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Report on Case Studies of Technology-based Services for Independent Living for Older People

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Abstract
This report elaborates five case studies of good practices of technology-enabled services for independent living of older adults at home from the 14 obtained in Deliverable 1 of the ICT-AGE project. The aim is to obtain policy lessons by studying a group of variables related to the creation and implementation of these services by public long-term care systems. These are for example business cases and models, training, scaling and market creation, evaluation processes and organisation change. A case study is provided for each good practice on the basis of the variables analysed.

Acknowledgements

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- From "Advanced Telecare": Eric Morival and Christelle Sartiaux from the Creuse Department (France) in charge of the implementation of the home automation and advanced telecare.
- From "TELBIL":
  - Iñaki Martin Lesende, primary health care doctor in Bilbao (Spain), responsible of the TELBIL projects
  - Juan Carlos Bayón, health economist at the Health Care Ministry of the Basque Region, part of the research team of the TELBIL projects.
  - Jimena Rodriguez from Saludnova (Spain), the company that develops the equipment used in TELBIL
- From "ACTION": Lennart Magnusson, Associate Professor at Linnaeus University, Dept. of Health & Caring Sciences and Managing Director at ACTION Caring
  From "TDP": Alistair Hodgson, Partnership Improvement Officer at the Joint Improvement Team
- From "HAL": Grit Braeseke, head of the socio-economic research of the feasibility study of HAL implementation in RNW

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Preface

This report on case studies of technology-based services for independent living for older people is the second deliverable of the project entitled "Long-term care strategies for independent living of elderly people (ICT-AGE)". The Institute for Prospective Technological Studies (JRC-IPTS)[1] was commissioned by DG Employment, Social Affairs and Inclusion (DG EMPL) of the European Commission to carry out this study under an Administrative Arrangement[2]. The project focuses on one of the actions of the Commission's Social Investment Package (SIP) (2013a), which aims to help the Member States to implement the Country-specific Recommendations of the European Semester for more effective long-term care policies.

This research aims to help DG EMPL guide Member States in the development of long-term care strategies, which use technology-based services to enable older adults to continue living at home independently. These services use any kind of technology including Information and Communication Technologies (ICT) to empower clients to manage despite their frailties (self-sufficiency). They also make it possible to organize the provision of care better and increase the productivity and quality of long-term care delivery (capital substitution for care manpower). The project is being carried out by the research team on ICT for Employability and Inclusion of the Information Society Unit. The project started in May 2013 and ended in December 2014.

The research will produce guidelines for the Member States on how to implement technology-based services for independent living, by:

- Identifying and mapping good practices in technology-based services that help older adults with different needs to live at home independently. These good practices have been successfully implemented in Europe, United States and Japan.
- Analyzing a selected number of good practices case by case, focusing on their business case, business model, technology and organizational change, technical standards, quality, scale and scale-up, and the role the individual Member States and the EU could play as regards leadership and transfer.
- Elaborating manuals on long-term care strategies to help policy makers design policies which help older adults to live at home independently for longer through the use of technology.
- Identifying how the European Union could help the Member States to implement these technology-based services.

Deliverable 1 of ICT-AGE has already been completed and the results published in: *Carretero, S. (2015). Mapping of effective technology-based services for independent living for older people at home. Sevilla: Joint Research Centre, Institute for Prospective Technological Studies, JRC Scientific and Technical Reports Series.* A draft of this report was produced in January 2014 and revised by participants at the First Stakeholders Consultation Workshop of ICT-AGE.

The second deliverable presented in this report focuses on 4 good practice case studies. These were selected in the mapping exercise described in Deliverable 1 of technology-based services that help older adults live at home independently in and outside Europe. We also decided to include a fifth case from the 14 good practices selected in deliverable 1: HAL. Though HAL is a robot in form of a suit that is currently being used in Japan for rehabilitation purposes in institutional settings, it has proved that it could also be used to help older people live independently at home. Its analysis could also provide some hints about the future development of this service in the EU.

[1] IPTS is one of 7 research institutes that form the European Commission's Joint Research Centre.
[2] JRC Nº 33156-2013-05 EMPL D.3

These case studies describe and analyse the business cases, business models, level of integration of services in the care delivery (organisational change), impact evaluation, technology components and technical standards and norms, quality of the service, training actions, scale dimension, and the policy role in the implementation of the service, as well as the effectiveness of the practice.

More information on the project can be found at:
http://is.jrc.ec.europa.eu/pages/EAP/eInclusion/carers_ICTAGE.html

This report may be referenced as follows: Carretero, S. and Kucsera, C. (2015). 'Report on case studies of the technology-based services for independent living for older people'. Sevilla: Joint Research Centre, Institute for Prospective Technological Studies, JRC Scientific and Technical Reports Series.

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EXECUTIVE SUMMARY

This deliverable describes good practice case studies of technology-based services that help older adults live at home independently. These cases were selected from the 14 identified in Deliverable 1 of the ICT-AGE project.

The following **methodology** was applied:

- A sample of 4 good practices was selected from the 14 identified in Deliverable 1 of ICT-AGE according to the availability of data and information in the literature, and how effective they are. We also ensured that practices using the main types of technology-based services from a representative sample of countries were selected.
- The variables in the analysis were defined according to the need to understand how the practices of technology-based services for independent living of older people at home were created and implemented in order to produce a manual for policy makers on long-term care strategies based on technology (D3). After discussion with a group of experts, 10 variables were identified:
    - Business case
    - Business model
    - The technological components
    - Technical barriers
    - Quality assurance of the service
    - Training actions
    - Scaling and market creation
    - Policies and the role of policy to create, implement and scale-up good practice
    - Evaluation process of the effectiveness of the good practice
    - Organisational change: integration of the technology-based service in the delivery chain

  The information on each variable was defined according to consultations of general documents on the topic and internal discussion in the team and with DG EMPL
- A template listing the information to be collected for each variable was elaborated, and a literature review and interviews with case representatives were carried out to collect the appropriate information.
- Finally, an analysis of the information collected was carried out, to elaborate each of the cases.

The **following four good practices were selected**:

- Advanced Telecare: an assistive technology with telecare implemented in France for frail older people.
- TELBIL: a telemonitoring service targeted to chronic patients implemented in Spain
- ACTION: a technology-based home care service for older people with chronic conditions and their carers, implemented in Sweden
- TDP[3]: a telecare and telehealth service for the whole population, implemented in UK.

We also selected a fifth case from the 14 good practices - Robot Suit HAL-5 (HAL). Although it did not match our selection criteria, it was included because of its potential for the further development of this kind service in the EU. A case study is provided for each good practice on the basis of the variables analysed.

[3] In the deliverable 1 of the ICT-AGE project, we use Scottish Telecare as acronym for this good practice. From now on, we are using TDP as the service is better known under this name.

1. INTRODUCTION

This report is the second deliverable of the project "Long-term care strategies for independent living of elderly people (ICT-AGE)". DG Employment, Social Affairs and Inclusion (DG EMPL) of the European Commission commissioned the Institute for Prospective Technological Studies (JRC-IPTS)[4] to carry it out under an Administrative Arrangement[5]. The cases studies described were chosen from good practices of these services mapped in the first phase of the project, and available in Deliverable 1: *Carretero, S. (2015). Mapping of effective technology-based services for independent living for older people at home. Sevilla: Joint Research Centre, Institute for Prospective Technological Studies, JRC Scientific and Technical Reports Series.* This last report was produced in January 2014 and revised in March 2014 at the First Stakeholder Consultation Workshop of ICT-AGE, and finally published in January 2015.

This second deliverable elaborates 4 case studies of good practices in technology-based services for independent living of older adults at home. These were selected from the 14 obtained in Deliverable 1. We have also included a fifth case - HAL, which was also chosen from the 14 good practices identified in Deliverable 1. HAL is a robot in form of a suit that it is currently being used in Japan for rehabilitation purpose in institutional settings. However, it could also be used for independent living at home and provide some hints about the future development of this service in the EU. These 5 case studies will describe and analyse the business cases, business models, the level of integration of services in care delivery (organisational change), impact evaluation, technology components and technical standards and norms, service quality, training, the scale dimension, the role of policy in the implementation of the service, and the effectiveness of the practice.

This report will contribute to the elaboration of manuals with guidelines for the Member States to design long-term care strategies than can increase the capacity of older adults to live independently even when they become frail or contract multi-morbidities, by using technology in ways identified in studies of good practices (objective 3).

In this section, we have explained the background and structure of this report. In Section 2, we explain the methodology. Section 3 offers a detailed case by case analysis of each good practice. Annex 1 contains the template used to collect the information on each practice.

This report may be referenced as follows: Carretero, S. and Kucsera, C. (2014). Report on case studies of the technologies for independent living for older people. Sevilla: Joint Research Centre, Institute for Prospective Technological Studies, JRC Scientific and Technical Reports Series.

[4] IPTS is one of 7 research institutes that form the European Commission's Joint Research Centre.

[5] JRC Nº 33156-2013-05 EMPL D.3.

2. METHODOLOGY

2.1 Selection of cases

The main sample of 4 good practices was selected from good practices identified in Deliverable 1 of this project (*Deliverable 1: Carretero, S. (2015). Mapping of effective technology-based services for independent living for older people at home. Sevilla: Joint Research Centre, Institute for Prospective Technological Studies, JRC Scientific and Technical Reports Series*). Deliverable 1 identified and mapped 14 technology-based services for independent living at home in and outside Europe. These good practices were selected through a systematic literature review of articles published in peer-reviewed journals, followed by an analysis of the outputs obtained. Table 1 gives a snapshot of the 14 good practices in technology-based services that help older people live independently. For more details, please read Deliverable 1.

The following criteria were used to select the 4 good practices:

- The availability of data and information in the literature on the variables of analysis according to Objective 2 of the project.
- How effective they were
- To ensure different countries were represented.
- To ensure representation of the main types of technology-based services for independent living for older adults at home.

Table 1: Summary of the good practices of technology-based services for independent living

#	TECHNOLOGIES	GOOD PRACTICE NAME (ACRONYM)	LEVEL OF NEEDS	COUNTRY	IMPACT ON				Reference of impact
					IL	CP	QOC	S	
1	ASSISTIVE TECHNOLOGY	INTELLIGENT SYSTEM FOR INDEPENDENT LIVING AND SELF-CARE OF SENIORS WITH COGNITIVE PROBLEMS OR MILD DEMENTIA (ISISEMD)	COGNITIVE IMPAIRMENT AND MILD DEMENTIA	DK, FI, EL, UK	✓				Mitseva et al., 2009, 2012
2	ASSISTIVE TECHNOLOGY + TELECARE	TELEMONITORING SERVICE FOR CHRONIC CONDITIONS FROM PRIMARY CARE (ADVANCED TELECARE)	FRAIL OLDER PEOPLE	FR	✓	✓		✓	Tchalla et al., 2012
3	ASSISTIVE TECHNOLOGY (ROBOT)	PARTNER PERSONAL ROBOT (PAPERO)	DEMENTIA	JP	✓				Inoue et al., 2012
4	ASSISTIVE TECHNOLOGY (ROBOT)	ROBOT SUIT HAL-Hybrid Assistive Limb (HAL)	FRAIL OLDER PEOPLE	JP	✓			✓	Watanabe et al., 2012; Yamamaki et al. 2012
5	ASSISTIVE TECHNOLOGY (ROBOT)	ROBOTIC STRIDE ASSISTANCE SYSTEM (SAS)	OLDER PEOPLE WITH POOR WALKING ABILITIES	JP	✓				Shimada et al., 2009
6	SMART HOME	X10 ACTIVEHOMEKIT (HOMEKIT)	OLDER PEOPLE WITH CHRONIC CONDITIONS	US	✓			✓	Tomita et al., 2007; Reeder et al., 2013
7	TECHNOLOGY – BASED HEALTH CARE – TELEHEALTH	TAIWAN'S TELEHEALTH PILOT PROJECT (TAIWAN TELEHEALTH)	OLDER PEOPLE WITH CHRONIC CONDITIONS AND THEIR CARERS	TW		✓	✓	✓	Hsu et al., 2010
8	TECHNOLOGY – BASED HEALTH CARE – TELEHEALTH	KAISER-PERMANENTE TELE-HOME HEALTH RESEARCH PROJECT (KAISER TELEHEALTH)	OLDER PEOPLE WITH CHRONIC CONDITIONS	US		✓	✓	✓	Jonhston et al., 2000; Aanesen et al., 2011
9	TECHNOLOGY – BASED HEALTH CARE – TELEHEALTH	TELEHEALTH (WHOLE SYSTEM DEMONSTRATOR) (WSD)	OLDER PEOPLE WITH CHRONIC CONDITIONS	UK				✓	Bower et al., 2011; Steventon et al., 2012
10	TECHNOLOGY – BASED HEALTH CARE - TELEMONITORING	TELEMONITORING SERVICE FOR CHRONIC CONDITIONS FROM PRIMARY CARE (TELBIL)	OLDER PEOPLE WITH CHRONIC CONDITIONS	SP				✓	Martin-Lesende et al., 2011, 2013
11	TECHNOLOGY-BASED HOME CARE	ASSISTING CARERS USING TELEMATICS INTERVENTIONS TO MEET OLDER PERSONS' NEEDS (ACTION)	OLDER PEOPLE WITH CHRONIC CONDITIONS AND INFORMAL CARERS	SE	✓	✓	✓	✓	Magnusson et al., 2002; Magnusson and Hanson, 2005; Magnusson et al., 2005; Torp et al., 2008
12	TECHNOLOGY-BASED HOME CARE – TELECARE	WEST LOTHIAN TELECARE	PEOPLE OVER 60 YEARS OLD	UK	✓	✓		✓	Kelly, 2005; Reeder et al., 2013
13	TECHNOLOGY-BASED HOME CARE - TELECARE/TELEHEALTH	NATIONAL TELECARE DEVELOPMENT PROGRAMME (TDP)	ALL OLDER PEOPLE	UK	✓	✓		✓	Beale et al., 2010
14	TECHNOLOGY- BASED WELLNESS SERVICES	BRAIN AGE	ALL OLDER PEOPLE	JP	✓				Nouchi et al., 2012

Notes: DK= Denmark; FI: Finland; EL: Greece; UK: United Kingdom; FR: France, JP: Japan; US: United States of America; TW: Taiwan; SP: Spain; IE: Ireland; PT: Portugal; SE: Sweden. IL: Independent living; CP = Productivity of carers; QOC = Quality of life; S = Sustainability. Good practices are identified by colours of the typology of technology-based services for independent living. Green for assistive technologies, purple for smart homes, blue for technology-based health care, orange for technology-based home care, and red for technology-based wellness services.

2.2 Variables and instrument

The main objective of the study was to understand how the examples of good practice in the use of technology-based services to help older people live at home independently were created and implemented, in order to produce a manual on long-term care strategies based on technology for policy makers (D3). To this end, a set of variables was defined, guided by:

- Discussion with experts at the first stakeholder consultation workshop of the ICT-AGE project, which helped us to identify the most relevant variables for the content of the manual
- A first approach was achieved through work sessions attended by JRC-IPTS and DG EMPL about the main themes to collect in the manual (D3) after recommendation by experts. The following topics were proposed for the manual, which illustrate drivers and hindrances:
  - Business cases and business models,
  - Enabling factors and barriers to scaling and market creation,
  - Available technologies to address the different needs for independent living of older adults,
  - Standards and interoperability of solutions,
  - Evaluation of the impact,
  - Examples of implementation models,
  - Integration in the long-term care system,
  - Policy role in the implementation models.

The following 10 variables were obtained for analysis for the case studies:

1. Business case
2. Business model
3. The technological components
4. Technical barriers
5. Quality assurance of the service
6. Training actions
7. Scaling and market creation
8. Policies and the role of policy to create, implement and scale-up good practice
9. Evaluation process of the effectiveness of the good practice
10. Organisational change: integration of the technology-based service in the delivery chain

The content of these variables was defined through revision of the main literature, sources obtained from experts at the consultation workshop, and discussion by the project team about the content needed to build the manual. A template was elaborated in order to define each variable, and the questions needed to guide the process of information collection (see Annex 1).

For the **business case**, we used the following relevant variables according to the interest of starting and developing the services for public authorities. Some of them are based on general business cases, and the variable of feasibility has been adapted from the business case tool for innovation in long-term care developed by TNO:[6]

- Motivation for the project identifies the reasons for starting and investing in the project.
- Solution description describes the ICT-based service to help older people live independently.
- Feasibility of creating the service, identifying the risks or potential hindrances

[6] http://www.businesscase-longtermcare.com/Introduction.aspx

- Benefits of the solution identifies the impacts found in scientific studies for each of the technological services, and according to the policy objectives of increasing independent living, productivity of carers, quality of care and sustainability of care systems.
- Costs. This section identifies all the costs related with the design and development (initial investment) and running of the service. These are all investments that have been necessary for the creation of the product/service or the group of products/services, as well as the on-going (operating) costs.

For the **business model**, we used the same template as was used in the previous "Study in business and financing models related to ICT for ageing well (Technolage)"[7] and the COMODAL project[8]. These projects used the Business Model Canvas. The Business Model Canvas was designed by Alexander Osterwalder and colleagues[5] as a strategic management template for developing new business models and documenting existing ones. It consists of a visual chart with elements describing a firm's or organization's value proposition, infrastructure, customers, and finances. It is generally used to assist firms and organizations to align their activities by illustrating potential trade-offs (Cenderello et al., 2013[9]). The business model canvas consists of the following nine interlinked building blocks (Cenderello et al., 2013):

- Customer segments: the different groups of people or organizations that the public authority aims to reach and serve with the service.
- Value proposition(s): the bundle of products and services that create value for a specific customer segment. A value proposition creates value for a customer segment through a distinct mix of elements catering to that segment's needs. Values may be quantitative (e.g. price, speed of service) or qualitative (e.g. design, customer experience).
- Communication channels: how the public authority communicates with and reaches its customer segments to deliver a value proposition.
- Customer relationships: those that the public authority establishes with specific potential beneficiaries segments to achieve beneficiaries' acquisition and retention and to possibly increase the number of beneficiaries. The relationship established with the possible beneficiaries could be:
  - Personal assistance (e.g. through call centres, by email),
  - Dedicated personal assistance (e.g. recognizable repeat advisors, carers),
  - Self-service (e.g. no direct relationship),
  - Automated services (e.g. no direct relationship, but prompted suggestions based on user profiling),
  - Communities (e.g. facilitating customer to customer contact),
  - Co-creation (e.g. user involvement in product/service development).
- Revenue streams: the cash flows the public authority generates from beneficiaries or intermediaries.
- Key resources: the most important assets required to make the business model work. It is possible to distinguish between physical (e.g. production facilities, logistics), intellectual (e.g. brand, patents, partnerships, customer database), human (e.g. engineers, designers, sales force) and financial (e.g. cash, credit line) resources.
- Key activities: the most important things the public authority has developed to make its business model work. It is possible to distinguish between production (e.g. designing, making, delivering in

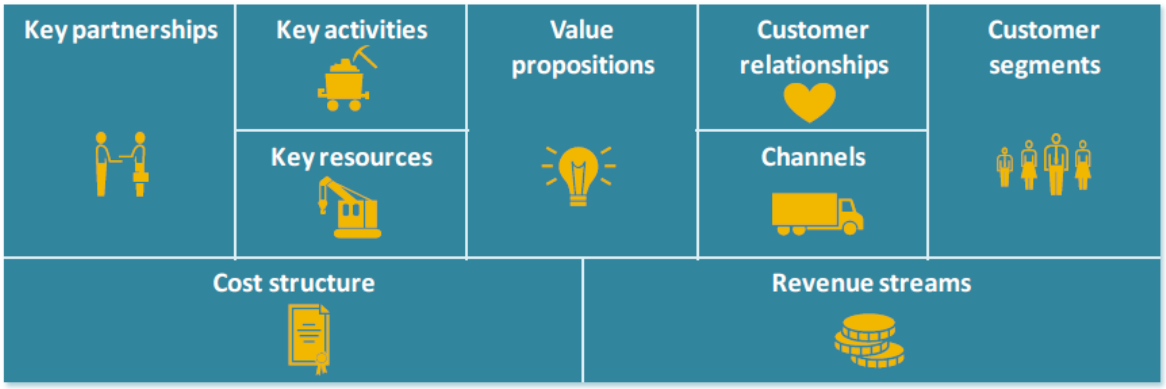
[7] www.technolage.org

[8] Consumer Models for Assisted Living: http://www.coventry.ac.uk/research/research-directory/allied-health/health-design-technology-institute/health-design-technology-institute-research-projects/comodal/

[9] Cenderello, A.; Gallasso, G.; Gargaro, F.; Miele, M.; Zamora, D.; Millard, J.; Carpenter., G. and Pedesen, K. (2013). Study on business and financing models related to ICT for ageing well. Final report (D8) on Technolage

size and quality), problem solving (e.g. knowledge management, continuous education and training) and platform/network activities (e.g. platform management, service provisioning, platform promotion).

- Key partnerships: the network of suppliers and partners that make the public authority business model work.
- Cost structure: all costs incurred by the public authority in the operation of the business model. These costs are necessary to provide the product/service or the group of products/services.



Source: Cenderello et al., 2013

The **technological components** variable refers to:

- Technological components of the service: Hardware, software and applications used in the service.
- Costs of these technologies for the public authorities in terms of acquisition, installation and maintenance.

The **technical barriers** variable details standards applicable to the technology-based service, and the compliance with them. It also covers whether the service is interoperable and the barriers to interoperability and solutions proposed.

The **quality of the service** variable identifies the quality of the service in the terms of how it is managed and assured.

The **training actions** variable looks the the service's strategy to inculcate and transfer skills and competences to use the ICT-based services is analysed. Information such as target group, stakeholders involved, material and competence train, and training methodology is detailed.

The **scaling and market creation** variable refers to how the public authority has implemented the service, thereby creating and implementing a new market, identifying enablers and barriers. It also refers to the replication of the service.

Another variable was to understand the **policies and the role of policy in the creation, implementation and scale-up of the good practice**.

For the **evaluation of impact**, each case study contains an analysis of the social, health and economic impact of the ICT-based service delivered. This analysis looks at how far the service has helped to achieve the four policy objectives for long-term care: independent living, productivity of carers, quality of care, and sustainability of the care systems. In other words, has service contributed to better quality of life (and not only cost reduction)? Moreover, this section also states

the final objective of this impact evaluation, and the methodology applied: the sample, the research method, variables and instruments used, and the process of collecting the data.

For the **organizational change regarding the level of integration of the ICT-based service in the delivery chain**, we elaborated the information around the change in the organisation to integrate the service in the formal existing system, based in the operational processes detected in the project "Economic and Business Modelling" (Down, 2014[10]) and adapted for the purpose of this project. Concretely, this variable collects information about:

- Policy framework: does a policy framework exist behind the integration of the service?
- Deployment plan: is there a roll out plan and how is it defined?
- Referral: how are older people referred to the service/how do they become beneficiaries?
- Procurement: how are goods, services or works from an outside external source acquired?
- Installation: how does equipment reach patients' homes?
- Service delivery and monitoring: how is the service delivered and how are data managed?
- Storage and maintenance: how is the equipment cared for?
- End of service and removal of the equipment: how does the service end and how is the equipment removed from patients' homes?

