be noted that other customer segments can also avail themselves of the services, such as:

- Physically disabled persons.
- Younger participants suffering from chronic diseases.
- Persons with cognitive impairments.
- Persons with severe physical impairments.
- Couples – partners can assist each other in using the devices.

It is important to try and tailor the solution to the needs of the customer. This will require a mass-customisation philosophy whereby only parts of the solution are offered as required, for instance:

- Telecare domotics and Mambo for customers with cognitive issues.
- The e*llo!* system for customers who are housebound and want to stay in touch with family and friends.
- Telehealth devices for customers suffering from chronic physical diseases, depending on the pathology and co-morbidities.
- Homematic devices for very frail customers.

An initial interview or assessment with the customer would be helpful in order to ascertain their motivation for accessing the solution. Further reviews with family

members and their existing care team will help to co-ordinate the person's needs with the relevant device solution.

A further layer to this offering could be an online store presenting further devices with video demonstration accessible either from the InTouch or similar touchscreen device.

8.3   Initial Planning & Installations

The initial planning stage requires an in-depth audit of the customer's home environment and connectivity. It is vital to have both a good quality broadband connection and cellular network in the customer's home. Speed tests should be carried out initially to ascertain whether a different pricing tariff is required from an ISP bearing in mind policies in relation to blocking VOIP.

Customer profiles should also be drafted with names of other contacts (professional carers, family and friends) and keyholders in order to agree escalation paths and update the notes pages on the portal screen. This will also assist in the planning of cognitive games required for the customer.

It is important that care is taken in the installation of telecare domotics, for example:

- The smoke detector will need to be kept away from the cooker in order to ensure everyday cooking emissions are not treated as an emergency fire situation.
- The presence sensors will need to be placed in the areas of the house which the person most occupies.
- The temperature sensor should be placed in the room most occupied by the customer during the day.

Consideration, in terms of placement, should also be given to the need to replace batteries regularly.

The Home Sweet Home project encountered difficulties in placing broadband routers, InTouch devices and *ello!* boxes together. The solution provided required hard wiring these systems together with the participant's television. Future solutions will need to consider a wireless protocol to alleviate the clutter associated with a set-up of this nature.

8.4   Device Selection & Training

One of the major lessons from the qualitative analysis of the Home Sweet Home project was the need to eliminate duplication in devices. This was particularly true in the case of the Mambo unit. While proving to be a particularly useful device, participants also felt that its functions were duplicating their mobile phones. Future service providers should bear in mind that equipment and devices should remain as hidden as possible so as not to disturb the customer's existing lifestyle.

The Home Sweet Home project encountered some technical malfunctions with the chosen equipment that led to loss of faith by some participants. Bearing this in mind, any new devices must be fully tested in order to ensure durability. Appropriate validation certificates and warranties should also be sought from all equipment suppliers, with calibration tests carried out at regular intervals. Importantly, the devices (especially the medical devices) should be tested on older people in order to ensure good quality functionality, appropriateness and a practical GUI.

There is an open question in relation to interoperability of devices. Each potential purchaser will need to weigh up the pros and cons of using a closed proprietary system versus an open plug and play type.

The Home Sweet Home project was four years in duration. Therefore with the progress in technological advancement, it is reasonable to conclude that the equipment tested is now out of date. Taking this into consideration, future deployments will need to be cognisant of new advances in this market and make use of off-the-shelf products, for example:

- Using a small, light and wireless tablet device instead of using the InTouch.

- Using Skype or MSN instead of the *Ello!* box; this would eliminate the need for family and friends to download additional software on their own computers.

- Incorporating the Mambo functions into existing mobile phones such as a Doro.

Most devices tested in the Home Sweet Home project are passive in nature, and require little or no interface with the participant. Other devices, and in particular the medical devices, require user intervention and therefore adequate training. Device training will need to be given individually and not in groups. This ensures that the customer is comfortable with using the device and is not too anxious to ask further questions. Repeat training will also need to be budgeted in cases where the customer requires a refresher course. Consideration should also be given to providing a help function with FAQs on the InTouch (or equivalent). Training could also be given in conjunction with family members and professional carers in order to increase familiarity with the equipment amongst the customer's care circle.

Training and instruction manuals, using plain language and images, are a useful component in improving customer satisfaction levels. These manuals could be in booklet format, or form part of the help function on the InTouch. Coupled with this, healthcare organisations should consider the maintenance support function. Where possible, the customer should be able to build up a rapport with the technician assigned to their account. Therefore, there is a challenge to reduce staff turnover in this area.