2.3 Procedure for the collection and analysis of data

The data were collected through:

- A review of the literature and documentation available on internet, mostly in scientific journals and reports, conference presentations and news, and interviews with the main actors involved in the creation, design and implementation of the practice.
- Presentation of the good practice by their case representatives at the first consultation workshop of the ICT-AGE project.
- Phone and written interviews with case representatives, who also verified the content of the case study.

A synthesis analysis has been done using the content collected in the template for each case.

[10] Down, K. (2014) Review of the Assisted Living. FAST UK Economic and Business Modelling projects http://www.fastuk.org/pagedocuments/file/fast_documents/Review%20of%20EBM%20projects%20-%20full%20paper.pdf

3. RESULTS OF THE CASE STUDIES

This section collects the four good practice case studies plus the fifth case study on HAL.

The four good practice examples, selected according to predetermined criteria, were:

- Advanced Telecare
- TELBIL
- ACTION
- TDP

The fifth case, also selected from the 14 good practices identified in Deliverable 1, was Robot Suit HAL-5 (HAL). HAL is a robot in the form of a suit that it is being currently used in Japan for rehabilitation purposes in institutional settings. However, it could be used to help older adults live independently at home. This case study could also provide some hints about the future development of this service in the EU.

The results of the case study research are presented below by individual good practice with a description of the content for each variable analysed.

3.1 HOME AUTOMATION AND ADVANCED TELECARE (ADVANCED TELECARE)

NUMBER	2
TYPE OF TECHNOLOGY-BASED SERVICE	ASSISTIVE TECHNOLOGY AND TELECARE
NAME OF THE PRACTICE	HOME AUTOMATION AND ADVANCED TELECARE (ADVANCED TELECARE)
LEVEL OF NEEDS COVERED	FRAIL OLDER PEOPLE
VERIFICATION OF THE CASE:	Verified by Christelle Sartiaux on 04/09/2014
COUNTRY	FRANCE
Brief description: Home automation with advanced telecare aims to allow older people to live independently at home. The system uses different available technologies such as sensors and light paths installed in the home to prevent accidents and keep older people safe. The technologies used are connected through a bracelet or a pendant to a telecare system. The telecare system is available 24h/24 and 7 d/7 and it can be activated either by the older adults if they need care or automatically if there is an accident through the sensors, allowing professionals to appropriately intervene. The system also helps to provide better care at home.	

3.1.1 Business case

MOTIVATION FOR THE PROJECT: As a general rule, the French government has been committed for many years to caring for older people at home. We can mention for example:

- Plan Solidarité Grand Âge (2007-2012) – Solidarity Plan for Older People that offered care and services at home for older people who want to to grow old at home.
- Plan Alzheimer (2008-2012) aimed to improve the care of people affected by this disease in order to relieve the informal carers.

In the specific case of the home automation and advanced telecare service (from now onward "**advanced telecare**"), the French regional authorities of Limousin stated in 2009 a long-term strategy to increase the independence and safety of older people at home. The Limousin region is the oldest French region and 30% of its population is made up of older people compared with the average 23% for the whole of France. The region is composed of three departments: Corrèze, Creuse and Haute Vienne. The strategy focused on reducing falls at home, because falls were identified as the main cause of domestic accidents and loss of independence for older French people and also because of the rise in public expenditure. In fact, falls are a main public health problem in France (Insee, 2009). Studies have found that there are around 1 million falls, 55,000 fractures and 9,000 deaths per year among older population due to falls, generating a medical cost of €2 billion per year (Dress, 2009).

Moreover, the 2006-2011 French national healthcare strategy stated as an objective that every person aged 75 years and over should be entitled to telecare and alarms services in their homes. Hence, the Limousin authorities, particularly the Corrèze Department, launched and funded the ESOPPE project to test the efficacy of an advanced home automation system and telecare to reduce falls at home and to generate savings in this area. The ESOPPE project was launched in September 2009 and lasted 14 months, equipping a total of 100 houses with technology solutions. Due to the results of this project, the Corrèze and the Creuse Departments stated their willingness to develop this technology-based solution on a large scale, and to make it available for all users in need. To this end, the Creuse Department initiated a Public Service Delegation[11] with a telecare provider in 2010. The Corrèze Department initiated their delegation in 2013, and Haute–Vienne is

[11] In France, the public service delegation or «délégation de service public (DSP) » is the set of contracts under which a legal person of public law entrusts the management of a public service for which it is responsible to a public or private operator whose remuneration is substantially related to operating the service result. This is a concept of French law (http://fr.wikipedia.org/wiki/D%C3%A9l%C3%A9gation_de_service_public).

still in the pilot phase. We focus this case study on the Creuse Department as it was the first to implement the delegation. We will, however, provide some data of interest on the Corrèze and Haute-Vienne Departments.

SOLUTION DESCRIPTION: Advanced telecare has the following aims:

- To improve the security of older people at home, particularly to prevent falls that are frequently responsible for institutionalizations.
- To allow older and dependent people to stay at home, by maintaining and enhancing their links with society.
- To improve coordination with home carers.
- To stimulate the economy, employment and the territorial know-how in the production, installation and maintenance of home automation material and telecare.

The basic and regular advanced telecare provides the following services:

- Telecare service available 24/7 through a local phone platform (located in the cities of Naves and Guéret) with operators, trained in communication and management of emergency, psychological or medical situations. The platform receives the phone calls or the alarms from the devices linked to the terminal, and it ensures a direct contact with the beneficiaries. The operators are also allowed to contact the carers, the doctor or the ambulance. Concretely, the following services are offered by the telecare service:
  - Assistance in emergencies: The service can be activated by the older adults in emergencies and allows professionals at the call centre to intervene, contacting their carers or the emergency services.
  - Support against loneliness and isolation. The older people can call the professionals if they need to and the professionals make regular calls to the older people (at least 13 per year) to chat.
- Home automation service which is constantly connected to the telecare platform and can detect emergency situations, and automatically alert the call centre, mostly:
  - Falls going from bed to bathroom at night (activated by motion detection),
  - Gas leaks,
  - Fire,
  - Temperature changes.

In the Creuse Department, users can add complementary services: for example, detection of unexpected movements, humidity, serious falls, etc.

Advanced telecare is being currently implemented in the three departments of the Limousin Region (Creuse, Corrèze and Haute-Vienne), through a Public Service Delegation to a telecare provider (SIRMAD) in the Creuse and Corrèze Departments. The Creuse department started this public delegation in 2010 to last 5 years (4 years plus 1 year extension), and have covered 2,000 homes. They are now currently launching a new delegation for a period of 10 years more (until 2025). The Corrèze Department started the public service delegation in 2013 for a period of 10 years and in 2013 they managed to install 1,263 advanced telecare devices.

FEASIBILITY: Regarding the **content-related feasibility**, the Creuse Department delivered an awareness and training plan to all the professionals involved in the delivery chain of the service before the implementation to ensure their acceptance. In fact, as informed by the case representative, one of the first barriers that the Department found during a first testing phase of the service in 2008-2009 and even at the beginning of the project was that the professionals were reluctant to use the service (they though that the service will reduce their work hours). This awareness and training plan contained information about the objectives and content of the service, and it was targeted at home care professionals, and other professionals involved in the delivery chain of the service (tradespeople, referrers from the General Council of the Department, and staff from the service provider). More details are provided in Section 3.1.6 (training actions). According to the case representative, the service is well accepted by the older people as many of them were already receiving a telealarm service (BIOTEL). As the professionals had received training, they were able to play a relevant role in convincing the older people about the added value of the advanced telecare compared with the telealarm (at a very similar cost) and the benefits of this new service for their well-being.

In terms of **organisational feasibility**, several professionals are involved in the advanced telecare delivery chain. The Creuse Department developed a training strategy to provide skills to the actors involved (see Section 3.1.6 on training actions). Moreover, technological resources are needed and they are provided through the Public Service Delegation by the service provider (SIRMAD) in agreement with two technological providers: LEGRAND and INTERVOX. The devices remain the property of the Creuse Department and they are being paid for by the General Council. This was included in the framework of the service delegation to ensure the availability of the equipment if the service provider should change. The service started after the Creuse Department agreed to launch a Public Service Delegation and allocated financial resources.

Regarding the **economic feasibility**, as pointed out by the case representative of the Creuse Department, the main added value of advanced telecare is that it helps people to keep their link with the social environment, and to feel secure at home. Compared with the previous telealarm service that only provided an emergency response from the fire brigade, with the new advance telecare service the older adults can interact with the professionals. Staff at the advanced telecare centre makes calls to the older adults for social purposes such as to hear their news or to congratulate them on their birthday. Older adults also feel free to call for a talk if they feel lonely or in emergencies. The older adults' homes are also more secure because of the different sensors installed there and connected to the telecare platform. These sensors allow the professionals to respond immediately in emergencies. In this sense, it seems that the service suits the need of the older adults.

Moreover, the case representative of the Creuse Department also informed us that, although any private company could offer this service, there is no similar service in the region, and the public service delegation has allowed the Department to provide advanced telecare at a similar cost to the telealarm. In fact, the economic model is based on funding provided by the national public allowance system for older and dependent people (APA[12]) or other private funding such as insurance funds, which provide a co-payment to older people for advanced telecare. The Creuse Department is currently applying a similar economic model in the framework of the new public service delegation for the next 10 years. The case representative also highlighted that this economic model is sustainable because the Department received public funding that helped them to launch the 2010-2015 public service delegation. This funding came from regional and national funds, and the European Regional Development Fund. The sustainability of the service for the next 10 years will also depend on the continuity of this public funding. This is why the Department is still waiting for the formal authorization to officially launch the 2015-2025 public service delegation.

[12] French public financial assistance for older and dependent people: APA (Allocation Personnalisée d'Autonomie)

In terms of **feasibility and quality of life**, the advanced telecare has been shown to improve some indicators related to older adults living independently at home. The ESOPPE study carried out in the Corrèze Department showed that, after a year of receiving the advanced telecare service, a lower percentage of older adults fell at home, were hospitalized due to falls at home, or were depressed, compared with non-equipped older adults (for more details see section 3.1.9).

The case representative of the Creuse Department reported that one of the factors that could undermine the feasibility of the advanced telecare service is whether or not the organisations that are currently co-funding the service to the older people will themselves receive funding. Currently, the service is successful because it can be provided at a very low price, and because the APA together with private insurance funds partially cover the cost paid by the older people for the service. When the service was first launched, it was provided only to the APA beneficiaries. The General Council of the Creuse Department found other entities willing to offer co-payments to older adults using the service, allowing the department to reach a wider audience. These private entities are:

- La Caisse d'Assurance Retraite et de la Santé au Travail (CARSAT), organisation of the French public Social Security System with regional competencies. They cover old age and professional risk insurance.
- La Mutualité Sociale Agricole (MSA) is a mutual benefit society in charge of the social protection of the pensioners of the agricultural sector.
- L'Office National des Anciens Combattants et Victimes de Guerre (ONACVG) - The National Office for Veterans and Victims of War.
- la Caisse Nationale de Retraite des Industries Électrique et Gazière (CNIEG), Special Social Security system for pensioners of the electric and gas industries.
- There is also an exemption of payments based on minimum earnings.

BENEFITS: A preliminary study called the ESOPPE project evaluated the efficacy of using a light path coupled with a telecare service for preventing frail older people from falling accidentally at home in the district of Corrèze of the Limousin Region (Tchalla et al., 2012). The authors hypothesized that a light path can reduce falls by helping people with ageing-induced-vision-dysfunction and by showing the right path to the toilets and by improving consciousness. The telecare service is effective 24/7, and it allows users to activate an alarm, which elicits a rapid response. The light path may also prevent falls at home by facilitating movement and thus contribute to neuro-sensorial and mobility preservation.

The study took place between July 2009 and June 2010 and included 194 adults aged 65 and over living at home. 94 were equipped with a light path coupled with telecare service and 96 were unequipped, over a period of 12 months. The people included in the sample had reduced independence at home (largely levels 2-4 on the AGGIR scale - the French scale used for grading the degree of an individual's dependency).The study showed the following benefits:

<u>Independent living of older people at home</u>:

- Reduction in falls:
  - At home. 30.9% of older people equipped and 50.0% of non-equipped fell at home during the 12 months of the study. This reduction was statistically associated with the use of the equipment.
  - Hospitalisation after falling at home: 9.6% of older people equipped and 25.0% of non-equipped that were hospitalised, fell at home during the 12 months. This supposes a reduction in falls by a factor of 1.6 and reduction in hospitalizations by a factor of 2.6, which was statistically associated with the use of the equipment.

- Reduction in depression. There was a significant difference in the decrease of the level of depression among the equipped and the non-equipped. The percentage of depressed older people who had the equipment dropped by 26% whereas percentage of older people who were unequipped dropped by only 10%.

Productivity of carers:

- Reduction in the need for caregivers' time: Equipped older people received 5% less care at home after 12 months, while non-equipped older people received 4% more care at home after the same period.

Sustainability:

- Cost efficiency: the package costs €1,700 the first year and €700/year thereafter, while the average cost of a hospital stay per fall is €8,000. The number of hospitalisations is reduced due to the reduction of the number of falls at home. There is therefore a saving of €6,300 per patient the first year and €7,300 per year per patient thereafter, due to the number of falls prevented by the use of the system.

COSTS:

The costs of the **Creuse Department** for the implementation of the service include:

- The payment to a private consulting firm for identifying the best economic model, and the human resource costs incurred by using General Council staff. This cost of human resources is not an extra cost but seen as linked to the cost of their existing human resources. The case representative supplied this data.
- A total of €2,790,000 paid to the service provider through the Public Service Delegation for the 5 years of Public Service Delegation, composed of:
  - A grant compensation for public service constraints: This amounts to €1,790,000 for the 5 years, paid monthly to the service provider. A revision of this grant is foreseen in the delegation agreement after one year to cover technical and economic changes (electricity costs, salary indexes) or on the request of the General Council.
  - An equipment grant of €1,000,000 to cover the cost of the devices installed in the older adults home. The devices installed remain the property of the General Council, which allows it to relaunch the delegation with another service provider. The payment does not cover the taxes associated with the purchase of the devices, and is made 30 months after proof of purchase.

In the **Corrèze Department**, the total cost of the Public Service Delegation for 10 years has been established at €23.9 million. Of this sum, the General Council pays a total of €11.5 million (this amounts to an average of €1.2 million per year over 10 years).

3.1.2 Business Model

CUSTOMER SEGMENTS: In the **Creuse department**, the advanced telecare service is targeted at dependent and not dependent older adults (levels 5-6, according to AGGIR, the French dependency scale). In the Public Service Delegation, advanced telecare is mainly targeted at:

- Users and applicants to the telealarm service of the Department (BIOTEL).
- Beneficiaries of the APA.
- Beneficiaries of disability benefits - Prestation de Compensation du Handicap (PCH).

In the **Corrèze department**, the service specifically targets the 65 and over age group with reduced independence at home (levels 2-4 according to AGGIR (Autonomie, gérontologie, groupe iso-ressources)[13], the French dependency scale).

VALUE PROPOSITION(S): The key value proposition of the service evaluated by ESOPPE is that it is very customizable. The solution is designed to offer final users a greater sense of security, independence and enhanced possibilities for communication.

CHANNELS: The system is being implemented in two of the three departments of the Limousin region: Creuse and Corrèze (and as a pilot in the Haute-Vienne Department). In both departments, the General Councils have public agreements with the telecare provider SIRMAD through a Public Service Delegation. SIRMAD has agreements in turn with technology providers (LEGRAND and INTERVOX). It is also in direct contact with the older people and has local presence, enabling the General Councils to successfully reach the customers. Moreover, the availability of the telealarm is also a channel to attract customers.

CUSTOMER RELATIONS: the service provider is in direct contact with the older people through the telecare platform, and the General Council through their services for older people.

REVENUE STREAMS: The **Creuse Department** received funding from different actors for the period of 5 years of the Public Service Delegation:

- €890,000 from the European Commission through the European Development Regional Programme (ERDF).
- €600,000 from the Limousin Region, through the framework "Contrat de Projets Etat-Région 2007-2013 – Volet Handicap et Dépendance".
- €150,000 from the French Government, through the "Fond National d'Aménagement et de Développement du Territoire (FNADT) dans le cadre du Contrat de Re-dynamisation du Site de Défense de Guéret".

[13] The national standardised instrument determining the degree of dependence of old people in France is the AGGIR scale (Autonomie Gérontologique - Groupes Iso-Ressources). This scale is based on the degree of difficulty experienced when performing activities of daily living (ADLs) Elderly people are classified according to six degrees of dependency: *GIR1 (very dependent) to GIR6 (not dependent*) (Joël et al., 2010). Attribution of the governmental financial assistance APA (Allocation Personnalisée d'Autonomie) depends essentially on the classification of frail old people in 6 degrees of dependency (GIR1 to GIR6).

KEY RESOURCES: For the creation of the service, a key intellectual resource was provided through the involvement of Autonom'lab (a "living lab"), and the creation of a rural excellence hub on home automation and health funded in 2007 by DATAR,[14] led by the Creuse Department. The hub allowed the department to implement the following actions:

- Action 1: the creation of a professional degree in home automation in 2008.
- Action 2: the testing of the home automation packages in institutions and homes between 2007 and 2008.
- Action 3: the opening of a resource centre in the City of Guéret in 2010, dedicated to training, incubation, test, exhibition of services and products, etc.
- Action 4: the deployment of the home automation package in the Department from 2010.
- Action 5: the establishment of a collective approach to structure a local network of companies.

For the implementation phase, the key resource was the launching of a Public Service Delegation, both in the Creuse and the Corrèze Departments where:

- The Departments are the main drivers and are in charge of: the communication and promotion of the service, the installations and satisfaction surveys. The Creuse Department also assumes responsibility for studying demand among older adults, their assessment at home and risk recommendations.
- The service provider provides the service and manages the installations and the telecare, coordinates with the emergency services, and deals with the maintenance, repair and removal of the equipment.

The technology provider (Legrand) assumed a central role in the procurement of physical and intellectual resources, in terms of know-how in the field of assistive technology. The human resources that carry out the day to day activities with the final users are from the company delegated to provide the service.

KEY ACTIVITIES: Key activities that make the business model work include:

- SIRMAD[15] (telecare provider) maintains daily contact with the older people and intervenes in emergencies or issues with the technology. They also install, maintain, repair and remove the equipment.
- The effectiveness of service has been evaluated through the ESOPPE project in the Corrèze Department by the Centre Hôpitalier Universitaire de Limoges (the University Hospital of Limoges). Positive results were obtained: the number of falls at home was reduced and the productivity of the carers was improved.
- In the Creuse Department, awareness raising among the main actors in the service delivery chain and their training before implementing the service was crucial for the success of the business model (see Section 3.1.6).

[14] The délégation interministérielle à l'aménagement du territoire et à l'attractivité régionale (DATAR) is a French administration working for the Ministère de l'Espace rural et de l'Aménagement du territoire.

[15] Sirmad Telecare (Sirmad Téléassistance) is part of the Fondation Caisses d'Épargne pour la solidarité. The Foundation is non-profit and it has been recognized as a public utility by decree in 2001 and non-profit. The object of general interest of the Foundation is the fight against all forms of dependency related to age, illness or disability.

KEY PARTNERSHIPS:

The roles of the main stakeholders involved in the service are:

Table 2: Stakeholders and roles

Name of the stakeholder	Role
The Region of Limousin	• In 2009, the region announced its long-term strategy to increase independence and safety of older people at home, reducing falls at home.
General Council	• In Creuse, it created a Rural Excellence Hub on home automation and Health • Responsible for and manager of the advanced telecare service • Launched and manages the public service delegation with the service provider (SIRMAD). • Promotes the service through information and communication • In Creuse, it receives requests from older people, and studies them according to the older people's needs and technical feasibility. • Decides who is entitled to the service • Promotes the device to potential users. • Controls the service through the delegate • Co-funds the service through APA and PCH
SIRMAD	• Telecare provider in the Creuse and Corrèze Departments per Public Service Delegation • Provides the advanced telecare service • Corrèze: Receives and studies the demands according to older people's needs and technical feasibility. • Creuse: Processes requests for subscription, which have been validated and sent by the General Council, organizes and updates the subscribers' records. Redirects the demand to the General Council. • Provides the materials • Installs and starts up the service at homes, and also uninstalls and removes devices from homes. • Receives, treats, and follow-ups alarms issued by the older adults 24/7. • Maintains and repairs on site the material in 24 hours. • Invoices subscribers monthly for access to the services. • Trains the call centre professionals and the technical officers in charge of the installation and maintenance. • Sends and updates technical information to the General Council to give it an initial diagnosis of the older people and their homes • Sends to the General Council the alarms (daily), calls (on demand), actives subscribers (monthly). • Promotes the service to the local government, home care associations, health care professionals, etc., together with the General Council. . • Reports its technical activities to the General Council: monthly and its technical and financial information yearly. • Acts as the channel linking between the two Departments and Legrand, the technological provider, to provide the service to the older persons • Supports Legrand to reach the final user. • One of the funders of the ESOPPE evaluation project.
LEGRAND	• A major French industry player in electrical and digital building infrastructure. • Engaged in a business-to-business relationship with SIRMAD to supply the devices. • During the implementation phase, assumes a central role in the procurement of physical and intellectual resources, in terms of know-how in the field of assistive technology. • Helps the General Council of the Creuse Department to train the home education stakeholders.
CARSAT, MSA, ONAC and CNIEG (Creuse Department)	• Co-fund the service to the users.

Network of tradespeople (Creuse Deparment)	• Deploys and maintains the installation and adapts the electric installation
Chamber of Trades and Crafts (MAC) of the Creuse (Creuse deparment)	• Trains and consolidates the network of tradespeople.
Public training bodies (AFPA, GRETTA and CFPPA) and the CNISAM Limoges (serving tradespeople for health and personal autonomy issues) (Creuse deparment):	• Help the General Council of Creuse to train the home education stakeholders.
EDF (Électricité de France) - generator and provider of electricity in France	• Adapts the electric installations of the houses
Centre Hospitalier Universitaire de Limoges	• Takes part in the evaluation programme ESOPPE in Corrèze Department that provides data to improve the model. It is member of Autonom'lab
Autonom'lab	• Livinglab created as an association. It was a key intellectual resource in the initial stages of the creation of the solution and it was also part of the evaluation programme ESOPPE in Corrèze Department.
Fondation Caisses d'Epargne pour la Solidarité (Corrèze deparment)	• One of the funders of the Esoppe evaluation project.
Université de Limoges	• Part of the evaluation programme ESOPPE in Corrèze Department
Équipe hospitalo-universitaire HAVAE (Handicap Autonomie Vieillesement Activité Environmente)	• Part of the evaluation programme ESOPPE in Corrèze Department
Institut régional de formation des éducateurs (IRFE)	• Part of the evaluation programme ESOPPE in Corrèze Department

The following key partnerships among these actors have been built:

- In both the Creuse and the Corrèze Departments, there is a partnership between the General Council and SIRMAD under a Public Service Delegation to provide the service.
- Another partnership is between SIRMAD (telecare provider) and Legrand (Technological provider). SIRMAD and Legrand work closely to provide the technology devices. Legrand relies on SIRMAD's local presence to reach the final users.
- The Creuse Department also has a partnership with:
  - SIRMAD, the Chamber of Trades and Crafts and the network of tradespeople to deploy and maintain the solution at home throughout the Department.
  - CNISAM to train the tradespeople to install the solution at home. This department has also developed recently a partnership with EDF to adapt the electric installations of the houses.
  - Legrand (the technical provider) to train the installers, electricians and other stakeholders.
- A partnership to evaluate the service in the Corrèze department under the ESOPPE project among:
  - The Conseil Général de Corrèze, Sirmad Corrèze Téleassistance and Fondation Caisse d'Epargne pour la Solidarité that funded the project.
  - Members of the livinglab Autonom'lab: centre hospitalier universitaire de Limoges, Université de Limoges, Équipe hospitalo-universitaire, HAVAE (Handicap Autonomie Vieillesement Activité Environmente), Institut régional de formation des éducateurs (IRFE), that participated in the project.

COST STRUCTURE: see cost section 3.1.1 of the business case.

3.13 Technological components

The technological components of the advanced telecare service include:

1.- **A basic home automation package** composed of:

- An issuer: the issuer in the form of a bracelet or a pendant connected to the transmitter by radio. By pressing the button of the issuer, the older people can trigger a call to the telecare platform.
- A gas leakage detection / alarm, which can include a mechanism to cut the supply of solenoid gas. The gas sensor is connected to the electrical network and the switch to cut the solenoid gas supply. The manufacturer/provider is INTERVOX
- A smoke sensor detects smoke in a room and sends an alert to the platform. The manufacturer/provider is INTERVOX

Source: Web page of the system

- A temperature sensor with high and low settings for housing temperature control. The smoke and temperature sensors are connected by radio to the transmitter, but are not connected directly to the phone and electric networks. The manufacturer/provider is INTERVOX.
- An automatic light system (LED light path) between the room and the bathroom. The light path is a 1.5 m device installed near the bed that turns on automatically when the person sets foot on the ground. It can provide adapted visibility by showing the right path and improving consciousness. This helps prevent falls for people who need to get up to eat or urinate at night. The light path is connected to the electric network. The manufacturer/provider is LEGRAND. In the Creuse Department, the light system automates the existing lighting with motion detection (instead of a LED).

Source: Web page of the system

These elements (less the light system) are connected via a terminal to the telecare centre (located in Naves in the Corrèze department).

2.- **A transmitter**: a device with a speaker and a microphone, installed by the service provider in the older people's homes. This device can be triggered remotely via a transmitter and environmental sensors. It allows the beneficiary make a call to a listening platform and interact with the service from home, without picking up the phone. It also transfers alert and technical messages from environmental sensors to a listening platform. The transmitter is connected to the electrical and phone (STN: Switched Telephone Network) networks. The **device, called the "Quiatil+" terminal**, is connected to the house telephone line and other peripherals to send out alarms to the control centre in emergencies and when the user wishes to access services. The home automation package is linked to this remote intercom. The electronic bracelet or pendent also links

to “Quiatil+” and when the button is pressed on the device an immediate connection is established with the telecare platform, which assesses the situation and responds appropriately (e.g. by reassuring the older person, calling the emergency contacts or the ambulance, or the fire brigade, etc.). The manufacturer/provider is INTERVOX

Source: Web page of the system

The Switched *Telephone* Network can be substituted by the connexion of a GSM gateway.

This telecare service is provided through 2 technical vigilance platforms 24/7. It was created in 2001 and updated in 2007. One platform, located at Naves (Corrèze Department), is multiprotocol (it has the capacity to connect all the brands of transmitters and issuers currently available in the market), and equipped with an integrated system provided by ESI (one of the main providers of alarm monitoring in France, which automatically receives and manages calls). A second platform, used as a backup, is located at Tulles (Corrèze). It is equipped with the same system provided by ESI. This platform immediately substitutes the main platform, should it cease to function. In the Creuse Department, this second platform was replaced in 2010 by a local platform. Both platforms communicate through VPN OLEANE.

The prices of these devices per unit and without taxes are:

Device	Price per unit without taxes (In Euros)
Quiatil + issuer	140
Smoke sensor	66
Temperature sensor	98
Gas sensor	132
Solenoid valve	58
Remote control shut off valve	45
Light Path (1)*	424
Light Path (2)*	351

Note: (*) They are two types of light path depending on the distance between the bedroom and the bathroom.
Source: Service de Délégation Publique (Contrat)

3.1.4 Technical barriers

Regarding the **standards applicable to the technology**, the information available only indicates whether the telecare service complies with the European standard for social alarms (EN 50134). The telecare device Quiatil+ is manufactured by INTERVOX and complies with the following standards:

- European standard for social alarm (EN 50134).
- European frequency for social alarm: 869.20-869.25 Mhz.
- The radio receiver class 1 complies with the last European directive on CE marking (2008)
- The product is manufactured in the EU according to the electric security standard of information processing terminals (EN60950).
- Compatible with the different European phone networks.

The pendant issuer complies with the norm EN 50134-2 for the trigger devices of social alarms.

Interoperability or technical barriers were an important technical problem in the deployment of the home automation package for Creuse General Council. They found that many of the electrical installations in the older adults' homes did not comply with the current standards. They therefore developed an electrical security plan to reform and adapt the electrical installations, consisting mainly of: installing a differential transformer of 30 mA (milliamps), an electric board, and carrying out the work to connect the electric installation to the ground. The General Council agreed with the association of tradespeople a flat rate package to proceed with the necessary installations and assumed the cost of this work. The cost varied between €200 and €1000, with an average cost per home of €500-700. The tradespeople were in charge of doing the new installation according to the current standards. Moreover, the Creuse Department also signed an agreement with EDF (the main producer and distributer of electricity in France) to align the electrical installations of the homes to the current norms at the end of 2013. With this agreement, EDF is now a partner of the programme and is funded for part of the cost of the adaptation work (the rest is funded by the Creuse General Council).

According to the case representative, the service is interoperable in the department, region and the country.

3.1.5 Quality assurance of the service

In the **Creuse Department**, there is no specific procedure for quality control of the service. The service provider, according to the Public Service Delegation, must inform monthly about their technical activity and report yearly about technical and financial functioning. In general, the monthly and yearly report inform about:

- Home care interventions: deployments, uninstallations, updates, and expenses.
- Exploitation: number of deployments, number of incoming calls, number of alerts attended in the call centre, number of friendliness calls, number of technical and maintenance interventions, and difficulties found with the users.
- Statistics on user satisfaction.
- Materials.
- Staff.

The General Council also carries out a technical and satisfaction follow-up on the service through phone calls and home visits when the equipment is installed, 6 months after the installation, and a satisfaction survey.

We do not have specific data on the satisfaction survey used in Creuse or on the results obtained. However, in the **Corrèze Department**, SIRMAD surveys the satisfaction of the users and the results may be very similar. The SIRMAD survey evaluates the following points of the service provision:

- Administration service: satisfaction with the reception and information
- Satisfaction with the installation of the device
- Satisfaction with the reply to the alarms.
- Satisfaction with the accompanying and friendship service.
- Satisfaction with the installed devices
- Satisfaction with the home automation
- General level of satisfaction

3.1.6 Training actions

Both the Creuse and Corrèze Departments have developed specific training strategies to give competences and skills to professionals in the service.

The **Creuse department** developed a strong strategy to train staff involved in providing the service before its implementation. This strategy was planned after the testing phase in 2007/2008, in which the awareness and training of the staff involved in the service delivery chain was found to be important for the successful implementation of the service. The aim was to ensure that the professionals were convinced that the service was appropriate and would transfer it later to the older adults. It also aimed to guarantee its correct installation, use, maintenance and repair. This strategy helps the end-users to feel more secure and convinced about the usefulness of the service for their wellbeing.

A network of tradespeople was educated to deploy and maintain the solution at homes throughout the Department. Around 25-30 tradespeople (includes plumbers / heating engineers –chauffagistes) were trained in home automation by SIRMAD (the telecare provider) and Legrand/Intervox (technical providers). This education was certified by the Centre National d'Innovation Santé, Autonomie et Métiers (CNISAM) of the Creuse Chamber of Trades and Crafts with a diploma in Master of Advanced Learning (Maître d'Apprentissage Confirmé – MAC).

The Creuse Department also trained General Council staff who intervene at users' homes (for home automation, care workers and social care workers), the home care services (provided by home care professionals of seven associations of the territory), and the installers. The training topics focused on:

- Features of the home automation pack devices.
- Psycho-sociology of people who have lost autonomy.
- Installation and maintenance of equipment.
- Prevention of health risks at home.

Each topic was generally allocated 1 day's training. The training method as based on exposition and demonstration, and a booklet was distributed as a memory support.

The following training partners helped the General Council of the Creuse Department deliver the training:

- DOMO23. This organisation is composed of three public training bodies: Association nationale pour la formation professionnelle des adultes – AFPA-, groupement d'établissements publics locaux d'enseignement – GRETTA, and Centre de Formation Professionnelle et de Promotion Agricole –CFPPA). It was created specifically to address the needs of the project.
- The Centre National d'Innovation Santé, Autonomie et Métiers Limoges (CNISAM Limoges), teaching tradespeople about health and personal autonomy issues.
- The manufacturer of the home automation equipment package LEGRAND (with its subsidiary telecare company: INTERVOX). Legrand is in charge of training the installers, electricians and other stakeholders, through its international education centre Innoval.
- The Caisse nationale de solidarité pour l'autonomie (CNSA)» (National Solidarity Fund for Autonomy).[16] In September 2012, the Creuse General Council and CNSA signed an agreement to

[16] The CNSA (National Solidarity Fund for Autonomy) was created in France in 2004 following the events linked to the 2003 heat wave and in connection with the new disability bill, voted in 2005. These events highlighted the need for the elderly and disabled people for modern social and medical residential facilities and support services which require increased funding. See: http://www.cnsa.fr/rubrique.php3?id_rubrique=148

modernise and professionalise the home care services in the Creuse Department for the period between 2012 and 2014. These home care services are provided by seven associations in the territory. One of the aims of this agreement is to train and qualify the home care staff to learn to use home automation technologies. The CNSA will train 750 home care staff with a session on the home automation system and advanced telecare.[17] The budget allocated to this action is €31,000 for the two years.

- The Communauté de Communes de Guéret Saint – Vaury (Community of Municipalities of Guéret Saint-Vaury) is a community of 19 Creuse municipalities, created in 2000 to promote cooperation. This Community created the Rural Excellence Hub on home automation and health to improve the quality of life of their population, promote companies and services to create jobs, and to ensure sustainable development. This institution developed initial and continuing training inside the Hub:
    - Launching, in collaboration with Limoges University in 2008, a degree in health sciences and technologies, specialising in home automation and autonomy. This training prepares technicians to propose and develop solutions that compensate for people's disabilities and delay their loss of autonomy. A professional masters in "circuits, system, micro and nanotechnologies" (University of Limoges) and the engineering degree "Electronics and Telecommunications" (ENSIL- University of Limoges) complete this training.
    - Building a continuing training programme with AFPA, GRETA, AFPI and CNISAM on accesibility, ICTs and independence.

This training was funded by different actors. The cost of training for the General Council's home automation team and the social and health care professionals was assumed by the General Council. For home care associations, the cost was covered under the terms of an agreement between the General Council and the CNSA. In the case of installers, the training was paid for by private organisations.

Since 2013, the General Council has been developing a huge training plan in the **Corrèze Department**. This is mainly focused on the setting up of a workshop and a showroom. The workshop is equipped with home automation devices and it has been open to professionals and individuals since November 2015. It allows:

- Individuals to test devices before buying them for their own homes.
- The General Council and its partners to present their devices and services.
- Professionals to use it for training.

The workshop was built by Legrand (the technical provider) in partnership with Corrèze Téléassistance. Legrand provides the home automation devices.

The General Council has also developed a showroom to interest people in home automation and mobile support and devices. For example, at the end of November 2013, a showroom was planned to present the latest technological innovations in home automation for health, mobility, communication and entertainment for the older adults. This showroom was developed in partnership with the Corrèze General Council, the Legrand companies, Corrèze téléassistance, Promotélec, Sensilia (specialist in digital competence for older people). It will present the devices for older people and disabled people to support and improve ageing at home with new technologies.[18]

We summarise below in Table 3 the main characteristics of the training activities for this solution.

[17] The training will be on the following components of the package: telecare, gas and smoke sensors, high temperature sensor, and light path.

[18] http://www.tourismelimousin.com/diffusio/fr/agenda/index/ussel/showroom-domotique_TF0239000521.php

Table 3: Summary of training activities for advanced telecare

Creuse Department	
Programme/Strategy	Global training strategy for actors involved in the provision of the solution.
Aim	To guarantee the correct installation, use, maintenance and repair of the solution.
Target	Actors involved in providing the solution: • Tradespeople (includes Plumbers / Heating Engineers –chauffagistes). • Professionals of the General Council. • Home care professionals. • Installers. • Technicians.
Content	Tradespeople: home automation. For professionals of the General Council, home care professionals and installers: • Features of the devices in the home automation pack. • Psycho-sociology of people suffering from loss of autonomy. • Installation and maintenance of equipment. • Prevention of risks to health of people at home. Technicians: Degree in health sciences and technologies, with a speciality in home automation and autonomy.
Timing	Tradespeople, professionals of the General Council and installers are trained at the beginning of the Public Service Delegation. One day per subject. Home care professionals are trained in the framework of a strategy covering the period 2012-2014. Technicians can study a master's degree at the University.
Training method	Training centres, with exhibitions and demonstrations
Certification	Tradespeople with a diploma in Master Advanced Learning from the Creuse Chamber of Trades and Crafts (CNISAM). Home care professionals are certified in home automation technologies. Technicians can get a degree in health science and technologies from the University of Limoges
Trainers/responsibility	Tradespeople are trained by the Centre National d'Innovation Santé, Autonomie et Métiers (CNISAM) of the of the Creuse Chamber of Trades and Crafts Professionals of the General Council are trained by DOMO23 (composed by three training public bodies). Legrand, the private technical provider, support all the training with the provision of the solutions. Technicians are trained by Limoges University and the Communauté de Communes de Guéret Saint-Vaury.
Funders	The General Council is a co-funder. For the training of home care professionals, the funding also comes from the National Solidarity Fund for Autonomy.
Corrèze Department	
Programme/Strategy	The provision of an equipped workshop and a showroom
Target	Individuals and professionals.
Aim	To allow individuals to test the technology, the General Council and partners to present the technology, and train professionals.
Content	There is no specific content
Timing	The programme started in 2013
Training method	The training is focuses on the demonstration of devices.
Trainers/responsibility	The General Council.
Funders	The General Council. Legrand, which provides the home automation devices.

3.1.7 Scaling and market creation

As already explained, the General Council created and developed the advanced telecare service through a Public Service Delegation in the **Creuse Department**. It set up "Domo Creuse Assistance" to deploy and manage advanced telecare in 2,000 homes of frail older people for a period of 5 years (2010-2015). The General Council envisages a new delegation for a further ten years from 2015.

As the case representative said, the **enabling factors for the creation of the service** were the demographic characteristics of the Department (aged population, isolated and dispersed), and the existence of a previous device (the telealarm) which had been widely used and accepted (BIOTEL).The most important facilitator has been the political will to start this project, work on it, meet actors, and to launch a large-scale deployment. She also notes that the most important **barrier for the service creation** was finding an economic model able to build an accessible offer for a large number of people. They resolved this problem with the help of a consulting company.

Regarding **facilitators and barriers for the implementation of the service**, the case representative of Creuse advanced telecare identified three factors that have enhanced the implementation of the services:

- One is that the Department supports and prescribes the project and the social workers recommend the service during the home visits.
- The second factor is the existence of the telealarm service, which was widely known and used by the population. It was possible to capture more people by telling those that asked for the existing telealarm service about a new and enhanced service.
- The third factor that facilitated implementation is that the Creuse Department is small and it is easy to meet all the stakeholders involved, to motivate them and to ensure their commitment to the new service.

The two main barriers for the implementation have been the problems mentioned regarding the electric installation, which were resolved when the General Council assumed the cost of new installation under an agreement with the tradespeople. The misconceptions held by professionals constituted a second barrier to the new service (such as it could reduce their working hours), which made them reluctant to recommend it. To overcome this, the General Council implemented an awareness-raising plan at the beginning of the deployment, before the professionals started communicating with possible end-users.

The service has been implemented in other 2 Departments of the Limousin Region (Corrèze and Haute-Vienne), and in another French Region in the Loir-et Cher Department (Centre Region). The strategy used in these cases is based on exchanges and collaborations among the policy makers and the technical officers of the Departments, about questions such as the economic and organisational models to be developed and the facilitators and barriers found. This collaboration happens at face-to-face or phone meetings, or in conversations or presentations. As the case representative commented, replicability of the service in bigger Departments could be more difficult than it is in smaller Departments.

3.1.8 Policies and the role of policy in creating, implementing and scaling-up the service

Advanced telecare is a measure which originated in the Departments, as the regions are responsible for long-term care. In this sense, the **Creuse Department** (and also Corrèze) plays a major role in the creation, implementation and scale-up of the service. They financially supported the testing of the service, and the integration of the service in the social services system for older people at home. They also created a Public Service Delegation that ensures the deployment of the service and that an appropriate number of people in need are reached. In the Creuse Department, the solution is totally integrated in the Department's governmental system because the Creuse department's actors have a shared vision.

In the **Corrèze Department**, the development of advanced telecare is included in the new strategy of the Corrèze General Council for 2012-2016 to maintain older people at home through new services.[19] This is a continuation of the former 2004-2008 gerontological framework. The objective of this previous framework was to propose innovative methods to support older people at home. Moreover, the provision of this service is also part of the the Corrèze General Council's local Agenda 21 for 2015 to adapt the homes of older people who are at risk of becoming dependent.

3.1.9 Evaluation process of the effectiveness of the service

Final objective of the evaluation process: A preliminary study called the ESOPPE project evaluated the efficacy of the advanced home automation system and telecare. This evaluation was an initiative of the General Council of Corrèze,[20] the Fondation Caisse d' Epargne pour la Solidarité, and Corrèze Téleassistance (Public General Delegation). Both organisations funded the project,[21] to test the potential to develop this solution as a service for ageing in place and to improve the quality of life of older people in this French Department. This evaluation is framed in the agreement between the French Government, the Caisse Nationale de Solidarité pour l'Autonomie (CNSA) and the General Council of Corrèze to modernize and professionalize the home help services in the Corrèze Department.

These organizations aimed to show that this system could effectively improve independence of older adults, by testing a specific component - the light path - coupled with the telecare service for preventing unintentional falls at home in a frail older population (Tchalla et al., 2012). The system was tested on 194 adults aged 65 and over living at home in the Corrèze Department in the Limousin Region. 94 were equipped with the light path coupled and the telecare service and 96 were unequipped, over a period of 12 months.

Definition of the evaluation process: The researchers in charge of the evaluation (Tchalla et al., 2012) hypothesized that the light path could reduce falls by providing better adapted ageing-induced-vision-dysfunction and by showing the right path to the toilets and by improving consciousness. The telecare service is effective 24/7, and allows older people to activate an alarm if they fall.

The sample was composed of 194 adults aged 65 and over living at home. 94 were equipped with light path coupled with telecare service and 96 were unequipped, over a period of 12 months. The

[19] Schéma Départemental de l'Autonomie 2012-2016, Conseil Géneral de la Corrèze : http://www.correze.fr/fileadmin/user_upload/Solidarite_insertion/Solidarite/schema_autonomie2012.pdf

[20] The legislative body of the Department of Corrèze

[21] The total budget allocated to the project was €517,150: €114,855 (Corrèze General Council), €179,100 (Corrèze Téléassistance), €155,145 (Téléassistance) and €68,050 (Other players).

older people included were affected by reduced independence (largely levels 2-4 on the AGGIR scale - the French scale used for grading the degree of an individual's dependency). People with severe dementia or already in fall prevention rehabilitation were excluded.

The research was a prospective cohort study that used dynamic random allocation with the minimization method to identify participants, who met the criteria, for the exposed and unexposed groups. All the participants were taken from the same population. The study was carried out from 1 July 2009 to 30 June 2010 in the Corrèze Department in Limousin area (southwest France).

The exposed group was equipped with light paths and the telecare service and the unexposed group remained unequipped. Participants in the exposed group were equipped with the advanced home automation system and telecare detailed above, although not all the elements were included. It included the home-based technology with the light path coupled with telecare. Each participant of the intervention group had the electronic bracelet with a pendant and a dialer.

The evaluation process was based on variables[22] which were measured at baseline and follow-up. Outcomes variables were also evaluated but only at follow-up. The variables evaluated at baseline and after the intervention, and the instruments used to do so, were:

- Socio-demographic data: age, gender, marital status, education, presence of caregiver and residence.
- Medical history of previous falls, comorbidities and medications.
- Functional autonomy status using ISO-SMAF classification. This classification has 14 profiles based on the 5 dimensions of the SMAF scale: Activity of Daily Living (ADL), mobility, communication functions, mental functions, and Instrumental Activity of Daily Living (IADL) (Dubuc et al., 2006).
- Frailty status according to Fried Frailty criteria. This tool measures five components of the frailty syndrome: unintentional weight loss, depression, weakness, slow walking speed, and low physical activity (Cesari et al.,2006).
- Cognitive status using the Mini Mental Status questionnaire (Pfeiffer, 1975),
- Nutrition status evaluated through the Mini Nutritional Assessment (MNA) (Rubenstein et al., 1999).
- Depression status using the Geriatrics' Depression Scale (GDS) (Yesavage et al., 1982).
- Arterial hypertension.
- Existing illnesses, visual and hearing impairment, incontinence and orthostatic hypotension.

Outcome variables evaluated at follow up were:

- Cumulative incidence rates of falls at home over the period of 12 months following inclusion in the study.
- Cumulative post-fall hospitalizations for fall at home.
- Acceptability: the acceptance rate for the home automation system, calculated as the ratio of people who initially chose to use the automation equipment and the number of patients who accepted the equipment.

The evaluation did not collect any economic data.

[22] As it is not the aim of the study to look specifically at the instruments used in each evaluation study, we refer the readers to the publications which have the specific references to the instruments.

Procedure for data collecting:

A researcher physician and a social worker visited eligible participants at home to explain the purpose of study, to obtain written informed consent, and to collect baseline data and follow-up data at 6 months and at 12 months.

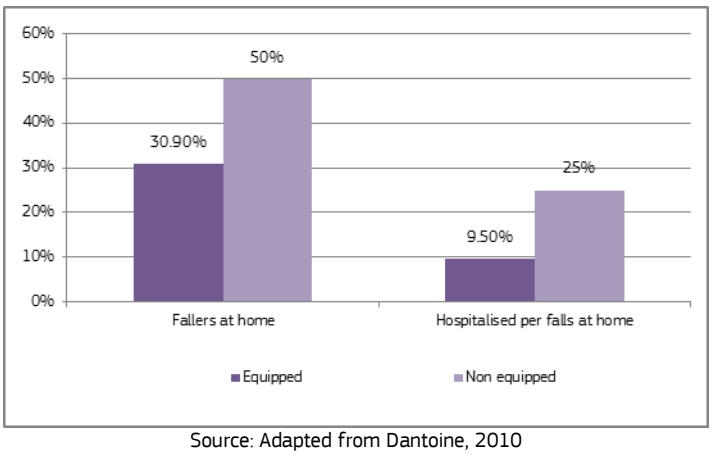
The confidentiality of the data was ensured, and the study protocol was accepted by the National Committee for the Protection of the Computerized Data DR-2010-329 (CNIL, Commission Nationale Informatique et Liberté) and the local ethics committee. Written informed consent was obtained from all participants involved in the study (for people with a cognitive impairment, a family member or carer provided the written consent).