Finally, healthcare organisations should be constantly aware of new developments and evolving technologies in this market space. Integration of new developments in a seamless fashion will ensure cost effectiveness in terms of future upgrades.

8.5 Monitoring of Alarms and Intervention Protocols

Customers need to be made aware of the importance of ensuring alerts sent to the Call Centre are suitable, and the escalation paths chosen are appropriate, given the circumstances. Clarifying objectives is a good starting point, for example:

- Responding effectively to emergency situations.

- Managing chronic conditions effectively.

- Minimising the instances of emergency room admissions.

- Reducing or eliminating stress for the customer.

Alarm thresholds should be individualised in order to minimise the number of false positive alerts sent to the Call Centre. This should be seen as an evolving process throughout the lifetime of the service. Maximums and minimums in terms of health parameters should be agreed in conjunction with the customer's GP and other care professionals. Input from the Call Centre can also be useful to learn from existing best practice in terms of environmental alerts.

Escalation paths should be agreed with the customer at the planning stage with the use of scenario testing ensuring zero tolerance for emergency situations. However, despite the planning at the initial stage, it is always useful to review the escalation paths and alarm protocols throughout the lifetime of the service and test for adequacy and appropriateness. A written flowchart and protocols should be signed off by the customer, or a family member, agreeing to the appropriateness of the escalation pathways going forward. Consideration should also be given to national rules in relation to escalation paths leading to emergency services calls.

The Call Centre staff will need to be trained in the use of devices in order to troubleshoot issues with customers over the phone. In order to ensure effectiveness, it is useful for the Call Centre to retain a selection of devices in their office for training and review purposes. A "Go Dark" protocol is also useful where the broadband coverage fails and emergency calls need to be responded to. Risk management plans in terms of power supply and service continuity should also be documented and updated where necessary.

Where Call Centre staff have little or no medical experience, it is vital that robust protocols are in place to ensure that alarms and alerts are dealt with correctly, and that no risks arise because of poor handling. The protocols / handbook must be very detailed in terms of "does and don'ts" in order to make Call Centre staff feel confident when dealing with an alarm, and relieve them of any kind of "medical understanding responsibility".

8.6 Professional Collaboration

First and foremost, these technologies should not be seen as a substitute for personal contact between citizens and their carers and healthcare professionals. Rather, they should be seen as a way of enriching contacts, by reducing the time spent on the more "mechanical" aspects of healthcare and home support provision (e.g. taking vital signs measurements).

In order to effectively deal with chronic physical conditions, it is necessary to have a strong multi-disciplinary team of medical and healthcare professionals working together. Using a technology solution should not be seen as a substitute for this. On the contrary, the Home Sweet Home project showed that the use of technology in the home actually places the person at the centre of this professional care circle. There is strong evidence that where measurements are taken by the older person themselves and alert responses are directed back to the older person, they become more aware of their condition and tend to self manage.

Co-ordinating the care team support can be a challenge, and is dependent on the remuneration process within the healthcare system. Behaviour will tend to follow reward in this instance. For example, where GPs are paid by the State per client by the number of visits, they will be less proactive about managing chronic conditions remotely. Therefore it is important for regions to re-align the reward system for care professionals in order to accommodate remote monitoring and care management from an individual customer perspective.

It is also helpful to engage a professional care circle that is experienced in any of the chronic conditions the customer may have. Where possible, the first recruits should be from existing healthcare workers already familiar to the customer. Regular team meetings are a good idea in order to assess progress and brainstorm new suggestions in order to improve care. There may be changes to existing workflows and responsibilities that will need to be agreed, adjusted and recompensed accordingly, for example, GPs are not required to take vital health measurements anymore and can spend more time on diagnosis and referrals.

8.7   Customer Satisfaction

In terms of the Home Sweet Home solution or similar packages, it is important to acquire and review any feedback from customers. In this instance, the views of internal and external customers need to be considered. Feedback loops are a vital component of good change management practice and are an invaluable source of knowledge to the new structure.

Independent living can expend a lot of resources both technically and on the human front. Therefore co-ordinating effort to the most effective solution is practical. However, the most effective solution does not necessarily mean the best solution for the customer, and can be subsequently rejected. Intermittent anonymous surveys from external customers should form part of the service review with an open mind from the professional care team to consider constructive suggestions for service improvement.