Findings were therefore focused on the quality of life of the older people, excluding any economic data and results on quality improvement. Two important findings from the study point to an improvement in the quality of life of older people who are equipped with the ICT-based service (compared with those non-equipped).

First, during the year of intervention, the use of light path with the telecare service helped older people to fall less often at home with a lower risk of being hospitalized because of a fall at home, (see Figure 1):

- Fewer older people fell at home in the group equipped with the light path coupled with the telecare service than in the group which was not equipped with this technological solution. 30.9% of older people who had the equipment fell at home in the 12 month period against the 50.0% of non-equipped older adults during the same period. This reduction was significantly associated with the use of the equipment. The light path coupled with telecare reduced falls at home by a factor of 1.6.
- Fewer older people were hospitalized due to falls at home in the group equipped with the light path and with the telecare service against those who were not equipped with this technological solution. In the 12 months of the study, 9.6% of equipped older people were hospitalized due to falls at home compared with the 25.0% of those who were not equipped. This reduction was significantly associated with the use of the equipment. The light path coupled with telecare reduced hospitalizations as a result of falls at home by a factor of 2.6.

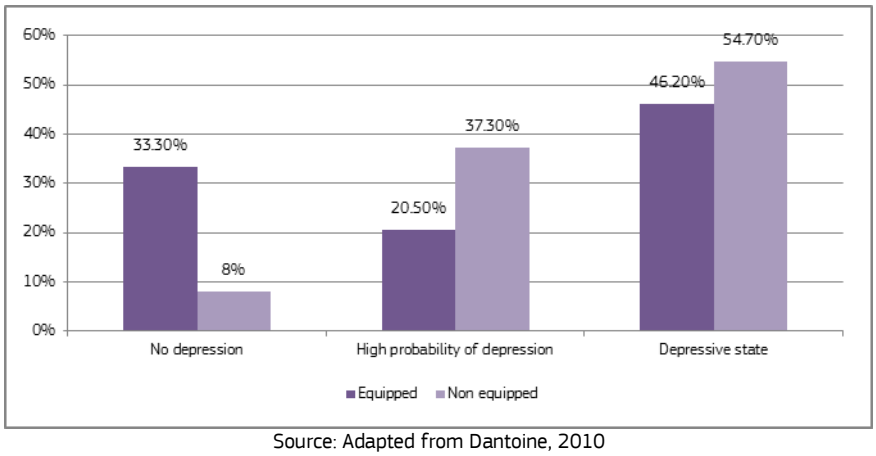
Figure 1: Fallers at home and hospitalized due to falls at home. Comparison between equipped and non-equipped. %



Source: Adapted from Dantoine, 2010

Secondly, after a year of intervention, fewer older people were depressed in the group which used the light path coupled with the telecare service (33.0%) than in the group which was not equipped with this solution (8.0%).

Figure 2: Level of depression among equipped and non-equipped. %



Source: Adapted from Dantoine, 2010

The only data available regarding cost-efficiency is the difference between the cost of the solution and the savings generated by reducing the number of hospitalisations due to falls at home. The package costs €1,700 the first year and €700/year the following years, while the average cost of a hospital stay per fall is €8,000 (Dantoine, 2010).

Other evaluations: There are currently two on-going evaluations of this technological solution. Firstly, the University Hospital of Limoges is now developing the Project "Home-based technologies coupled to a tele-assistance service for the Elderly" – The DOMOLIM study.[23] This research is testing the complete solution with 1,200 participants, in order to evaluate the cost-effectiveness of the home automation pack coupled with telecare for preventing falls in the frail older population. Two groups – equipped and non-equipped – have been randomly selected and will be compared regarding their cumulated incidence of falls (primary outcome), and functional autonomy, regular physical activity, admissions in institutions, and length of stay in rehabilitation unit (secondary outcomes). This randomized study will use the criteria of the Model for Assessment of Telemedicine (MAST[24]) for medico-economic evaluation of technology solutions for the prevention and care in older population. MAST includes a multidisciplinary assessment to describe and assess the different outcomes and aspects of the specific telemedicine application. The different outcomes are divided into 7 groups or domains (Kidholm et al., 2010):

- Targeted health problem and characteristics of the application
- Safety
- Clinical effectiveness
- Patient perspectives
- Economic aspects
- Organisational aspects
- Socio-cultural, ethical and legal aspects

The project started in October 2012 and it will be completed in March 2015.

Secondly, this solution is also being evaluated in the project ICARE.[25] This industrial project evaluates on a large scale the economic, organizational, health and social impacts of the solution in

[23] The data on this study has been retrieved from http://clinicaltrials.gov/show/NCT01697553.

[24] For more information on MAST, see the MAST final report at http://www.mast-model.info/Downloads/MethoTelemed_final_report_v2_11.pdf

[25] http://www.projet-icare.fr/

four Departments: Creuse, Corrèze and Haute- Vienne (the 3 Departments of the Limousin Region), and Loir-et-Cher (a Department in the Centre Region). This project started in January 2013, and it will last 24 months. Legrand leads the project, and it is supported by the Limousin Region and the Health Regional Agency. The consortium is composed of 24 organisations (institutions, services, banks, health organisations, hubs and networks and industry). The project is funded by the programme «Développement de services numériques pour la santé et l'autonomie» of the Fonds national pour la Société Numérique (FSN) which is part of the wider programme des Investissements d'avenir[26].

The ICARE project will deploy two levels of technological solutions linked to an advanced telecare platform, in 2,048 homes in four Departments. The first deployment refers to the regular home automation with advanced telecare described: i.e. a light path, smoke and fall sensors, and advanced telecare. The second deployment includes this standard package complemented with a touch device, a notebook, a telemanagement service and a home telemonitoring system. Two levels of evaluation will be implemented. The first deployment will undergo an economic evaluation in the Departments of Creuse, Corrèze and Haute-Vienne in 2000 households, with a representative sample of the population over 75 years of the Departments. The researchers will obtain a cost-efficiency evaluation of the solution. The second deployment will be assessed through an organizational and health and social evaluation in 293 homes in the four Departments.

3.1.10 Organisational change: integration of the technology–based service in the delivery chain of care

In the three Departments of the Limousin Region (Creuse, Corrèze and Haute-Vienne), the solution is provided to older people by the General Council. In the Creuse and Corrèze Departments, the General Councils of each Department have created a Public Service Delegation with a private care provider to deploy and manage the advanced telecare at the homes of older people. In the two Departments, this Public Service Delegation has been awarded to the care provider Sirmad Telecare.

In the **Creuse Department**, the Public Service Delegation was awarded in June 2010 for a period of 5 years (2010-2015). The Public Service Delegation is called "Domo Creuse Assistance". It aimed to implement an advanced telecare service based on the progressive substitution of the telealarm service already implemented in the Department, and to provide the service in the homes of up to 2,000 frail older people. The **deployment plan** was progressive. From 1996 to August 2010, a first generation telecare (telealarm provided by BIOTEL) had been provided to users. From September 2010, the service care provider changed the device for a new solution, covering 1,850 users. The existence of a previous telealarm system and the fact that the professionals involved had been trained in the new system and made aware of its advantages (see Section 3.1.6) before the service started were decisive factors in the successful deployment of the service. Some initial difficulties were caused by the non-adaptation of the electric installation of many houses to the current electrical norms. This difficulty was overcome when the General Council assumed the cost of adapting the old electrical systems with the new under an agreement with the relevant tradespeople.

The Public Service Delegation establishes different functions for the Department and for the care provider. The General Council retains the global management of the service (the analysis of the needs; the reception and study of requests; awareness raising and promotion of the device; and the monitoring and follow-up of the installations). General Council staff goes to the older people's homes (to evaluate the feasibility of installing home care automation, to establish a diagnostic for risk prevention, and to control the installations and the satisfaction surveys). The care provider is,

[26] http://investissement-avenir.gouvernement.fr/content/programme-d%E2%80%99investissements-d%E2%80%99avenir-14-projets-s%C3%A9lectionn%C3%A9s-dans-le-cadre-de-l%E2%80%99appel-%C3%A0-proj

according to the public service delegation, in charge of carrying out the installation and maintenance of the devices, managing the telecare platform and the coordinating assistance.

The Creuse General Council is in charge of the **referral process**. Requests for the service may coming into the General Council directly, or may be passed on by the service provider through the telecare platform. In any case, only the General Council can entitle people to the service. The older adults access the service after an evaluation by the General Council, which decides whether they can receive the service and what they will pay (co-payment or not). The evaluation considers the older peoples' care needs and the technical feasibilility of installing the equipment in their homes. Currently, discussion is taking place about delegating the responsibility for this evaluation to the service provider. For the time being, however, it is still the General Council which decides who is entitled to the service. The costs of the service are paid to the service provider as follows:

- For a user with no coverage, the monthly cost of the subscription is €38.27 per month. This cost includes: the cost of the service covered by the Department, the cost of the installation, and the cost of the maintenance.
- The monthly fee may <u>be partially or totally covered</u> by private insurance plans or by public subsidies, concretely by:
  - The Conseil Géneral covers a part of the cost of the service for users under minimum revenue. These users pay €6.30 per month.
  - Fiscal reduction for taxable users.
  - Caisses d'assurance retraite et de la santé au travail (CARSAT) and Mutualité Sociale Agricole (MSA) cover between €15 and €25 per month depending on the income.
  - Office National des Anciens Combattants (ONAC).

At this stage, the General Council transfers the dossier to the care provider (Sirmad Telecare). The service provider is then responsible for organising the service, installing it at the older people's homes, providing the telecare and carrying out the maintenance and supervision of the care package. These responsibilities have been transferred by the General Council to SIRMAD under a **procurement** agreement (the Public Service Delegation), that defines the roles of the care provider contracted (see details of the roles in Table 2 of Section 3.1.2). This agreement states that all devices used must comply with all the telecare equipment standards.

Once the service is received, the telecare provider and the older people sign a contract that regulates the provision of the service. After signing this contract, the care provider sends an installer to connect all the devices, carry out the testing and settings needed, and explain to the older people and their carers how the equipment works. The equipment is installed in a period of 15 days maximum; unless it is urgent (24 hours) and it supposes 0.5 to 1.5 person/month per home.

The **service is delivered** to the older people following a protocol to manage the different types of alarms provide by the sensors or activated by the users (see service provision in Section 3.1.1):

- General procedure.
- Falls or discomfort.
- Friendliness.
- Request for services.
- Request for repair.
- Demonstration, installation, and maintenance.
- Anxiety.
- Information.

There is also a general procedure for activating the solidarity network in cases where the user does not respond, falls, requests a service, suffers discomfort or when service deliverer makes contact with the user to hear their news..

Service provision is **controlled** by the General Council through monthly and yearly reports on statistics of use and interventions (see Section 3.1.5 on quality).

Maintenance is carried out by the service provider. A regular technical test is carried out at the call centre every 48 hours, and different actions are taken depending on the results of the test. The service provider guarantees to act immediately if there is a technical problem, and subcontracts a 7days a week maintenance and repair service with the different technical companies. The case representative has reported that the main barrier at the moment are technical problems with the phone network (Orange), as its functioning does not depend on the General Council or the delegated service provider. Any technical problem with the phone network leaves the older people without service and the service is not re-established until the phone company is able to resolve it. The General Council has tried to find solutions with the phone company, such as prioritising houses equipped with the advanced telecare when they have problems, but the phone company is not able to respond appropriately. The only solution possible is to switch to a mobile connexion (3G) until the land connexion is re-established.

The equipment is also **removed** by the care provider under different circumstances:

- When technological evolution makes it possible to replace the equipment with a more innovative solution.
- At the end of the contract, the equipment is removed within 15 days maximum, and a removal certificate is given to the users. After the removal, the equipment is tested and stored by the technical provider.

The **Corrèze Department** set up a Public Service Delegation to offer the home automation with advanced telecare service on 1 January 2013. This Public Service Delegation offers the service, under the name of "Corrèze Téléassistance," through Sirmad Telecare for a period of 10 years. A previous Public Service Delegation has been in place since 2000 offering the telealarm service (as in Creuse). Between 2009 and 2011, the Corrèze Department carried out the ESOPPE project to evaluate how effective home automation with advanced telecare was for 100 users. In 2012, due to the positive results of this study, the Corrèze General Council renewed the Public Service Delegation to include the deployment of the home automation with telecare. The delegation is similar to the one in Creuse.

The table below shows the service prices (in Euros) in the Corrèze Department. These prices will be revised every year on 1 January during the Public Service Delegation 10 year contract. The maximum coverage of the monthly fee, determined by the Public Service Delegation, is €18 which is, paid by the APA or PCH.

	Including Tax and VAT	Excluding Tax
1.- Subscription telecare	€18	€15.05
2.- Subscription advanced telecare and home automation with LED type path light	€30	€25.10
3.- Subscription advanced telecare and home automation with path light integrated in the electric installation	€40	€33.40
Installation 1	€15	€12.60
Installation 2	€26	€21.70
Installation 3	€90	€75.25

The **Haute-Vienne Department** is still in a testing phase and the service is provided through an agreement between the General Council, Legrand, the National Solidarity Foundation for Autonomie (CNSA), Fondation Caisse d'Épargne pour la Solidarité and Sirmad. Older people can participate in the testing after accepting the proposal for the Allocation Personalisée D'Autonomie –APA – (Autonomy Personalised Benefit). Once the older people accept the offer, a home automation technician evaluates how feasible it would be to install the system and give support to the users. The system is installed for 2 years and will be made available to 250 recipients of the APA or Social Allowance.

In the case of the Haute–Vienne Department, the cost of the service is as follows:

- The monthly subscription is €42, due to the contribution of €23 per month to the total price made by the National Solidarity Fund for Autonomy (CNSA- Caisse Nationale de Solidarité et d'Autonomie).
- For older people entitled by the Personal Care Allowance at home (Allocation Personalisée d' Autonomie – APA), these €42 per month can be partially or totally covered by the APA depending on the older people' resources.

Table 4 presents a summary of the role of the public and private sector in the integration of the solution in the care system.

Table 4: Summary of roles of the public and private sector in the integration of advanced telecare in the care system

Roles	Public institution	Private	Partnership
Creuse and Corrèze Departments			
Policy	X		
Communication	X		
Awareness raising	X		
Planning of deployment	X		
Diagnosis (individuals)	X		
Control of installation	X		
Control of service delivery	X		
Entitlement of service	X		
Funding service	X		
Service delivery		X	
Customer support service		X	
Training	X	X	
Haute-Vienne Department			
Policy	X		
Communication	X		
Awareness raising	X		
Planning of deployment	X		
Diagnosis (individuals)	X		
Control of installation	X		
Control of service delivery	X		
Entitlement of service	X		
Funding service	X		
Service delivery			X
Customer support service			X
Training	-	-	-

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3.2 TELEMONITORING SERVICE FOR CHRONIC CONDITIONS FROM PRIMARY CARE (TELBIL)

NUMBER	10
TYPE OF TECHNOLOGY-BASED SERVICE	TECHNOLOGY-BASED HEALTH CARE - TELEMONITORING
NAME OF THE PRACTICE (ACRONYM)	TELEMONITORING SERVICE FOR CHRONIC CONDITIONS FROM PRIMARY CARE (TELBIL)
LEVEL OF NEEDS COVERED	CHRONIC CONDITIONS
COUNTRY	SPAIN
VERIFICATION OF THE CASE:	Case verified by Iñaki Martín-Lesende, case representative, on 22 July 2014. Economic data were also verified by Juan Carlos Bayon, TELBIL's health economist, on 23 July 2014
Brief description: TELBIL is a telemonitoring service which targets chronic patients affected by heart failure and chronic lung conditions, and whose functional limitations make it difficult for them to leave their homes for treatment. This service monitors their health from their homes, in order to deal with the deterioration in their health and emergencies. The service was implemented by the Spanish Basque region from 2009 to 2014 as part of a health care policy to address the impact of the increase of chronic patients. The telemonitoring system consists of a smart phone personal digital assistant that records the patient's health data and sends it to a web manager, who makes it accessible to health care professionals at the primary health care centres. These health care professionals can check every day the status of their patients remotely, and respond to any deterioration in their health or an emergency. The service was provided as part of the public health care service portfolio of the health care department of Bilbao (Basque Region).	

3.2.1 Business case

MOTIVATION FOR THE PRACTICE: The motivation for the telemonitoring service for chronic conditions in primary care (called onward as **TELBIL**) was the health care strategy of the Basque Region in Spain. In 1992, the region was interested in pursuing the development and implementation of health care technologies, and created a service for the evaluation of health care technologies called OSTEBA: Basque Office for Health Technology Assessment[27] as part of the Health Care Regional Ministry. Later, in July 2010, the region also published a renewed health care policy in a document called "Strategy to deal with the challenge of chronicity in the Basque Country" (Gobierno Vasco, 2010a). This 2010 health care strategy was structured around chronic conditions, they constitute a major challenge for the health care system of the region, because they:

- Highly limit the quality of life and productivity of affected people.
- Increase morbidity and mortality.
- Increase health and social costs endangering the sustainability of the social protection systems in the medium term.

The 2010 health care strategy was designed to improve the health and well-being of the chronic patients, and to reduce the incidence and impact of these diseases at micro-, meso-, and macro levels. This strategy was structured around 3 main axes:

- A mid-term vision, which defined and described the future situation for the Basque Health Care System. The vision was focused on transforming the health care system of the region, making it able in the mid-term to address the needs of chronic patients and their carers, health care professionals, and citizens, in general.

[27] OSTEBA (Servicio de Evaluación de Tecnologías Sanitarias) - Basque Office for Health Technology Assessment was established in autumn 1992. It aims to promote the appropriate use of health technologies in terms of safety, effectiveness, accessibility and equity, providing necessary information for decision-making.

- The second axis referred to the health care policies for chronic conditions as guides to reach the mid-term vision. These policies were focused on prevention, care, rehabilitation and health care of chronic patients, as complementary to the management of acute patients.
- The third axis was 14 strategic projects that contribute to generating and implementing the change to realise the vision and the policies. One of the 14 strategic projects was focused on promoting a Multichannel Health Service Centre in order to increase the channels through which citizens can interact with the health care system. This project also planned to create a home care service through telemedicine (remote assessment and a telemetric service) for chronic patients with multiple, unstable and advanced pathologies at home. Accordingly, several structures were created to promote the change of model, and projects were launched to discover appropriate practices inside these structures. These projects were funded by the chronicity office of the Health Care Ministry (in charge of coordinating these projects), the "Equipo de Apoyo a la Investigación en Acción" (EDALIA) (work group in charge of promoting projects among professionals), and more recently by the Association Centre for International Excellence in Research on Chronicity- Kronikgune (Asociación Centro de Excelencia Internacional en Investigación sobre Cronicidad).

In these regional policy frameworks, a telemonitoring model, targeted at chronic patients in primary care, called TELBIL (TELBIL Randomised Control Trial: TELBIL RCT), was tested in 2009. This randomised control trial project aimed to find out how effective, acceptable, viable, satisfactory and cost-effective the TELBIL telemonitoring model was. The aim was to show the results to the health care professionals and managers to convince them to introduce this model if the results were good. Due to the success of the pilot project in terms of benefits showed mostly for the sustainability of the health care system, a further project called TELBIL-A was implemented from February 2012 to February 2014.

SERVICE DESCRIPTION: The telemonitoring service aims to monitor the health of chronic patients and to detect health deterioration and emergency situations at home. This service:

- Detects symptoms and irregular health parameters before the routine visits of the health care professionals to the patients.
- Applies corrective measures to the patients, preventing health difficulties.
- Reduces the number of visits of the patients to health care centres.
- Increases the quality of life of the patients.
- Optimises the use of health care resources.

The telemonitoring system consists of:

- Daily measurement and collection of chronic patients' health status through a smart-phone Personal Digital Assistant (PDA).

  The following health status indicators are measured and collected in a non-automatic way:

  - Clinical parameters of the patients: respiratory rate, heart rate, blood pressure, blood oxygen saturation by pulse oximetry, weight and temperature. These data are measured and collected by automatic sensors and some of them (heart rate, blood pressure, and oxygen saturation) transmitted to the PDA via Bluetooth. A manual sensor is used for transmitting weight and temperature.
  - A perception of their clinical and functional status over the previous day, manually captured through a brief questionnaire containing qualitative questions about these conditions (e.g. how their breathing was, etc.).

  These data are sent every day from home to the health primary care centre's web platform, via GPRS (General Packet Radio Service).
- Reminders to patients to take their medication and follow any diet prescribed.

- Daily revision of these data by health care professionals (primary health care doctor or nurse) at the primary care centre on the web platform. Immediate follow-up of patients if alerts are received of irregular values are carried out. Bi-weekly phone calls to patients are also made (by nurses). The professionals access the data during business hours from Monday to Friday. The PDA is also programmed to send alerts to the patients during the week-ends (when the primary health care centre is closed) when their values are above or below the threshold, suggesting they contact an emergency service.

The Basque Region started to implement the telemonitoring service in February 2010 in 20 primary health care centres of the Bilbao health care department of the Basque Region, monitoring at home, patients affected by heart failure and chronic lung diseases. The implementation, which started first as a randomised control trial called "TELBIL Randomised Control Trial" – TELBIL RCT (Bayón-Yusta et al., 2013; Martín-Lesende et al., 2013a,b,c; Martín-Lesende et al., 2011a,b), aimed to evaluate the effectiveness, cost-efficiency and satisfaction with this health care service model from 2010 to February 2012. It then continued until February 2014 with two implementation projects: one called TELBIL-A (Orruño et al., in press) that consisted of an extension of the pilot trial (TELBIL RCT) and a second one called TELBIL-T, which offered a telemonitoring service with telecare (Asensio et al., 2013). The service stopped in February 2014 because of lack of funding. Some patients were still being telemonitored during the elaboration of this report (July 2014), but the service will be closed in the coming weeks.

FEASIBILITY: Regarding the **feasibility of the content of the service**, Martín-Lesende et al. (2011b; 2013a,c) evaluated the ***satisfaction of professionals*** involved in several telemonitoring services in the Bilbao area, including TELBIL. The authors found that health care professionals accepted and are satisfied with the service. They valued the benefits of this service to manage and follow-up the chronic patients, mostly because they perceived that the service:

- Empowered patients to take charge of their own care, and gave them more security (also to their carers)
- Facilitated better coordination among the care service levels. The telemonitoring service succeeded in involving and coordinating professionals from primary, specialized and institutional care to assist chronic patients, allowing them to be continuously cared for with direct access to the health care system.
- Has benefits: some professionals had seen that their patients were admitted to hospital less often and the length of time they stayed in hospital was shorter.

Nevertheless, the health care professionals also pointed to some barriers to the use of the services, in particular:

- They indicated that the telemonitoring service supposed a higher care load. They proposed an increase in human and instrumental resources to reduce this overload.
- They also noted equality problems because the service was limited to the patients of the study.
- They reported some doubts as to whether the service reduced hospital admissions, or improved the health status and quality of life of the patients. This shows the importance of giving the results of the study, once the impact evaluation has been completed, to the professionals.
- The professionals also complained that patients were more dependent on them, because they needed to learn how to use the telemonitoring system, lowering the motivation among doctors and nurses. Regarding this, professionals suggested educating the patients, to teach them to recognize the symptoms, to manage their medication, making them more included and responsible for the management of their own health status.

Moreover, a quantitative analysis of the ***satisfaction of patients*** (n = 26) ***and their informal carers*** (n = 23) with the telemonitoring service carried out in the project TELBIL RCT (Martín-

Lesende et al., 2013) showed that the telemonitoring service was also accepted by patients and their carers. This analysis showed that:

- 80.8% were very satisfied with this new technology for monitoring their diseases.
- 88.5% claimed to know how to use the devices well.
- 69.2% thought that the devices were easy to use.
- 61.5% felt secure with the telemonitoring service.
- 76.9% controlled their disease better with this service.

A comparison of the satisfaction questionnaire scores for telemonitored patients in the TELBIL RCT and TELBIL-A studies showed that patients and carers of TELBIL-A were similarly or more satisfied with the service than they were in the TELBIL RCT, indicating that the improvements made in the service worked (Orruño et al., in press).

Regarding **organizational feasibility**, TELBIL's case representative informed us that the provision of the service is compatible with the regular clinical practice. The case representative also indicated that it is appropriate to include a project coordinator in each health care region, who can work in collaboration with the health care professionals, to monitor the implementation process of the service. The technological components, as described in Section 3.2.4, are also necessary to conveniently deliver the service.

The service is being provided as part of the national health care system, as a primary care service. The telemonitoring service does not require specific authorization to be delivered, although it had to be adapted to comply with confidentiality and data protection norms. The company in charge of the recording and storage of patient data followed the law on protection of personal data ("Ley Orgánica 15/1999, de 13 de diciembre, de Protección de Datos de Carácter Personal").

In terms of **economic feasibility**, a competitive advantage of the service is that it is provided as part of the national primary health care system, and is potentially accessible to everyone. Moreover, the telemonitoring service has been seen as an opportunity to address the challenges posed by chronic patients because this service could:

- Empower chronic patients to manage caring for their disease and their welfare themselves.
- Allow health care professionals to detect symptoms and irregular health parameters in normal or emergency health care visits, and to adopt corrective measures before more severe health situations develop.
- Reduce the number of visits to health care centres.
- Optimize the use of care resources and the productivity of health care professionals.
- Improve the efficiency of the care systems.

Although there have been some **technical problems** that could limit the economic feasibility of the project, these were raised mainly during the pilot trial (TELBIL RCT) and they were resolved in the implementation project (TELBIL- A):

- One of the main technical problems in the TELBIL RCT project was the web manager platform and its configuration. This platform, provided by the technical provider (Saludnova), had been used previously in a hospital with very few patients and the alerts were mostly managed by emails. The web management system needed to be adapted to a new setting (primary health care) and a higher number of patients.
- There were difficulties with the data transmission and reception due to lack of coverage or problems with the Bluetooth transmission. These difficulties caused delays and sometimes the information did not reach the platform. Generally, they were quickly resolved because a

technician from the technical provider worked closely with the project coordinator throughout the project.

The case representative informed us that, despite of the benefits shown, one of the main barriers to the economic feasibility of TELBIL has been irregular funding. So far, it has not been possible to include TELBIL in the public health care system budget as a regular health care service.

The service has demonstrated that it is **feasible** in term of improving the **quality of life** of older people and their informal carers. Regarding the effects on patients, Martín-Lesende et al. (2013a) carried out an analysis of the quality of life of 58 patients affected by heart failure and chronic lung disease in the TELBIL RCT study. The patients were recruited, and randomly assigned to treatment (receiving telemonitoring) and control (receiving usual care) groups for 12 months. The results showed a statistically significant tendency for telemonitored patients to report that they perceived their quality of life as better than that of those receiving usual care, after 12 months of treatment. Nevertheless, the authors did not find any significant differences between the groups in terms of quality of life related to health and in functional health after this period. Similar results were found later in the TELBIL-A study (Orruño et al., in press). The authors also evaluated the burden of the informal carers in the TELBIL RCT study. They found that, although a high percentage of them did not feel burdened (84%), those who cared for telemonitored chronic patients showed a statistically significant tendency to say that their burden was lighter after 12 months than that of the carers of patients receiving usual care.

In general, the case representative felt that the implementation of the service was feasible because it demonstrated benefits, at the same cost as the usual care (see below sub-section on benefits), with good acceptance by health care professionals, patients and their carers. Moreover, the service introduces an innovation in the provision of health care: it uses ICTs to deal with chronicity in the primary care service, as a service that is accessible to all citizens because it is included in the universal health care system.

BENEFITS: During the TELBIL project, a randomised controlled trial with a one-year follow-up (February 2010 – August 2011) was carried out by the Health Department of the Basque Region to assess the effect of the telemonitoring service on the number and length of hospital admissions for patients with heart failure and chronic lung disease, compared with the standard health care practice (TELBIL RCT). The use of other health care services was also evaluated, as was impact on the quality of life and mortality, adherence to the telemonitoring service, and satisfaction of patients, carers and professionals with this service (Martin-Lesende et al., 2013a,c).

The study was carried out across 20 primary health centres in Bilbao (Basque Country, Spain). Fifty-eight patients, who had been living at home and were diagnosed with heart failure and/or chronic lung disease in the previous year, were recruited. 28 patients were randomly allocated to the intervention group (telemonitoring service) and 30 patients to the control group (usual care). The 12-month follow-up was completed by 21 patients in the intervention group and by 22 patients in the control group. The patients of the intervention group measured daily their respiratory-rate, heart-rate, blood pressure, oxygen saturation, weight, body temperature and completed a health status questionnaire using PDAs. Alerts were generated when pre-established thresholds were crossed. The control group received usual care.

During the implementation of the project (TELBIL-A), another evaluation of TELBIL was carried out from February 2012 to February 2014 (Orruño et al., in press). In this case, the study consisted of a pre-post evaluation that included a sample of 28 older chronic patients who were telemonitored (11 had already enrolled as telemonitored patients from the TELBIL RCT, and the rest were new patients) during 12 months. The study was carried out in 23 health primary care centres of the Bilbao health care department. The same intervention as the one for the TELBIL RCT study was

carried out, although an improvement on the alerts was introduced based on the experience of the previous study. Concretely, two levels of alerts were used instead of one, one to predict the need for hospital admissions and the other for less serious alerts.

After 12 months of intervention, these studies found the following benefits regarding ***the policy objectives of this research*** (for more details, see Section 3.2.9):

- **Impact on the independent living of the older adults:** better perceived quality of life related to health for the telemonitored chronic patients compared to those who received usual care (Martin-Lesende et al., 2013a,c).
- **Impact on the sustainability of the care systems:**
  - *For telemonitored patients, there was a reduction in use of health care resources* such as hospitalisations, emergency service visits, and appointments with doctors (Martin-Lesende et al., 2013a, c; Orruño et al., in press).
  - *Cost-efficiency:* The cost-effectiveness analysis showed that telemonitoring intervention was cheaper (-2,230.63€) and more effective (0.06415 QALY) than the regular procedure used for treating the same patients.

COST STRUCTURE: We detail below the investment and operating costs of the Basque Region for the creation and implementation of TELBIL RCT, which include the provision of the telemonitoring service for 28 chronic patients and 10 health care professionals. As we can see in Table 5:

- The Basque government received funding of €80,000 from the Spanish Ministry of Health, Social Services and Equality, to test the telemonitoring service in the primary health care centres of Bilbao. This funding was dedicated to cover all the cost associated with the pilot study.
- The total cost of the telemonitoring service including the equipment and the registration of the devices for all the patients and health care professionals was €8,762 for one year of implementation.
- The telemonitoring service also includes a monthly fee (which adds up to €2,080 a year) to cover the maintenance of the service and the software by the technical provider.
- The investment in human resources to access the platform was calculated as €7,614.32. It was not an additional cost as it was quantified as part of the regular salary of the professionals.

Table 5: Costs of TELBIL: investment and operating costs

Concept	Number of units	Unit cost in Euros	Cost in Euros
Investment costs			
One-off funding from national and regional programme			
Funding from a national programme for TELBIL RCT: the Spanish Ministry of Health, Social Services and Equality for TELBIL			80,000
Telemonitoring system:	**28**		**8,762**
Telemonitoring equipment	28	149(a)	4,172
Registration of users (centres, patients and professionals) in the system by the technical providers (b)			4,590
Registration of the organization	*1*	*1500*	*1500*
Registration of the devices	*28*	*85*	*2380*
Registration of an extra centre	*1*	*460*	*460*
Registration of the web end-users (health care professionals)	*10*	*25*	*250*
Total			
Concept	**Number of Units**	**Unit cost in Euros**	**Cost in Euros**
Operating costs			
Monthly fee of the software for telemonitoring patients (c)			**2,080**
Monthly fee of the primary health care centres	1	260	260
Monthly fee per devices	28	65	1820
One-off human resources investment (d)	**28**	**271.94**	**7,614.32**

Notes:

(a)The total cost of the telemonitoring equipment is 782 €/device. The total cost of €149 was calculated for the first year taking into account amortization, assuming 6 years in which the investment in the device can be amortized with a discount rate of 3%. These assumptions were made following indications stated in Drummond (2005) Methods for the Economic Evaluation of Health Care Programmes.

(b) The registration included the installation and placement of the devices at patients' home, as well as the training of the end-users (health care professionals and patients) by the technical provider.

(c) The monthly fees cover the renting of the software as well as the maintenance, repair and upgrade of the web platform device and software.

(d) One-off human resources investment corresponds to the cost of human resources in their use of the tele-monitoring service. It was calculated taking into account the time invested and their salary, assuming that they spend an average of 2 minutes/day to access to the web manager.

These costs can also be applied to the study of TELBIL-A. More funding of €63,165 from the regional programme of the International Excellence Centre Association for Research on Chronicity of the Basque Region (Asociación Centro de Excelencia Internacional en Investigación sobre Cronicidad-Kronikgune – Kronikgune) was made available for TELBIL-A. This specific funding covered the technological devices, and the partial disengagement of a nurse and the case representative from their regular care duties to be involved in the telemonitoring service.

3.2.2 Business model

CUSTOMER SEGMENTS: The customers of this service were heath care professionals of the primary care centres of the Bilbao health care department of the Basque Region. Those professionals, who were interested in implementing the service, selected and proposed their chronic patients to be enrolled in this new service.

Potential patients were those that had the following characteristics:

- Home patients who were regularly cared for at home due to their limited mobility,
- They were assigned to the mentioned health care department, and
- They were affected by heart failure and/or chronic lung disease, multiple pathologies, and had been admitted to hospital twice during the last year.

VALUE PROPOSITION(S): The value of this service for the customer segments is that:

- It is a unique solution that is valid for a set of pathologies.
- The service can be personalised for each patient according to their pathologies.
- The system allows health care professionals to read clearly and to interpret easily the vital signs of the older adults which are sent though wireless sensors connected to the mobile device.
- The system is intelligent, in the sense that it carries out a local analysis of the values measured, alerting staff automatically and in real time when values are unusual. Meanwhile normal values are recorded in the mobile device to be sent at least once a day to the web management system. This is a secure and confidential tool to help the professionals to monitor and manage patients. The doctors rather than the patients receive feedback and alarms and they then decide whether to take measures like sending an ambulance to the patient's home or whether to visit them at home or not.
- The system allows older people to be closer and to have a better access to the professionals, and to be more empowered to care for their own health.

The main success resulting from creating these value propositions has been to manage complex patients (affected by multiple pathologies) within the regular care structure.

CHANNELS: The health care professionals were contacted by the case representative team of the TELBIL studies. Meetings between the representatives and the professionals were organized in the primary health care centres, after the professionals had been informed by the coordinators of their care centres. Each coordinator was briefed about the project during the health department;'s coordinator meeting. During the meetings with the health professionals, all of them were were given more details about the project and the profile of the patients to be recruited. In general, the health care professionals were reluctant to use this new service because they thought that it could represent extra work. The case representatives tried to convince them by giving them data about the high time investment they would have made with the standard procedure.

In the TELBIL RCT, older chronic patients were randomly selected from all the chronic patients who attended the primary health centres in Bilbao and had been diagnosed with heart failure and/or chronic lung disease. For the TELBIL-A study, some of the older adults had also participated in the TELBIL RCT study. However, most of them were new ones, proposed by professionals for this study.

CUSTOMER RELATIONS: The principal relationship with the customers is based on the fact that health care professionals at the primary care centres had informed their patients about the telemonitoring service, their values and benefits.

REVENUE STREAMS: The Regional government does not obtain any revenue for providing the service. The telemonitoring service is currently being provided to patients of the primary care centres of the Bilbao health care department as a regular service in the service portfolio of the regional health care system. The service is therefore free of charge, framed in the Spanish health care system which gives universal access.

KEY RESOURCES: The key resources which made the business model work were:

- The technology was validated by Basque Office for Health Technology Assessment (OSTEBA) to telemonitor chronic patients.
- The professionals of the primary health care centres integrated their telemonitoring service provision with their regular activities.
- The professionals has been trained to use the telemonitoring service
- The service was implemented thanks to funding from the national government and Basque Country regional government.

The several benefits of the telemonitoring service and the demonstration that the service does not represent a higher cost to the public budgets constitute the main success factors. Despite this, funding for the service stopped in 2014. Funding has therefore become a barrier to the continuity of the service, rather than a key resource.

KEY ACTIVITIES: The case representative identified three key activities that made the business model work:

- Having a project coordinator who is responsible for monitoring the implementation of the service.
- Evaluating rigorously the benefits of the service, and the satisfaction of the customers and end-users with the service.
- Disseminating through scientific articles the implementation process of the services and their impacts.

KEY PARTNERSHIPS:

The main stakeholders involved in the service were:

- Saludnova: the telemonitoring system's technical provider. This organisation was also in charge of training and demonstrating the functioning of the system to the health care professionals and the patients, and was responsible for installing, maintaining and repairing the devices.
- The government of the Basque Region, through:
  - The Regional Health Care Ministry of the Basque Region, which was in charge of defining a new health policy to deal with the increase in chronic patients and to maintain the sustainability of the health care system.
  - The Basque Office for Health Technology Assessment (OSTEBA): this office of the regional health care ministry that funded the pilot study (TELBIL RCT) to evaluate the effectiveness of the telemonitoring service.
  - The Association Centre for International Excellence in Research on Chronicity (Kronikgune – Asociación Centro de Excelencia Internacional en Investigación sobre Cronicidad) of the Basque Foundation for Health Innovation and Research (BIOEF), which funded the project to implement and evaluate the telemonitoring service (TELBIL-A).
  - The primary health care centres of the Bilbao health department: their 23 centres were in charge of implementing the service.

- The health care professionals: The coordinator of the project was in charge of implementing and controlling the development of the project. The health care professional teams at each primary care centre were in charge of monitoring their patients and responding to their alerts.
- The Spanish Ministry of Health, Social Policy and Equity funded OSTEBA to develop the pilot study of the telemonitoring service.

The partnerships made to create and implement the telemonitoring service were:

- Two agreements for funding the two pilot projects. The projects were carried out by the Health Service of the Basque Region, and made with two public funding organisations of the same region. The first agreement was made with OSTEBA for carrying out the TELBIL RCT, and the second agreement with Kronikgune to fund the piloting and implementation of the project (TELBIL-A).
- Agreement between the health care Ministry of the Basque regional department and Saludnova to: supply, install, maintain and repair the devices, and train patients at home.

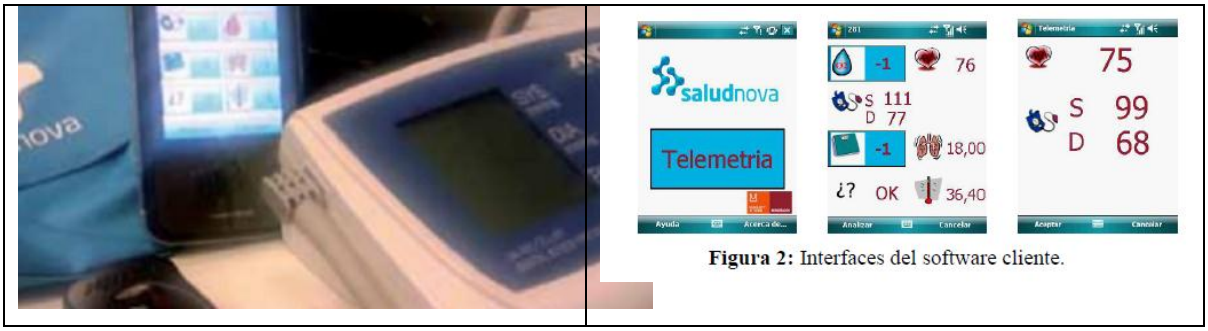
COST STRUCTURE: the costs are the same as the ones described in the business case (see Section 3.2.1).

3.2.3 The technological components

The telemonitoring equipment (Figure 3) is delivered by a private Spanish company called Saludnova (the technical provider) and it is commercially called Careline Home. The equipment is installed at the home of the chronic patients and it consists of a smart phone-personal digital assistant (PDA) equipped with:

- A Windows mobile operating system.
- A tactile screen.
- A set of bluetooth wireless sensors to measure the blood pressure, the heart frequency and the oxygen saturation.
- A manual input of temperature, heart frequency, weight, situation questionnaire and clinical changes, and recording of intake and compliance with medication and diet.
- Software that interprets the data captured and communicates with the different types of sensors.

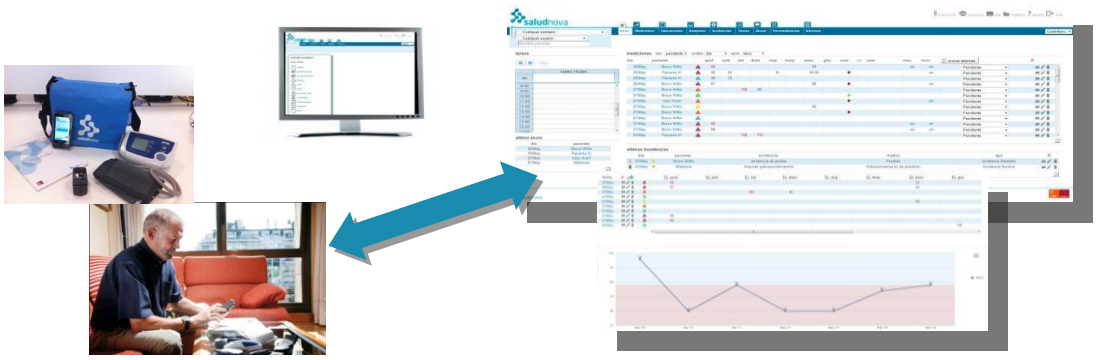
Figure 3: TELBIL PDA



Source: Mendirichaga, 2013

The system sends the health data by GPRS to a web management system which belongs to the technical provider. This system can be accessed by internet and it is ubiquitous. As shown in Figure 4 below, the PDA and the web management system interact, capturing the data from the sensors, and analysing these data in the PDA software, communicating bi-directionally between the two parts, and following-up the data in the server software. The main function of the web management system is to graphically present and summarise chronic patients' health evolution, together with the emergencies detected. It also allows the professionals to adapt the different care packages in a remote, easy and fast way to the needs of each user in order to provide personalised care according to their pathologies.

Figure 4: TELBIL interaction between the PDA and the web manager



Source: Mendirichaga, 2013

The **web management system has four parts** (see figure 5):

- An authentication screen where each user can access to their information through a user name and a password.
- A call centre that register the alarms.
- Patients and family can see in a secure and confidential way the data recorded. The data can be completed with the medical history of the patients.
- Professionals can access and see their patients' data in real time without them having to be there. The measures can generate figures, allowing the professionals to classify the information per patient, pathology, date, etc.

Figure 5: TELBIL interface of the web manager

Source: Mendirichaga, 2013

The **mobile/web software has the following features**:

- Audit or system usage log.
- Identification of the computers on the network.
- Password management system.
- Safe procedure login.
- Access control policy.
- Users and passwords log.
- Privileges and access rights.
- Automatic users' disconnection.
- Connection time limit.
- Incidents and technical improvements management
- Patient anonymization.

The technical provider provides the following **infrastructure** to the organization using the telemonitoring service:

- Physical security perimeters, physical controls.
- Security against malicious code (FW).
- Backups.
- Network traffic and security monitoring.
- Production environment software and source code monitoring management.
- Ports protection, network connections monitoring.

The **costs of the technological components** are the following:

- The total cost of the telemonitoring equipment is €782 per device.
- The installation is considered as a registration fee that include the installation and placement of the devices at patients' home, as well as the training of the end-users (health care professionals and patients) by the technical provider.
- Registration of the organization: €1,500.
- Registration of the devices: €85 per patient.
- Registration of the web end-users (health care professionals): €25 per professional.

3.2.4 Technical barriers

The technology complies with the applicable law:

- Intellectual property law.
- Company's documents protection.
- Personal data protection.
- Private data abuse prevention.
- Security standards policy.
- Information system audit.

The characteristics of the mobile kit components comply with the regulations that apply to:

- Sensors classified as health product (93/42 directive CEE).
- Market mobiles or smartphones.
- Communication modules via 3G, GSM, SMS gateway, WiFi or synchronization via computer with internet.

The technology could operate in other region or countries, and it can be integrated into other health systems by means of web services, XML and HL7. Nevertheless, although the communication system used is GPRS, the system is built to be only used in Spain. Moreover, roaming could be a barrier for services in frontier regions, as Spanish citizens living on the French or Portuguese side of the border have to pay much more for mobile communications. Furthermore operators are able to localise their clients in the country of origin, but not in a neighbouring country, which is an issue in emergencies.

During the implementation of the service, the main technical barriers found were: a) delays in receiving the information or the information did not reach the web server. Sometimes this was due to problems in locating the house; and b) failures in the devices, such as the PDA. These technical problems were resolved by the technical provider, although as pointed out by the case representative, sometimes this took longer than expected.

3.2.5 Quality of the service

The method applied to ensure and improve the quality of the service was to have a coordinating team composed of a doctor and a nurse. They monitored the the project and resolved any problems. The project also established a detailed follow-up of specific objectives and measurement of accomplishment of these objectives by indicators. These objectives were related to clinical results, health care procedures, and professional education.

There are no specific laws, standards or guidelines to ensure quality at national or regional level for the provision of telemonitoring services. Nevertheless, the studies were approved by the Scientific Studies Ethics Committee of Bilbao's main hospital, to which the primary health care centres belong. Moreover, patients and families gave their informed consent before participating in the study.

3.2.6 Training actions

To allow better integration of the service, participating health care professionals were trained in the use of the telemonitoring system in their health primary care centre. The training focused on learning how to use the web platform to follow-up patients and on issues related to the recording and management of cases.

Patients were also trained at home in ICT and their pathology by the case representative team or the technical provider, through explanation and demonstration on how to use the device (introduce their data, etc.).

Other training actions focused on empowering patients to deal with their diseases through the service, and assess their health. There was also communication via messages and phone contacts.

See table 6 for a summary of the TELBIL training actions.

Table 6: Summary of the training actions

Programme/Strategy	A training programme in the primary health care centre and at chronic patients' home
Aim	Train and empower end-users.
Target	Patients and doctors/nurses
Content	To use the technology-based service and on the pathology
Timing	-
Training method	Demonstration with explanation
Certification	No certification
Trainers/responsibility	Technical provider/ project coordinators and health care professionals
Funders	The training is included in the implementation of the system

3.2.7 Scaling and market creation

The Basque Region created and implemented the telemonitoring service based on a new health care policy which targeted people affected by chronic conditions and linked it to the public health care service, concretely the primary health care service. One the strategies of this new health care policy was based on using information and communication technologies to address the care of chronic patients at home. The regional government funded projects to implement this service in the public health care system at the Basque country.