9. Conclusions

The conclusions on the findings of the project at the end of the trials are summarised below.

9.1 Monitoring and alarm handling subsystem

This contributes to the safety of the older person in terms of both their health, particularly when they suffer from chronic conditions, and their physical safety around the home.

Health monitoring

This has been well received, and is probably the most favoured of the services offered.

However, reliability of some of the devices has been disappointing, and battery life is an issue. The latter is related to the use of Bluetooth as the transmission standard. It is well known that Bluetooth is very much energy consuming, but no other standard is currently available from medical devices manufacturers.

Environmental monitoring

These have generally been found to be useful and accepted, though care is needed in where the devices are located, particularly the smoke and flood detectors.

Mambo

A personal alarm device is an important component of the total system, even if it is not used "in anger" very often.

9.2 eInclusion subsystem

This provides videoconferencing services to help include the older person in the society.

Since the inception of the project, services such as Skype have made significant progress into society. While these services do not provide some of the protection for the older person, particularly against unwelcome third party callers, the *ello!* service has not been used very much.

For the future, it is more likely that eInclusion services will be met through existing products available free in the marketplace.

9.3 Home automation subsystem

This supports management of the house by the older person even if he/she suffers from physical impairments, including assistance from the Contact Centre.

It has not been possible to install the device needed to provide this service, due to:

- The devices would not work with the windows and radiators in most of the participants' homes.

- Unwillingness of participants to have the necessary holes made in their doors and windows, especially where homes were rented.

9.4 Daily Scheduler

This is designed to assist in the organisation of the daily life of older people.

In principle, this service was welcomed by participants. However, without the ability for the older people themselves, or their carers, to enter events into the scheduler through the InTouch, its use has been severely compromised.

The InTouch currently does not have a keyboard. However, moving this to e.g. a tablet would remedy this, making it easier to implement entry of events by the older parsons and their carers / relatives if they were allowed to do so (this was not the case in Home Sweet Home).

9.5 Navigation Subsystem

This support the orientation of the older person when outdoor, providing the ability for the older person to ask for directions from the Contact Centre.

However, in testing it proved difficult for Call Centre staff to provide clear enough directions to the older person, and this would be doubly true if the older person is confused. This has been used very little by participants, and at this stage no feedback has been gathered on its use.

9.6 Mental faculty maintaining or cognitive training

This supports the training and maintenance of mental / cognitive faculties, and the measurement of these.

This has proved very popular with the participants, but requires a large investment of effort to create and maintain the exercises, particularly those exercises which are language and culture dependent.

In the future, service providers should seek to enter into collaborative agreements with existing providers of language / culture independent games (e.g. Sudoku, card and tile based games, etc.) but providing more general knowledge type exercises could be more difficult.

However, a new generation of serious games with a more intuitive interface and more oriented to images rather than text could reduce the cost of adapting the tool to the local context.

9.7 Call Centre

The use of a Call Centre is vital to filter calls from citizens, to handle both false alarms and technical issues, which should not be passed to healthcare staff.

9.8 Overall conclusions

The inclusion of the Home Sweet Home solution into the existing health ecosystems has the potential to transform the landscape in terms of both costs and utility.

Personnel

It is not clear at this stage whether staff reductions will occur as a result of the introduction of the Home Sweet Home solution, but the staffing mix will undoubtedly evolve. A new layer of actors will be introduced in terms of Call Centre personnel and telehealth triage staff. However this new layer can help to replace the necessity for regular GP, consultant and clinic visits that are costly to both healthcare providers and the older person.

Hospital and residential care costs

The telehealth component of the Home Sweet Home solution will detect early signs of declining conditions and will, therefore, assist medical professionals with early interventions to prevent emergency episodes. Using telecare domotics and assisted living technologies can prolong the time before the need to move to residential care and reduce the length of time spent convalescing in hospitals. This is particularly relevant considering the average length of hospital stay for people over 65 years is three times longer than people under 65 years.

Quality of Service

Increasingly, evidence has shown that many older people prefer to live in their own homes in preference to residential care. However, quality of care has always been a vital component in this decision. Reducing healthcare budgets are forcing decision makers to consider new and innovative types of care in an effort to maintain current quality. The Home Sweet Home solution is one such innovation, and with the introduction of an added layer of responsibility in terms of the Call Centre, ensures that there is an increase in quality of care.