The creation and implementation of the service was therefore facilitated by a policy framework and the availability of public funding from the Regional Health Care System. This policy leadership gave the health care professionals the opportunity to test new services like the telemonitoring service and freed them of their usual care responsibilities. The public funding provided by two agencies (first by OSTEBA and later by Kronikgune) facilitated the testing and subsequent implementation of the service in the health care system. However, the service stopped in May 2014 due to a cut in funding.

In order to replicate the service outside the Basque Region, researchers related to TELBIL are participating in European projects, such as the United4Health: UNIversal solutions in TElemedicine Deployment for European HEALTH care.[28] The United4Health project is co-funded by the European Commission's ICT Policy Support Programme. It aims to exploit and further deploy innovative telemedicine services implemented and trialled in 15 European regions. The Project is also supported by the participating regions' national Health Authorities responsiblr for the healthcare budget. They are fully committed to deploying telemedicine services in their territory and also to co-operating among themselves to promote the further uptake of the services at pan-European level.

Moreover, the project case representative team has advised the implementation of the telemonitoring service, based on their experience in other Spanish localities, such as Sevilla (Andalucian Region) and Valencia (Valencian Region).

[28] More information on the project can be found here: http://ec.europa.eu/information_society/apps/projects/factsheet/index.cfm?project_ref=325215

3.2.8 Policies and the role of policy in creating, implementing and scaling-up the service

TELBIL started in 2010 as an evaluation project of the telemonitoring service from primary health care, as part of the Evaluation Service of Health Care Technologies (OSTEBA) of the Basque Public Health Care System. OSTEBA promotes the appropriate use of health care technologies in terms of security, effectiveness, accessibility and equity, providing information needed to take decisions on their use by health care professionals. TELBIL's primary goal was therefore to test the effectiveness, acceptance, viability, satisfaction and cost-effectiveness of this telemonitoring model for chronic patients in primary care (TELBIL RCT). Any positive results could be shown to health care professionals and managers to convince them to back this model. This project was funded by OSTEBA, with the co-funding the Spanish Ministry of Health, Social Services and Equality

At the same time, the Basque Region developed a policy strategy which focused on addressing the impact on the population's health status of chronicity and on the sustainability of the public health care system. The Basque region launched this policy in July 2010 publishing the document "Estrategia para afrontar el reto de la cronicidad en Euskadi" (Strategy to deal with the challenge of the chronicity in the Basque Country) – Gobierno Vasco, 2010. One of the 14 strategic projects in this policy framework was focused on promoting a Multichannel Health Service Centre in order to increase the number of ways in which citizens can interact with the health care system. In this strategic project, a home care service through telemedicine (remote assessment and telemetric service) for home-based chronic patients with multiple, unstable and advanced pathologies was proposed. The Regional Basque government made funding available for the development of this ICT-based home care service, first under the Chronicity office of the Health Care Department (in charge of coordinating these projects), the "Equipo de Apoyo a la Investigación en Acción" called EDALIA (work group in charge to promote projects among professionals), and more recently under the Association Centre for International Excellence in Research on Chronicity- Kronikgune (Asociación Centro de Excelencia Internacional en Investigación sobre Cronicidad). After TELBIL RCT, the following implementation was funded by these organizations (TELBIL – A and TELBIL- T). Nevertheless, this funding has stopped, blocking also the continuity of implementation of the telemonitoring service.

The Basque Government also published recently a catalogue on technology-based services for health care to boost the development and implementation of these services in the Basque country and help the stakeholders to identify the actors involved in their offer. The TELBIL technology is part of this catalogue.

3.2.9 Evaluation process of the effectiveness of the good practice

FINAL OBJECTIVE OF THE STUDIES ON EFFECTIVENESS: The effectiveness of the telemonitoring system in primary health care centres was evaluated by two complementary studies. One evaluation was a pilot study (ECA – TELBIL) carried out in 2009 (Martin-Lesende, 2013a,c) and the other was an implementation study (TELBIL-A) carried out in 2012 (Orruño et al., in press). Both studies aimed to show the benefits and the appropriateness of the telemonitoring service in the Basque Regional health care system. These studies were promoted and funded by the regional health ministry for this reason**.** More concretely, TELBIL RCT aimed to assess the effect of a primary care-based telemonitoring system on the number and length of hospital admissions in patients with heart failure and/or chronic lung disease at 12 months post-randomisation compared with the standard health care practice. In the specific case of the TELBIL-A study, the evaluation focused on testing the integration of telemonitoring and the resulting improvement in the professional primary care practices in monitoring and managing these patients.

DEFINITION OF THE EVALUATION PROCESS FOR EFFECTIVENESS:

a) For the pilot study (ECA-TELBIL) (Martin-Lesende, 2013a,c), the sample included fifty-eight in-home patients, diagnosed with heart failure (HF) and/or chronic lung disease (CLD), aged 14 or above and with two or more hospital admissions in the previous year. They were randomly allocated to the intervention group (n= 28 patients, from 14 different health centres) and to the control group (n = 30 patients, from 6 different health centres). The 12-month follow-up was completed by 21 patients in the intervention group and by 22 patients in the control group.

The research was designed as a randomised controlled trial with a one-year follow-up (February 2010 – August 2011) and analysis at 3, 6 and 12 months postrandomisation. It was carried out across 20 health centres in Bilbao (Basque Country, Spain) to assess the impact of home telemonitoring on in-home chronic patients compared with standard care. The study lasted for one year. The intervention consisted of the use of a telemonitoring system provided by a technical provider called Saludnova (commercially named "Careline home"). Patients measured their respiratory-rate, heart-rate, blood pressure, oxygen saturation, weight, body temperature every day and completed a health status questionnaire using PDAs. Alerts were generated when pre-established thresholds were crossed. The control group (CG) received usual care.

All health professionals participating in the study (for both, IG and CG) received specific training aimed at strengthening and standardising the management of the clinical conditions under study.

In the case of variables and instruments,[29] an *initial assessment and collection of baseline data* was carried out, which evaluated:

- *Patient's socio-demographic data*: date of birth and age, gender, health centre, assigned GP and nurse, level of education, social and family characteristics.
- *Clinical data* were also recorded:
  - Diagnosis of Heart Failure or Chronic Lung Disease, based on the computerised primary care registry and hospital medical records, specifying the aetiology, degree of severity of the disease (based on the FEV1 – forced expiratory volume in one second – for COPD and on the NYHA – New York Heart Association – classification and the ejection fraction for Heart Failure).
  - whether home oxygen therapy was required.
  - Comorbidity using the Charlson comorbidity index score (Farrero et al., 2001).
  - Regular medication: taken from medical records and confirmed by health professionals and/or patients themselves or their relatives.
  - Treatment adherence measured using the Morisky Adherence Scale (Pare et al., 2006).
  - Functional status - The Barthel Index (BI) (Mahoney and Barthel, 1965).
  - Health outcomes using the EuroQol questionnaire (EQ-5D) (Badía et al., 1999; Herdman et al., 2001; Oppe et al., 2007).
  - The burden of informal carers trough the Zarit Burden Interview (ZBI) (Zarit et al., 1980; Izal et al., 1994; Martín et al., 1996).
  - The number of hospital admissions noting whether they were cause-specific, that is, related to the conditions under study and the mean duration of the hospital stay.
  - The use of other healthcare resources during the year prior to the inclusion in the study: emergency department attendances; appointments with specialists; home visits, including both scheduled visits and those prompted by the telemonitoring of the patient; and other

[29] As it is not the aim of the study to refer specifically the instruments used in each evaluation study, we refer the readers to the publications referred to have the specific references of the instruments.

contacts with health centre professionals by telephone or face-to-face, even if patients themselves did not attend, for administrative tasks, follow-up, prescriptions, etc..

The following *outcome measures* were collected after 3, 6 and 12 months of follow-up:

- *Primary outcomes measure:* Number of hospital admissions that occurred in a period of 12 months post-randomisation.
- *Secondary outcomes measures:*
  - Duration of hospital stay: number of bed-days for emergency admissions with a primary diagnosis of heart failure or chronic lung disease (i.e., COPD, asthma and other respiratory conditions) and other causes during 12 months after randomisation.
  - Number of hospital admissions due to exacerbation of heart problems or chronic lung disease (i.e., COPD, asthma and other respiratory conditions) that occurred in a period of 12 months post randomisation.
  - Mortality rate: number of all-cause deaths at 12 months. Cause of death will be taken from the primary and/or secondary care clinical records.
  - Level of use of health resources measured during a period of 12 months after randomisation:
    - Number of emergency department visits for a cardiac or respiratory cause and for all causes.
    - Number of home visits (by GPs or nurses).
    - Number of primary care visits.
    - Number of telephone contacts with primary health care professionals.
    - Number of visits to the specialist doctors.
  - Cost-effectiveness analysis. The costs associated with the health care resources used will be estimated based on the following variables: duration of hospital stay, use of emergency services, purchase and maintenance of telemonitoring devices, number of consultations and time of the health care personnel, and the time dedicated by the health care professionals to using the telemonitoring equipment. The effectiveness will be expressed in Quality-Adjusted Life Years (QALY) and will be calculated from the data of the Health Related Quality of Life (HRQL) obtained from the generic EQ-5D questionnaire.
  - Health-related quality of life (HRQL). The validated Spanish version of the EQ-5D questionnaire will be employed for the quality of life assessment (Badía et al., 1999; Herdman et al., 2001; Oppe et al., 2007). This questionnaire describes the health status in five dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) with three possible responses for each item and using the visual analogue scale (VAS) ranging between 0 and 100.
  - Other variables of clinical efficacy: number of episodes of worsening of the pulmonary and/or heart condition.
  - Functional status. The Barthel Index (BI) (Mahoney and Barthel, 1965) was used to measure Activities of Daily Living (ADL).
  - Caregiver burden. The burden of the family/caregiver will be measured using a validated Spanish version of the Zarit Burden Interview (ZBI) (Zarit et al., 195; Martín et al., 1996; Izal et al., 1994). The score ranges from 0 (no burden) to 88 (highest level of burden).
  - Degree of acceptance and satisfaction of patients and health professionals. The degree of satisfaction of the patients with the telemonitoring intervention will be assessed using a questionnaire based on validated published surveys adapted for this study (Bakken et al., 2006; Demiris et al., 2001; Yip et al., 2003).
  - Evaluation of the technical performance and compliance with the telemonitoring system. Compliance with telemonitoring will be evaluated through the analysis of the frequency of

data transmitted by patients and the number of times that health care professionals access the telemonitoring Web-platform.

- The reliability and performance of the telemonitoring system will be assessed (malfunctions of the system, problems concerning the transfer, reception and visualisation of data). The security of the system will also be evaluated (external attacks to the transmission system or server, etc.).
- The reasons for the losses occurred during the study were recorded, such patients moving house or dying, failure to correctly manage the system, technical problems, requirements for specific health care (for example, patients in need of palliative care at home) and institutionalisation. Additionally, data concerning eligible patients or professionals who declined to participate in the study and the reasons for not participating in the study were also recorded.

The study's procedure for data collecting was approved by the Scientific Research Ethics Committee (CEIC, Basurto University Hospital, Bizkaia). Patients or relatives gave their informed consent in writing prior to participating in the study. Patients' identity was kept private at all times during the course of the trial.

b) In the case of the study (TELBIL A) (Orruño et al., in press), the sample was 28 older chronic patients selected from 23 health primary care centres of the Bilbao Department, who completed the 12 month follow-up (from a total of 42 patients recruited). The patients were not randomly selected: 11 were already enrolled as telemonitored patients in the TELBIL RCT, and the rest were new patients usually from the control group of the TELBIL RCT study or new ones proposed by health care professionals.

The research design was a pre-post intervention study where patients were telemonitored for 12 months. The same intervention was carried out as in the TELBIL RCT study, although an improvement in the alerts was introduced based on the experience of the TELBIL RCT. Two levels of alerts were used instead of only one: those at prompted hospital admissions and those that were less serious.

Regarding the variables measured and the instruments used in this study, an *initial assessment and baseline data* were collected, concretely:

- *Sociodemographic data.*
- *Variables of clinical description:*
  - Main pathologies: health failure, chronic lung disease.
  - Pluripathologies
  - Acute situation
  - Number and list of regular medication
  - Barthel Index to evaluate the level of functionality for carrying out activities of daily life (Mahoney and Barthel, 1965),
  - EuroQol D5 (EQ-5D) questionnaire to evaluate the quality of life related to health in primary care (Badia et al., 1999; Herdman et al., 2001; Oppe et al., 2002).

Moreover, *outcomes measures* were evaluated at 4, 8 and 12 months from the start of the study:

- *Primary outcome measures:*
  - Number of hospital admissions (totals and specifics)
  - Number of total hospital admissions: number of hospital admissions, due to any cause, that occur in the periods of 12 months before and after the start of the study.

- Number of specific hospital admissions: number of hospital admissions such as consequences of exacerbations due to heart failure, chronic lung disease or specific pathologies in the 12 months before and after the start of the study.

- *Secondary outcome measures:*
  - Hospital stay length: average number of days of hospital stays due to heart failure of chronic lung disease or other causes during the 12 months before or after the start of the study.
  - Number of visits to the hospital emergency visits during the 12 months before or after the start of the study.
  - Functional status, evaluated with the Barthel Index
  - Quality of life related to health evaluated with the EQ-5D validated in Spain (Badia et al., 1999; Herdman et al., 2001; Oppe et al., 2002).
  - Assessment of the patients and relatives'satisfaction with the telemonitoring service, through a questionnaire made by the research team.
  - Assessment of the health professionals' satisfaction with the telemonitoring service, through a questionnaire made by the research team.

The Scientific Research Ethics Committee approved the study's data collection procedure, Patients or relatives gave written informed consent prior to participating in the study. Patients' anonymity was preserved at all times during the course of the trial. The initial assessment data were collected at the beginning of the study by the health care professionals during their first visit to patients' homes to explain the functioning of the telemonitoring service. Outcome measures were collected at 4, 8 and 12 months from the beginning of the study. Data on patients' satisfaction with the telemonitoring service were collected only once - at month 8 from the beginning of the study.

FINDINGS ON EFFECTIVENESS: After 12 months of intervention, these studies found the following benefits regarding ***the policy objectives of this research***:

- **Impact on the independent living of the older adults:**
  - Better perceived quality of life related to health: In a visual scale from 0 (worse state) to 100 (better state), telemonitored chronic patients said they felt significantly better than chronic patients receiving usual care, after 3 (51.82 vs 34.44), 6 (50 vs 36.11) and 12 months (52 vs 30.75) (Martin-Lesende et al., 2013a,c).

- **Impact on the sustainability of the care systems:**
  - ***Reduction in use of health care resources*** (Figure 6, Table 7):

    Reduction in the number of hospitalisations:

    42.9% of patients in the intervention group completed the follow-up without any hospital admissions, compared to 13.6% of the patients in the control group (Martin-Lesende et al., 2013a,c).

    Telemonitored patients significantly decreased their number of total and specific hospital admissions from 2.57 to 1.07 and from 1.86 to 0.61, respectively (average hospital admissions per patient) (Orruño et al., in press).

    Reduction in emergency service visits:

    Telemonitored patients significantly decreased their number of visits to emergency service from 4.25 to 2.11 (average hospital admissions per patient) (Orruño et al., in press).

    Increase of phone contacts and decrease of appointments with doctors. A significant increase in the number of telephone contacts in the intervention group in the follow-up period was also found. Moreover, the study also found a significant decrease in the number of appointments with the specialists and the number of appointments at the primary care health centres among the patients in the intervention group compared to those in the control group (Martin-Lesende et al., 2013a,c).

Figure 6: Comparison of resource use at health centres in the intervention and control groups.

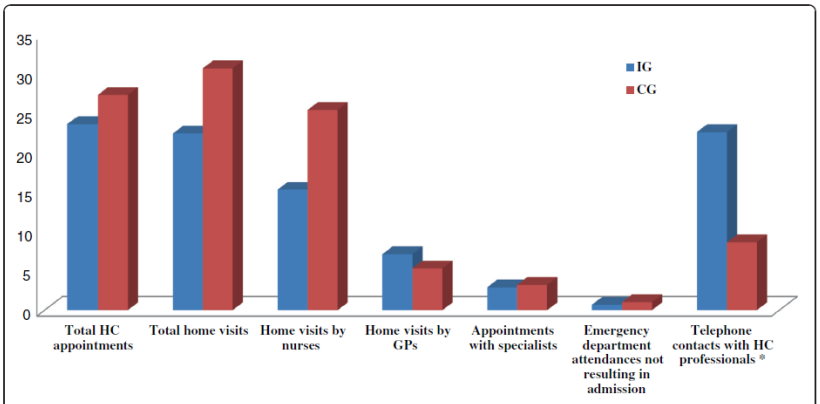


Figure 2 Comparison of resource use at Health Centres in the IG and CG. The figures presented were calculated considering the mean per patient among those who completed the 12-months of follow-up. * The only statistically significant difference was found for telephone contacts (p = 0.001). IG: intervention group; CG: control group; HC: health centre.

Source: Martín-Lesende et al., 2013c

Table 7: Difference in healthcare resource use between the year prior to inclusion and the follow-up period

Table 3 Difference in healthcare resource use between the year prior to inclusion and the follow-up period[I]

	IG (n = 21) median (IQR)	p value[II]	CG (n = 22) median (IQR)	p value[II]
All-cause hospitalisations	−2 (−3 to −1)	0.042	−1 (−3 to 0)	0.033
Cause-specific hospitalisations	−2 (−2 to −1)	0.086	−0.5 (−1 to 0)	0.244
Length of stay[III]	−0.4 (−3.8 to 1.6)	0.733	−1 (−5.5 to 5.3)	0.798
Health centre appointments[IV]	−11 (−16 to 0)	0.015	2 (−6 to 6)	0.801
Total home care visits	−1 (−2 to 12)	0.734	5 (−4 to 8)	0.152
Home visits by doctors	0 (−3 to 3)	1	0 (−2 to 2)	0.745
Home visits by nurses	2 (−2 to 4)	0.281	1 (−5 to 9)	0.384
Telephone contacts*	10 (6 to 24)	<0.001	3 (0 to 6)	0.147
Emergency department attendances	0 (−1 to 0)	0.210	0 (−1 to 1)	0.981
Appointments with specialists*	−1 (−2 to 0)	0.033	0 (0 to 1)	0.607

IG: intervention group; CG: control group; IQR: interquartile range.
[I] A positive/negative difference in the means indicates an increase/decrease in use of the corresponding healthcare resource in the 12-month follow-up period compared to the 12 months before the study.
[II] Wilcoxon signed-rank test assessing whether the differences between the 12-month prior to inclusion and the 12-month follow-up period were statistically significant, in each group (IG and CG).
[III] Mean length of stay per admission (hospitalisation), considering only patients who were admitted at least once (12 in the IG and 19 in the CG).
[IV] Appointments with doctors and/or nurses at the health centre concerning the participating patients, even if the patients themselves were not present.
* Statistically significant differences between the two groups in terms of changes from the year prior to inclusion to the follow-up year: total health centre appointments, p = 0.035; telephone contacts, p < 0.001; and appointments with specialists, p = 0.033. No other statistically significant differences were found.

Source: Martín-Lesende et al., 2013c

- ***Cost-efficiency:*** The cost-effectiveness analysis showed that the telemonitoring intervention in primary care for home care patients with cardiac insufficiency and/or bronchial disorders was cheaper (-2,230.63€) and more effective (0.06415 QALY) compared with the customary procedure used for treating the same patients. The Incremental Cost-Effectiveness Ratio (ICER) obtained was -34,772.10 €/QALY. The cost efficiency acceptability curve indicated that for an acceptability threshold of 20,000 €/QALY the probability of the telemonitoring procedures being cost-effective would be 60.2%, increasing to 63.3% and 72.4% for threshold of 30,000 €/QALY and 120,000 €/QALY, respectively.

3.2.10 Organisational change: integration of the technology-based service in the delivery chain

The telemonitoring service was implemented in 2009 by the Basque Regional Health Care Ministry, as part of their policy strategies towards health care technologies and chronicity to improve the sustainability of their health care model. The service was first deployed as a clinical trial, and two years later as an implementation project due to the benefits showed in the trial. This service monitored patients affected by health failure and chronic lung conditions at home. The aim was to reduce the number of hospitalisations (3-4 per year) of these patients. The service was provided by their primary health care centre by their primary health care doctor. The telemonitoring service was tested and later implemented in 20 of the 24 health care primary centres in the Basque Region's Bilbao Health Department.

The telemonitoring service was offered to health care professionals at the above mentioned primary health care centres as a possible way of monitoring these chronic patients. Once the professionals and the patients had agreed to participate in the project, the telemonitoring service was installed in patients' homes. The technical provider (Saludnova) registered the patient in the web management system. The professionals and coordinators were also registered with their own user name and password. The older adults and the health professionals were trained to use the telemonitoring system, as explained in Section 3.2.6., and a demonstration of the service was carried out at patients' homes. Patients also gave their informed consent at the beginning of the study,

The patients could access the service through the public regional health care system, although in practice it was the health care professionals who admitted their patients to this service according to the target population defined in the project. The telemonitoring service was free for the end-users as it was delivered under the public health care system. The service targeted home patients with health failure or chronic bronchial disease, with two hospitalizations in the previous year, at least one of which had to be related to one of the two pathologies.

Concretely, the use of TELBIL included 4 steps:

- Step 1: Delivery of the kit to the patients, personalised according to their health conditions.
- Step 2: Registration and analysis of the health symptoms of the patients: the patients checked their health status according to the health professional's indications with the Bluetooth sensors and the questionnaires. The health records were locally analysed.
- Step 3. Monitoring of the evolution of the patients by health professionals. The system monitored the health indicators of the patients. The rules, thresholds, questionnaires, alarms, etc. that compose the intelligence of the system were changeable from any place at any time.
- Step 4: Follow-up, evaluation and prioritisation of the care of the patients according to a protocol previously defined that allowed the professionals to intervene if patients' health deteriorated and in emergencies.

The data collected with TELBIL were remotely sent and saved in a web manager of the technical provider. This web manager could be accessed by internet from any place by the health care professionals, although in TELBIL the health care professionals accessed the web management system only from the primary health care centre during business hours from Monday to Friday. Out of these hours, a message was sent to the patients suggesting they contact an emergency service.

These data were transferred once a day unless an alarm was triggered, in which case the transfer was done real-time. When the measurements fell outside the established limits, alerts were triggered via the PDA terminal and the clinical staff acted according to the medical condition of the patient. Real alerts were differentiated from false alarms through the assessment of all the clinical information and the health status questionnaire received through the telemonitoring system.

Therefore, even if an alarm was triggered for a specific clinical parameter, it was the patient's overall health status that was taken into consideration by healthcare professionals, before taking any further action. Patients were advised to call the emergency services through the telemonitoring system at weekends and at times when the health centres were closed. Only the doctors received feedback or alarms and they decided whether to take action or not (i.e.: sending an ambulance or a nurse to the patients or visiting the patients). Customisation of the solution enabled taking care of the needs of the institution providing the service and could also be done for each end-user.

The technology was provided by the technical provider. A contract was signed with them for the installation, provision and the maintenance of the devices and for training the professionals and the older adults in the use of the devices. The service was provided at home by the health care professionals, nurses and doctors of the primary health care centre, who checked their patients' health status and progress daily (from Monday to Friday) from the health care centre. A project coordinator team composed of a doctor and a nurse was in charge of monitoring the development and implementation of the service in the health care area.

Once the patients were discharged, they were deleted from the web management system. The health care professionals were in charge of collecting the devices from the patients' homes and sending them back to the technical provider.

As we have explained earlier in the business case and the evaluation sections (see sections 3.2.1 and 3.2.9), the satisfaction with the service and their benefits have been tested in two research studies, and they have allowed the region to improve the delivery of the telemonitoring service. They have also had a favourable impact on their policy objectives (quality of life and sustainability of health care system).

Table 8: Summary of roles of the public and private sector in the integration of TELBIL in the public health care system

Roles	Public institution	Private	Partnership
Policy framework	X		
Communication and awareness on the service	X		
Deployment plan			X
Referral	X		
Procurement	X		
Installation			X
Service delivery and monitoring	X		
Storage and maintenance			
Customer support service			X
End of the service and removal of the equipment	X		
Funding service	X		
Training			X

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Interviews:

- Three interviews on 18 March, on 22 June and 8 July 2014 with Iñaki Martín-Lesende, coordinator of the implementation of TELBIL in the primary care centres of Bilbao and case representative.

- Interview on 18-19 March 2014 with Jimena Rodriguez, owner of the technical provider Saludnova.

- Interview on 15 July 2014 with Juan Carlos Bayón

3.3 ASSISTING CARERS USING TELEMATICS INTERVENTIONS TO MEET OLDER PEOPLE'S NEEDS (ACTION)

NUMBER	11
TYPE OF TECHNOLOGY-BASED SERVICE	TECHNOLOGY-BASED HOME CARE
NAME OF THE PRACTICE	Assisting Carers using Telematics Interventions to meet Older People's Needs (ACTION)
LEVEL OF NEEDS COVERED	Older people with chronic conditions and informal carers
VERIFICATION OF THE CASE:	Case verified by Elizabeth Hanson and Lennart Magnusson, case representatives, on 21 July 2014.
COUNTRY	SWEDEN
Brief description: ACTION aims to increase the autonomy, independence and quality of life of frail older people and their family carers. These objectives are achieved by providing a self-care and family care support service with access to information, education and support for end-users via the use of Information and Communication Technology (ICT) in their own homes (Magnusson and Hanson, 2005). In particular, ACTION consists of four components: i) integrated multimedia caring programmes that families access via their ii) TV sets (initially in the EU project) and subsequently via their personal computers, (in the latter part of the EU project and in the Swedish project) (Magnusson et al. 1998; 2002; Hanson and Magnusson, 2011) iii) ACTION call centre that was developed to meet user needs identified in the EU project and iv) education and supervision programmes for users and for staff working directly with the service in the participating municipalities.	

3.3.1 Business case

MOTIVATION FOR THE PROJECT: The research and development of ACTION (Assisting Carers using Telematics Interventions to meet Older People's Needs) started in 1997 with a three-year research and development project funded by the Fourth Framework Programme of the European Commission. The University College of Borås (UCB) coordinated a team of care providers and universities from Sweden, England, Northern Ireland, the Republic of Ireland and Portugal to carry out the project. The project focussed on maintaining or enhancing the autonomy, independence and everyday quality of life of frail older people by supporting their family carers using a modern, easily accessible ICT solution.

The rationale that motivated the development of the project in 1997 was based on the following policy and research drivers of that time. At policy level, we can highlight:

- The need to develop community care policies and create resources for "ageing in place", due to the ageing demographic trends and finite economic resources.
- The recognition of role played by the family in supporting frail older relatives and the room for improvement, mostly in Swedish policy (Board of Health and Welfare Sweden, 2002).
- The onset of EU policies in the mid-nineties focused on the active inclusion of older and disabled people within the new information society. The fourth framework programme (1994-1998) developed a specific call for Information Society Technologies. The TIDE initiative (Telematics Integration for the Disabled and Elderly) acted as a "flagship" for these key policies.
- The potential role of technology in enhancing the independence of older people living at home was recognized in UK (Audit Commission, 2004) and Swedish (Board of Health and Welfare Sweden, 2004) policies.

At research level, there was also a need to improve the development of telecare and telehealth services with feedback from the target end-users: older people and their carers. This would help to increase the use and acceptance of these services by the users (Magnusson et al. 2004; Magnusson and Hanson, 2005).

After the EU project, further research has been carried out in Sweden on a project entitled "IT based family care support in health and social care" with funding from the Swedish Ministry of Health and Social Affairs to further develop and test the ACTION services in Sweden (2000–2002). This project was led by the University College of Borås. Since 2004, research and development work has continued with a support programme, "ACTION Living with Dementia" for older people with early stage dementia and their families and subsequently with the concept of "Blended Learning Networks" based on Communities of Practice to help all key stakeholder groups to share experiences and learn from each other about using and working with and implementing the ACTION service in the municipalities (Hanson et al 2009; Hanson et al 2011).

SOLUTION DESCRIPTION: ACTION aims to increase the autonomy, independence and quality of life of frail older people and their family carers by helping:

- Frail older people gain more knowledge and feel better prepared to manage their own care; thus they have more control over their situations and the risks of being lonely and isolated are reduced.
- Family carers gain more knowledge and feel better prepared to care, have more control over their caring situation. This can help maintain or improve their relationship with the one they care for and also helps reduce the risk of being lonely and isolated.
- Helping health and social care staff experience more job satisfaction and have opportunities for personal development in their work.
- Help health and social care providers to increase the quality of everyday life and social inclusion of older citizens and their family carers whilst also helping to reduce health and social care costs.

These objectives are achieved by providing a self-care and family care support service with access to information, education and support for end-users via the use of Information and Communication Technology (ICT) in their own homes (Magnusson and Hanson, 2005). In particular, ACTION consists of four components:

1. Multimedia educational programmes: caring skills in daily life; planning ahead; respite care; economic support; a service guide; coping strategies; living with dementia; and life after a stroke. Additionally, there are programmes for physical and cognitive training and online games for leisure, and coping programme (Magnusson et al 2002).
2. ACTION call centre with video-telephony is used to inform, educate and support older people and their family carers. Videophone facilities enable families to have visual and oral contact with professional carers and other families involved in the project. ACTION call centre staff helps to create informal support networks amongst ACTION users (Magnusson, Hanson and Nolan, 2005).
3. ACTION computers with videophones are placed in the older person's home. Users have access to the ACTION programmes via their ACTION computer and they can talk with other families and to health and social care staff via the videophone and camera. All functions start automatically (Hanson and Magnusson, 2011).
4. Education and supervision. Families are invited to take part in an initial education programme to learn how to use the ACTION service, as the majority of users are computer novices (Magnusson and Hanson, 2012).

ACTION is currently running as a mainstream service in the Borås municipality in western Sweden. There have also been implementation projects in an additional twenty municipalities across Sweden. ACTION Caring co-operated earlier with Telia Sonera to offer the ACTION service with a high degree of accessibility and reliability, but now EVRY Healthcare Solutions AB is the business partner of the service. ACTION Caring is a company which is connected to the University College of Borås.

FEASIBILITY: Overall ACTION Caring has a lot of experience of implementing services in various Swedish contexts, and is prepared to support the municipalities with know-how, from comprehensive training and education plans to offering certain services for a possible outsourcing. Thus, the municipalities don't have to create and run a full caring "ecosystem" locally (e.g. a call centre). In addition, the service seems to be responsive and tailored to the needs of older people using their feedback in its development. The most challenging aspect of the implementation is certainly financial sustainability, and without sufficient funding the service is struggling to scale up. The chapter on "Scaling and market creation" elaborates more on this main issue of feasibility of implementation.

BENEFITS: Since the inception of ACTION, numerous studies have revealed the benefits of this service. These studies assessed the impacts of ACTION on nearly 400 users through questionnaires, interviews and focus groups (for the details see the chapter on Evaluation). The benefits found are:

Independent living of older people at home:

- ACTION helped to increase the social inclusion of frail older people and their carers who are traditionally excluded from the benefits of information and communication technology (ICT) (Magnusson et al. 1999).
- Family carers and the older people they care for feel less isolated as they develop informal support networks with other participant (user) families in similar situations (Magnusson et al. 2002).
- The majority of users perceive that the service has helped them to improve their everyday quality of life. A specific study with 34 family carers recruited from two municipalities in West Sweden found that their perceived quality of life increased through using the ACTION service (Magnusson et al. 2005).

Care-related quality of life of informal / family carers: After using the ACTION system in their own homes for a minimum period of three months, participant family carers (Magnusson et al. 2005):

- Felt more competent, satisfied and secure in their caregiving role;
- Gained more control over their individual caring situation;
- Increased their self confidence in their ability to care.

Quality of care:

- ACTION has the potential to empower older people and their carers – i.e. to gain more overall control over their own life – and to enrich the caring relationship (Hanson et al. 2002).

Sustainability of the health and social systems:

- A specific study of 34 family carers calculated an average saving of €10,300 per family per year for the municipality as a result of reduced use of home help services and delayed entry to nursing home.

COSTS: The cost structure of the ACTION service (the "user side") as of June 2014 was reported by Hanson and Magnusson (2014):

	Costs[30]	Responsible for paying
The ACTION application	890 SEK (€100) /month/user	The municipality
Technical support	Remote support included in the monthly cost for the ACTION-application	
Computer, web camera, loudspeaker, antivirus program	Varies, approximately 400 SEK (€45) /month/user	Varies, depending local decisions in the municipalities. Either the user or the municipality
User fee	150 SEK (€17) month/user	The user

Source: Hanson and Magnusson (2014)

An interesting aspect of the monthly user fee (150 SEK) is that other potentially payable services are offered to the users and are included within the fee.

The costs above do not include the price of a broadband connection, which is paid for by the users. Additionally, the sometimes necessary on-site technical support / problem solving was around 1,000 SEK (€113) / year / user back in 2005, calculating with a couple of consultations (Magnusson and Hanson, 2005).

The "other side" of the ACTION service is the call centre, and its costs are detailed in the following table (Hanson and Magnusson, 2014):

	Yearly cost in SEK (in EUR)[31]
Salary for one full time practitioner, including social insurance and vacations	584,000 (65,742)
Housing costs	25,000 (2,814)
Equipment (based on writing of within 36 months)	8,000 (901)
Telecommunication and Internet	5,000 (563)
Additional travel, education and social activities with the users	30,000 (3,377)
Total	653,000 (73,510)

Source: Hanson and Magnusson (2014)

The total cost of a call centre is 653,000 SEK (€73,510) per year in total for providing a service for 50-80 families. This was based on estimations from the empirical literature and from experience in the ACTION call centre that one nurse working full-time could support approximately 50-80 families; and therefore the yearly per-user cost varies between 680 and 1,090 SEK or €77 – €123 (Hanson and Magnusson, 2014).

Earlier estimations put the cost for the ACTION programme development and maintenance at 1,200,000 SEK per year (€132,000 per year), a cost of 2,400 SEK per family per year (€260 per family/year) based on 500 users. These figures were based on the researchers' experience assuming that there was one nurse and one IT-worker working full-time on programme development and maintenance in order to guarantee 'state-of-the-art' work. Costs of equipment, office and administration were also included in the yearly figures (Magnusson and Hanson, 2005).

[31] The prices were given in Swedish krona (SEK), and we used the exchange rate of the ECB as of 2nd of January, 2014 to convert them into EUR (1 EUR = 8.8832 SEK).

3.3.2 Business model

CUSTOMER SEGMENTS: Current ACTION clients are the municipalities in Sweden. ACTION is currently running as a mainstream service in the Borås municipality in western Sweden, where about 100 families using it. Borås was one of the pioneer municipalities that began working with the ACTION prototype service during the EU project and has continued since then to actively support the service (for more about projects and implementations across Sweden see the chapter on scaling up and market creation).

The ACTION service primarily helps older spousal (or partner) carers, who live in their own home with their aged spouse who has a chronic long-standing condition and requires help with the instrumental and personal activities of daily living. The ACTION service can support:

- Older people and their family carers,
- Older people with early stage dementia and their next of kin,
- Older people, carers and staff within municipality day centres and at disability and voluntary organisation centres
- Family carers in a respite care setting.

The informal carer often provides the bulk of the care to his/her spouse single handedly and/or with the help from social services such as home help services and respite care services. Family carers are commonly older spousal carers (partners). They are at least 70 years old and their spouse is of a similar age or older and commonly requires help with both the personal and instrumental activities of daily living as a result of chronic illness/es such as stroke, dementia. In fact, information collated from earlier project data and more recent data collected by participant municipalities participating in implementation projects reveals that service users are predominantly female spousal carers aged between 75 and 85. They are caring for their spouses who are commonly aged between 75 and 90 and have chronic conditions such as heart and circulatory problems, dementia, cancer, neurological diseases and diabetes. The socio-economic status of users varies. Service users with ethnic minority backgrounds are largely under-represented.

VALUE PROPOSITION(S): The service has several advantages that encourage customers to acquire the service. It is research-based and has undergone iterative cycles of development, and evaluations based on extensive feedback from all key stakeholder groups, particularly users. Older people and their carers have been involved in all stages of the design process. The representatives of the service therefore feel that the claims about the benefits of the service are legitimate and grounded in research and in a generally inclusive approach (Hanson and Magnusson, 2014).

The evaluation studies – see the chapter about Evaluation for details – proved that the service has value for different stakeholders. The service appeals to (Magnusson and Hanson, 2005; Magnusson and Hanson, 2012; Hanson and Magnusson, 2014):

- Older people and their family carers (the end users), as it can enhance their quality of life by 1) linking them with others so they are therefore less isolated socially; 2) it can increase their sense of togetherness and their intergenerational relations; and 3) using of information technology can help older people to be a part of "modern times". The device can also empower and reassure carers;
- Formal caring staff, as they may experience greater work satisfaction and it may help them to work more efficiently; and finally
- The municipality may consider implementing the service as it can save money (approximately €10,807 per family / year), may help freeing up caring capacities by reducing the need for home help and may delay the entry of care recipients into a nursing home.

It is known that the cost evaluation data together with the quality of life data proved to be critical in the formal decision taken by Borås's Social Services Committee for Older People in 2004 to integrate the ACTION service within their existing support services for older people.

CHANNELS: The service end users often get to find out about the service from municipality care practitioners, for example:

- Need assessors who identify their care needs and match them with the available services. They tell users if ACTION could play a significant role and whether they are eligible for the service;
- Care advocates who are working directly with the family carers;
- Call centre practitioners via the municipality's website and at local meetings and gatherings where they inform older citizens and carers.

Potential end-users may also get to hear about the service from their local carer association or pensioners' organization. These organisations are the main targets for information and awareness-raising campaigns by ACTION Caring.

In informing and persuading policymakers, the local care managers – who are the eventual customers-in-charge of the service at the municipality – have a very important role. They can be considered the "local champions" of the service.

ACTION Caring Sweden advertises from time to time and also uses the website www.actioncaring.se to post information and videos about their activities and services, clients and results of research. The website has a Swedish and an English version. Additionally, its personnel actively take part and are invited to contribute at international, national, regional and local care conferences and exhibitions, where they help to promote awareness of the services.

CUSTOMER RELATIONS: The length of contracts between ACTION Caring and the municipalities is in general 2 or 3 years, although it can vary depending on the yearly budget of the municipalities. Regular network meetings are offered to all staff working with implementing the ACTION service in the involved municipalities. These usually take place twice a year and include 2 days of sessions including time for knowledge exchange and seminars/lecturers to highlight ongoing research results in the field and brainstorming sessions to further improve the service. Also, the education and certification system for carers includes regular supervision sessions by ACTION staff that takes place via videoconference.

In the relation between the end-users and ACTION Caring, feedback from the end-users are taken into account to tailor and develop the service to meet their needs and preferences.

REVENUE STREAMS: Municipalities can subscribe to the service at a fixed price of Kr2.990 per month and user (about €337) (Kubitschke and Cullen, 2010). On average users pay a fee of Kr150 (€17) per month (which is equivalent to the cost of an alarm system).

The municipalities covered the margin, using their own sources or governmental funds they successfully applied for. One of the two main governmental funds that were used to implement and finance the service aimed to help the municipalities to develop more flexible, individualized services for carers (from approximately 1999 through to the end of 2010). The other source was a development project fund granted by the Swedish Institute for Assistive Technology via their government-funded Older People and Technology, Programmes I and II (2009-2012).
But after these programmes came to an end – i.e. the funds dried up – the municipalities could not finance the service anymore.

KEY RESOURCES: According to our overall assessments and aided by Hanson and Magnusson (2014), the key resources of the service are the following:

- Staff and local champions: Lennar Magnusson in particular and Elizabeth Hanson have been the driving force behind the service from its inception as a research project to the present day, when it is struggling with sustainable scaling up. Their determination seems to have been of crucial importance throughout. Local champions can be for instance municipality caring professionals (and are not part of ACTION Caring), as their promoting role is very important.
- University College of Borås: They stood behind the project as an organization and founded ACTION Caring as a spinoff company. They ensured the scientific approach to the development of the service.
- An open / innovative municipality: Borås municipality stood behind the project throughout: it was the "cradle" and is currently the "stronghold" of the service. Good interpersonal trusting ties between the researchers / promoters and municipality officials were a key asset. They were also open to innovative solutions in care, were receptive to the good efficiency indicators and the overall entrepreneur-friendly culture of the municipality also helped ACTION to be mainstreamed there and to remain an integral part of the care services to date.
- A business partner: A business partner seems to be a must, especially when it comes to technological development and commercialization of the service. Telia Sonera wanted to enter the health and care field and they saw it as a business opportunity.
- Financial resources: ACTION's work has always been affected, facilitated or hampered by the availability of financial funds. The availability of funds helped the idea to become a mainstream service and to be implemented in several places. When funds dried up, however, the service had to close in most places. Without funds, the municipalities saw the service as unsustainable in the current adverse economic climate.
- Legal framework: at the moment, however, there is no legal framework or regulatory environment that could facilitate solutions that emphasise the involvement of family carers (or more details, see the section 3.3.8 on policies).

KEY ACTIVITIES:

- Introduction and follow-up support: Education and training programmes and support. There is a separate chapter about training, but it is important to summarise here, that for the successful implementation and running of the project, constant training is one of the key elements. There are training and education programmes that cover the whole cycle of implementation and running of the project, targeting all interested parties and stakeholders, with appropriately tailored education materials. ACTION Caring provides training for the municipality's caring practitioners.
- Usage statistics are made available. The municipality is able to access data on how much the ACTION-programme has been used, what parts have been used and whether and to what extent the videophone has been used.

KEY PARTNERSHIPS: ACTION has been developed in partnership with frail older people, family carers, health and social care practitioners and care providers, a university and a technical supplier: i.e. the University College of Borås and ACTION Caring Sweden, with financial support from the EU's Fourth Framework of funding, the Ministry of Health and Social Affairs, the Knowledge Foundation, the Vårdal Foundation, the Curamus Foundation, the Handicap Institute together with Borås, Mark and Härnösand municipalities, the West Sweden region, Telia Sonera and EVRY Healthcare Solutions AB. It was a critical factor in its development that in 2003 the University of Borås set up a spin-off research and development company, ACTION Caring AB, which went into partnership with Telia Sonera, the largest telecommunication operator in Sweden in order to make the service more widely available (initially across Sweden, and later to other Nordic and European countries). Telia eventually left in 2009 and EVRY has been the business partner ever since.

Main stakeholders and their current roles:

- University College of Borås (UCB):
  Coordinator of the three-year EU-funded project within the Fourth Framework Programme that started the research and development of ACTION in 1997. It is still a stakeholder in ACTION Caring AB, the spinoff company from the UCB.

- Borås municipality:
  Municipality where ACTION is running in the mainstream care system.
  It subscribes to the service from ACTION Caring.
  Receives the payment from the end-users.

- ACTION Caring AB:
  This spin off from the University College of Borås (ACTION Centre AB) is responsible for advertising and communicating the service. It established the contract to provide the service to the municipality based on the annual budget. It also developed training for introduction and follow-up support.

- EVRY Healthcare Solutions AB
  Is the business partner, which provides the technical skills and maintenance services for the technical platform and service connectivity. EVRY is refunded for its efforts with a fixed part of the customer fee. Also, as a provider of software and services to the healthcare market, EVRY is interested in exploring the business opportunities of home care.

- Older people and their carers:
  Involved in all stages of the design process.

- Professor Mike Nolan, University of Sheffield. Professor John Keady, University of Manchester, Professor Tomas Gustavsson, Chalmers Technical University and Professor Anders Wallin, Sahlgrenska University hospital:
  Support the research.

COST STRUCTURE: The bulk of the research, development and evaluation work is funded by different research and/or development grants. Staff working for the company are partly employed by the university and partly employed by ACTION Caring.

The municipalities finance the service by buying it from ACTION Caring. End users pay a fraction of the actual price. Up until now, the service has been delivered via an implementation project with time-limited financial support in the form of a development grant and/or governmental support funds, which are applied for by the staff in the municipality concerned. Thus, income so far has come predominantly from the state, and could not provide the sustainability of the service on a mass scale. This is highlighted by the fact that services subsidized by these special schemes were closed down when the funds dried up after some years. There are clearly documented costs for the municipality to cover, which consist primarily of costs for the videophone licenses in addition to the database, server maintenance and costs for personnel, offices, logistics and administration. The municipalities provide users with computers to access the ACTION service for free or for a monthly fee, and they also offer designated practitioners who work with the service via the call centre.

Users pay the service subscription fee, the broadband connection and – depending on the decision of the municipality – sometimes a renting fee for the hardware (See Section 3.3.1 Business case for the details).

3.3.3 Technological components

Families access the multimedia caring programmes via their personal computers. No advanced technology is needed to use ACTION - only a computer with a screen, keyboard, mouse, a videophone and a microphone. Broadband connection is also a requirement. Computer security is guaranteed via VPN (Virtual Private Network), anti-virus programme and a firewall.
The informative programmes are designed as normal webpages, in which the text and colour can be adjusted to make them as readable as possible for users with special needs and desires. The videophone software is specially developed to be easy to use.

3.3.4 Technical standards and norms

ACTION does not require any specific standards to be met, although it only runs on a Windows platform – Windows 7 recommended. The only thing that binds the ACTION client to the Windows platform is the video component. In order to make the service interoperable and thus exploit new market opportunities, a project has just been initiated that will look into the possibility of making the service available on a number of mobile platforms, tablets and smartphones. This project will also evaluate the possibility of using a non-platform-specific video client in the future.

3.3.5 Quality of the service

Since ACTION is part of the mainstream care delivery chain, all the relevant national and local regulations apply.

Besides the general legal framework, there is a comprehensive quality assurance plan developed by the creators of the service specifically for ACTION. This forms part of any detailed bid submitted for tender by ACTION in a municipality. Several municipalities have also developed detailed specifications in their procurement documentation when inviting tenders. For example, Västerås have involved end users of ICT services in discussions about what they consider as important when choosing an ICT service.

Training and education activities offered can also be considered as quality assurance activities.

3.3.6 Training actions

In ACTION, a specific training strategy has also been developed. In fact, “education and supervision” is one of the four integrated components of ACTION. This component aims to develop family carers' skills and competence to use the solution. This end-user focus is based on ACTION's theoretical foundation in the “Carers as Experts” model (Nolan et al., 1996, 2001). Family carers take part in an initial education programme to learn how to use the equipment and how to read and search for information and training programmes, run by the call centre staff.

Care practitioners working in the ACTION call centres are required to attend an education programme run by ACTION caring in the municipality. They are trained to carry out the following tasks: 1) inform, train and support older people and their family-member carers, and continually follow-up their needs, their situation and the results of measures taken, and 2) to provide necessary introduction and training to new staff and users of the service. The sessions are a blend of theory and practice and include practical ‘hands on’ sessions, ‘role play’, small group work and seminars. Their education programme includes a follow-up, certification and regular supervision by ACTION Caring, a mix of real, on site and virtual, videophone sessions. A key part of these sessions is

allowing participants to share their experiences and learn from each other (Bergström et al., 2010). ACTION Caring supplies the teachers of end users with the required teaching material for older people and their carers.

Moreover, awareness training by ACTION call centre practitioners, acting as peer role models, has been implemented blended learning networks have been established – carers, older people, practitioners, decision makers, business representatives, members from civil society organisations together with researchers – to facilitate learning and sharing knowledge about the use of ICT for staff (Hanson et al., 2011).

We summarise below in Table 9 the main characteristics of the training activities of this solution.

Table 9: Summary of the training activities for ACTION

Target	Informal carers	Caring staff professionals
Aim	To educate informal carers in the use of ACTION.	To make them able: 1) to inform, train and support older people and their family-member carers as well as continually follow-up their needs, their situation and the results of measures taken; and 2) to provide necessary introduction and training to new staff and users of the service.
Content	How to use: 1) the equipment and the information and training programmes; 2) the videophone, the e-mail and the Internet.	Theory and practice on ACTION and its use in interaction with the older and their family-member carers.
Timing	Informal carers are trained when they started with ACTION.	First sessions of three days, with a follow-up at six months, and finally 18 months later two days with a certification component. There are regular monthly sessions and supervision for 30 hours.
Training method	Training materials distributed	Takes place in the call centres and supervision is done through video-phone.
Certification	No	Yes
Trainers / responsibility	Call centre staff	ACTION Caring AB
Funders	Municipality	Municipality

3.3.7 Scaling and market creation

In 2011, around 350 people were using the ACTION service, but by 2014 this number had fallen to around 100. However, the potential user base is around 80,000 (Chianti et al, 2011). The system is currently operating in the Borås municipality. 25 municipalities tested the service back in 2012, but decided not to implement it without adequate financial support from the governmental resources. Many of these municipalities, though, started to use some kind of ICT-enabled services and they acknowledge ACTION was a catalyst in the process.

We asked Hanson and Magnusson (2014) to give us their own assessment of why it has not been possible to scale-up the in the past, and they attributed it to the following factors:

- Many municipalities used national funds to establish the service, but they could not maintain it from their own budgets when those funds were dried up.
- It requires extensive training from all the sides: ACTION providers, care recipients and their family carers, and the caring staff of the municipalities.
- Sometimes it fell victim to politics. Some local politicians seemed to embrace the idea of implementing an innovative solution in care of the elderly but they were not determined / powerful enough to upset the status quo in local caring provision in the long term.
- GAPET, a cheaper, alternative solution – albeit different in many aspects – was chosen over ACTION. GAPET requires the possession of more computer skills to operate. Another competitor is Tunstall Nordic, which offers standard telehealth and telecare solution packages, which may affect present and future scaling-up opportunities.
- Many of the local implementations were small-scale, around 20 users, which were not enough to create the critical mass of user base.

Considerable challenges lie ahead if the ACTION initiative is to be mainstreamed and used widely in Sweden. Magnusson and Hanson (2012) and Hanson and Magnusson (2014) see several factors that need to be tackled in order to help the service to be mainstreamed / transferred elsewhere, for example:

- Organisational complexity and other municipality-related issues (i.e. the organisation in charge of care):
  - Integration of the service into the delivery chain, as a standalone service has low chances of sustainability;
  - Stimulus funds are no longer available for the municipalities and they could not easily provide all the finance for the services from their own budget alone;
  - There is an inherent tension between the municipalities' yearly budgets and the long-term and significant investment that launching and operating of ACTION requires;
  - Policy makers prefer cheaper and quick-fix solutions to services that have longer-term returns, and they tend not to understand / rate empirical evidence about the effectiveness of these services;
  - Municipalities tend not to invest in prevention: their caring approach is more "crisis"-oriented, i.e. they focus on those in considerable need already.

- Challenges in relation to the local caring staff:
  - Comprehensive education of the staff, i.e. hard and prolonged work is needed;
  - Negative attitudes of caring staff, especially care assessors, as some of them believe that only human interventions can be successful (those "gatekeepers" need to be addressed, e.g. get those "hostile" professionals to meet with actual users);

- Relatively high level of turnover of senior caring managers and it can be an issue when trained and dedicated ACTION-champions leave. iI is hard to replace them and this is certainly a setback for the service. In fact, there were instances where a manager didn't want to continue and the service was eventually terminated.

- Lack of sound and convincing evidence of impact and efficiency (particularly financial).
- Sound business / financial plans and models are needed.
- Favourable policy context is important in all relevant levels (local, regional, national).
- It is hard to build up the critical mass of users.

ACTION Caring is trying to move forward technically as well, reflecting the changes in the technological landscape. There are plans to offer the service on different devices (tablets) as well in the unspecified future.

3.3.8 Policies and the role of policy in creating, implementing and scaling-up good practice

Policies and funds have been of central importance ever since the concept of ACTION was born. It started as an EU-project and then national R&D funds helped its development and implementation into the mainstream delivery chain first in Borås, and then across Sweden. But eventually the drying up of the national funds exposed ACTION to the lack of a sustainable financial support model / policy for the service.

These issues were elaborated elsewhere in this case study, especially in the previous chapter on scale dimension.

This chapter concentrates on the current policy environment – its strengths and weaknesses / limitations –at local, national and EU-level in relation to scaling-up and re-design of the service (Hanson and Magnusson, 2014).

- Local level:

  It is easier to promote ACTION for municipalities with a clear LTC-related policy document that emphasize the need for an innovative and flexible support services in their portfolio.

- National level:

  There was not much emphasis on family carers or technology-enabled caring solutions recently. There was, for instance, a major initiative to improve care for older people and subsequently for the seriously ill older people, but those aspects mentioned – that could put services like ACTION into a good position – were not considered in it.

  E-health was promoted in Sweden, but the focus is on self-care and person-centred care – i.e. on the patient –, and the family and or other informal carers are not particularly given roles in these caring models and policy approaches.

  A policy that promotes preventive and integrative services could help services like ACTION to thrive, especially if it would promote explicitly the use of ICT-enabled services.

  Usually neglected, but a holistic policy approach to the situation of (family/informal) carers – often still active on the labour market – should also be needed, i.e. their support could be integrated into education, employment and business policies.

- EU-level:
  Policies promoting the inclusion of older people in the information society and the role of the family / informal carers are very important, but it takes considerable time while they are infiltrating into national/local policies and practices.

3.3.9 Evaluation process of the effectiveness of the good practice

Final objective of the evaluation process: ACTION was firstly evaluated between 1997 and 2000, to see whether the technological solution developed in the framework of the European project helped older people and their carers. The researchers wanted to test if ACTION could help to maintain older people's autonomy, independence and quality of life. They also wanted to know whether the solution was user-friendly and acceptable to the users, and cost effective. This objective was addressed in a study published in 2002 by Magnusson and colleagues (Magnusson et al., 2002).

Encouraged by the results, the University College of Borås decided to further develop and test the ACTION services in Sweden with funding from the Ministry of Health and Social Affairs between 2000 and 2002. This second study analysed two objectives:

1) Whether the use of ACTION by participating families reduced their potential use/costs of other services whilst maintaining or enhancing their quality of life. This objective was addressed in a study published in 2005 by Magnusson and Hanson (2005).
2) Whether family carers benefit from the use of ACTION. This objective was addressed in a study published in 2005 by Magnusson and colleagues (2005).

ACTION was also tested in Norway by the University College of Borås (Sweden) and the Vestfold University College (Norway). In this third study, ACTION was tested in two Norwegian municipalities for one year (2004). The evaluation was supported by the Norwegian Directorate for Health and Social Affairs and the Norwegian Association of Local and Regional Authorities. The aim was to analyse whether ACTION enabled family carers to establish an informal support network, and whether it helped to reduce carers' stress and mental health problems. This objective was published in Torp and colleagues (2008).

Definition of the evaluation process:

1.- For the first study mentioned, Magnusson et al. (2002) developed the following methodology:

The sample consisted of 1,838 frail older people and their family carers, who had been using ACTION in their homes for a minimum period of 3–4 months. Users were collected from the countries involved in the European project: i.e. England (n= 328), Northern Ireland (n = 445), Republic of Ireland (n = 206), Portugal (m = 410), and Sweden (n = 449). The older people and their carers were recruited at the health centres by community nurses.

This study used a participatory research design, which consisted of a multi-method and pluralistic approach, that mixed quantitative and qualitative research methods.

The study evaluated the following variables and instruments[32]:

- Autonomy, independence and quality of life of older people and their family carers: this information was collected through interviews, using a conversational approach, following the work of Bury and Holme (1991), where participants are encouraged to talk freely about their experiences.
- Cost factors associated with the ACTION system and services:. This information was extracted from focus groups with care providers, administrators and managers.

[32] As it is not the aim of the study to refer specifically the instruments used in each evaluation study, we refer the readers to the publications referred to have the specific references of the instruments.

Procedure for data collecting: The data on autonomy, independence and quality of life were collected using interviews with the older people and their family carers. When it was not possible to get the information from the older people, the information was obtained from the informal carers. Informed consent was gained from all family carers. Ethical approval from a local medical ethics committee was gained in all partner countries prior to the evaluation phase. There is no more information on the procedure used to collect the data. The data on cost were collected through focus groups at the end of the demonstration phase.

2.- The second study (Magnusson and Hanson, 2005; Magnusson et al., 2005) used the following methodology:

The sample was composed of a total of 34 caring dyads who had tested the ACTION system and services in their homes for approximately three months to a maximum of one year. The participating families were recruited from two municipalities in the west of Sweden.

In order to gather data on cost (first objective), the nurses of the ACTION call centre were asked to select five participating families (of the 34) on whom they considered ACTION had had a major impact in preventing increased care costs. The costs for these five families were used to calculate the final average hypothetical cost saving calculations for the total sample.

Research design: Based on the previous study (Magnusson et al., 2002), this study used a participatory research design, with a multi-method and pluralistic approach, that mixed quantitative and qualitative research methods. The cost analysis work was conducted in Autumn 2002 as a sub-study within the overall Swedish ACTION project, and it was, in essence, a cost description. A cost description is defined as 'a measurement of the costs of one thing, or of more than one, in a way which allows an explicit or implicit comparison of costs' (Øvretveit 1998). A case study design was employed for the cost description analysis, which means that each selected family represented a case and the descriptive data concerning care service costs and the ACTION intervention costs were analysed with regard to the family's perceived benefits from ACTION, resulting in a hypothetical cost assessment of usual service costs. In this way, the method of the instrumental case study was employed.

For the first objective of the study (regarding costs), a preliminary cost analysis for 5 families was done, based on:

- A description of the family and their caring situation. These data were collated with the families' consent from existing general background demographic project data.
- A description of the benefits from ACTION perceived by the families. This information was obtained from project interviews with the families.
- An assessment of the number of care services needs for the five families without ACTION and their costs. This was carried out by the needs assessors, and validated by a joint meeting in the family's own home between the family, the needs assessor, the first author of this study and an ACTION call centre nurse. The costs for different kinds of usual care services were obtained from the financial departments in the two participating municipalities.
- The ACTION service costs, based on real actual costs for equipment, communication, technical support and the ACTION call centre. The use and cost of telecommunication and Internet were based on information from the telecom company's invoices for the period July 2001 to June 2002. The costs of development and maintenance of the ACTION programmes were based on estimations from previous experience within the ACTION project.

Based on the results of these hypothetical cost assessments, an estimate of the average cost saving per family based on the total sample of 34 ACTION families was made.

Data collection was carried out by the needs assessors who knew the families involved, together with the ACTION call centre nurses.

For the second objective, a multi-method pluralistic evaluation model was used. This model captured the views of families and professional carers, through a carer questionnaire and interviews. A modified version of the PREP[33] evaluation questionnaire was used with family carers (Bond, 2000). It comprises 40 statements that explore the PREP domains of preparedness for, predictability of, and rewards and satisfaction with caring.

The families were interviewed after field tests on their experience and evaluation of ACTION services. Similar interviews were conducted with the call-centre staff on the benefits of the project for the participating families and its impact on their ways of working. Three focus group interviews were also carried out with staff from the participating care settings about their experiences of using ACTION with older people, family carers and other care staff.

The views of the professionals were collected through individual in-depth interviews with the two assistant nurses and the district nurses who were most closely involved in the call centres. Focus group interviews were also conducted with various professionals who worked in several care settings where ACTION was installed.

3.- In the third study, Torp et al. (2008) used the following methodology:

19 older spousal carers were recruited from two municipalities in eastern Norway. They were referred to the project by general practitioners, hospital physicians, and community care nurses. They could also be self-referred, having learned about the project from a local voluntary organisation and/or newspaper advertisement. All the 19 recruited carers cared for a husband or wife.

The project started in January 2004. At baseline, the 19 carers participated in the individual interviews and filled out the self-administered questionnaire. At follow-up (12 months later), all the carers took part in a focus group interview, and 18 filled out the questionnaire.

The research design used was a pilot intervention study. Regarding variables and instruments[34], a multi-method evaluation model was used to collect the following quantitative and qualitative data:

- Socio-demographic data on the spousal carers. In the baseline interview, information regarding age, housing, education, occupation, public services, and when the cared-for person received their current diagnosis, were collected.
- ICT use through the items 'To what extent have you previously used a computer/PC at home or at work?' at the baseline, and How often have you used the computer in the last 3 months?' at follow-up.
- Knowledge about chronic disease and caring, through the items 'What information do you need about the cared for person's disease and how to best take care of him/ her?'.
- Social network, measured by the Family and Friendship Contacts Scale developed by Andersson (1984).
- Social support, measured with a 20-item scale developed by Russel et al. (1980).

[33] The PREP model of nursing interventions aims to increase the knowledge and skills of family carers by raising their Preparedness (PR) for, Enrichment (€) from, and the Predictability (P) of their personal caring situation. This is achieved by providing individualised advice and support, initially through home visits, and subsequently by telephone (Archbold et al., 1995).

[34] As it is not the aim of the study to refer specifically the instruments used in each evaluation study, we refer the readers to the publications referred to have the specific references of the instruments.

- Burden of care, assessed by the 15-item Relative Stress Scale (Greene et al., 1982).
- Mental health, evaluated with the 20-item version of the General Health Questionnaire (GHQ-20) (Goldberg, 1985; Malt, 1989; Goldberg and Williams, 1991).
- Carers' experiences of the intervention (use of ACTION) were collected through focus group interviews. A semi-structured interview guide was developed to collect more in-depth information on the same topics as in the questionnaire, namely knowledge, social contact and support, stress and health.

For the data collecting, initially, a structured interview was carried out with the participating family carers. They also completed a self-administered questionnaire at baseline and after 1 year. In addition, they were interviewed in focus groups after participating in the study for approximately 6–8 months. Logging data of the carers' use of ICT was collected and interviews were carried out with professionals participating in the project. The interviews took place in a rehabilitation centre well known to the participants, and with the carers' permission the sessions were recorded. Each interview lasted approximately 1–2 hours.

The Research Committee for Medical Research Ethics in southern Norway and the Norwegian Data Inspectorate assessed and approved the study. During the entire research project, due consideration was given to respecting the rights of participants with regards to informed consent, confidentiality, anonymity and appropriate data storage (Research Committee for Medical Research Ethics 2006).

Findings were focused on the impact of ACTION on the quality of life of carers, their productivity and quality of care provided, and on the cost-efficiency of the technological solution. The studies showed that ACTION helped informal carers to be more independent in their tasks and responsibilities. Family carers considered that ACTION helped them in various ways with regard to their caring situation. In particular, ACTION reduced the sense of isolation, created a sense of presence, and provided them easier access to care professionals (Magnusson et al., 2002). There was also a positive and significant change in scores with regards to contact with family and friends and a sense of social support from other people (Torp et al., 2008).

ACTION also increased carers' productivity. ACTION was found to empower family carers in the sense that it gave them ready access to the information they required without necessarily having to go through a professional (Magnusson et al., 2002). In addition, formal carers said they saved time, had more time for those patients with more intensive care needs, and were more satisfied with their jobs. Professional carers acknowledged that the videophone saved them travelling time as they could conduct follow-up consultations via the videophone (Magnusson et al., 2002). Community nurses recognized that videophone also allowed them more time to visit those patients with more intensive nursing needs (Magnusson et al., 2002). ACTION call centre practitioners highlighted the fact that they experienced improved job satisfaction as a result of working in partnership with families to help empower them in their situation (Magnusson et al., 2005).

Formal carers also said their work environment was better, with more cooperation between the formal and informal sphere. The service represents a more environmentally friendly way of working for staff as they use the video-system when contacting service users, thus staff travel less and carry out fewer home visits to clients (Magnusson et al., 2005). ACTION raised awareness of the need for professional and family carers to work in partnership. The staff reported new insights into the situation of family carers, into the interdependencies in caring relationships, into the knowledge and expertise held by carers, and into their own potential to enhance these caring resources (Magnusson et al., 2005).

ACTION was also found to increase the quality of care provided. For informal carers, the solution increased their care competence. Family carers explained that ACTION had helped to improve their knowledge and skills so that they were able to care more effectively for their relative (Magnusson

et al., 2002). In fact, in the Norwegian study at follow-up, carers reported less need for information about the cared-for person's illness and caring (Torp et al., 2008). Moreover, ACTION was also found to enrich their caring relationship (Hanson et al. 2002), help informal carers to feel more prepared and confident in their tasks (Magnusson et al., 2005). For formal carers, ACTION call centre practitioners highlighted that they experienced improved client satisfaction as a result of working in partnership with families to help empower them in their situation (Magnusson et al., 2005).

ACTION was also found to save costs. The study with 34 family carers recruited from two municipalities in West Sweden calculated an average saving of €10,300 (exchange rate as of 28 June 2002, 1 EUR=9.08 SEK) per family per year for the municipality as a result of reduced use of home help services and delayed entry to nursing home (Magnusson and Hanson, 2005).

3.3.10 Organisational change: integration of the technology–based service in the delivery chain of care.

As already described, ACTION became part of a mainstream caring delivery chain in Borås for use in private homes. We can add here that ACTION Caring now plans to apply for grants to develop the service further and adapt it to institutional use / environment (care home, hospital). This aspiration is in line with the trend to integrate health and social care (telehealthcare).

However, there is no general **policy framework** that could facilitate the integration of ACTION into the local delivery chains. The Social Services Act ordered the local municipalities to support informal carers, but not how should that be done. The municipalities can define their own carer supporting policies and a number of them have explicitly chosen to do so with ICT-enabled services in their policies.

Generally, there were no well-defined **roll-out plans** at the municipalities where ACTION was implemented and tested. This was partly due to small-scale implementation and the fact that when the state-funded – sometimes only testing – periods ended, the municipalities decided not to continue and scale-up – which would have required the creation of a roll-out plan. One municipality however – Mölndal –started to work on a deployment plan, concentrating mostly on an information campaign, targeting the stakeholders (practitioners, politicians and carers).

ACTION Caring, nevertheless, acknowledge the need to provide more support for the municipalities to formulate their own roll-out plans in the future (Hanson and Magnusson, 2014).

Regarding the referral process, ACTION, being integrated into the caring services could be offered in theory whenever the needs assessors found it the best option to address a caring need. Generally, this would be to a "unit" of an older – cared for – person living with his or her relative(s) / family carer(s), but in Borås, older people living alone could also get the service if needed.

For instance in Borås, the following criteria are used by the assessors. An individual has to meet at least one of them for ACTION to be granted (offered):

- The service would enable the person to stay in their own home for longer.
- Self-care is made easier possible.
- Formal care services are reduced.
- It would promote social contacts and break social isolation and loneliness.
- It would make the carer's work easier/possible.

It is known, however, that sometimes the need assessors didn't offer ACTION routinely to individuals though their caring needs would have warranted it. This was due to limited financial opportunities

at the municipality, too small-scale local application and because of their own negative attitudes to technology-enabled care (Hanson and Magnusson, 2014).

Procurements are taken care of by the municipalities, and national and local regulations apply to these processes. Generally no special procurement plans are known, although there was an interesting procedure where user representatives were directly involved in the procurement process. A working group of carers in Västerås defined the required technical parameters and properties that they thought would be best suited for older people. They defined obligatory as well as desired parameters, which were included in the original request for proposal. When the offers were considered, the carers' working group graded the submitted applications, comparing them to the criteria they had created, and it was a part of the overall evaluation (Hanson and Magnusson, 2014).

The **installation** of broadband and equipment in the user's home, together with the required technical support is provided and supplied in collaboration with an ACTION centre or its contact person.

In terms of **service delivery and monitoring**, the ACTION service is run through the ACTION call centre. It is manned by trained assistant nurses and district nurses. In cases where a municipality or municipal district choose not to start an ACTION centre of their own, the ACTION service can be purchased from ACTION Caring.

There are no special ACTION data management practices. In the caring record of the older – cared for – person, it is recorded that he / she was offered ACTION (but not into his / her health record). The strict data protection policies only allow the individual care records to be analysed within dedicated research projects approved by ethics committees, and naturally their scope is limited. Handling personal data is obviously a very sensitive issue, and it makes data protection policies not only strict but rigid as well. For instance, it is a well-known problem that individual carers' supporting services could not be recorded by the municipalities by law, and only the overall number of users is documented. Moreover, no change can be expected in the policy in the near future. But, for a complex service, like ACTION, it poses a problem, as ACTION Caring is less able to support its claim about the benefits of the service with evidence. This makes the planning and management of services supporting informal / family carers more challenging. ACTION Caring, nevertheless, releases aggregated quarterly data to the municipalities (Hanson and Magnusson, 2014).

Installation and maintenance is offered by the service provider and usually needs a dedicated IT worker to be employed. Besides the planned, routine yearly maintenance procedures there may be occasional problems to resolve.

Decisions about the equipment removal at the end of service are often discussed between the front-line practitioner and the manager. Where necessary, the installers remove the equipment which may be upgraded, updated and redeployed to a new user. Usually equipment not older than 3-5 years can be considered for re-deployment.

The obvious and probably most frequent reason for the removal of equipment is the death of the older – cared for – person. There is, however, a very interesting practice in Borås, where the removal is not automatic in cases like this (Hanson and Magnusson, 2014). They realised that using ACTION can sometimes support the bereaved carer in his or her grieving process, and for this reason the equipment stays put. Coping with loss can be made easier for bereaved carers with the peer support that they can get via the network of users, especially from those who already have experiences of similar life situations. Moreover, the bereaved carer can act as an expert or mentor for novice users. It might even help the bereaved carer to redefine him- or herself, to re-create and strengthen his or her own identity in this new situation.

Table 10 provides a summary of the role of the public and private sector in the integration of the solution in the care system.

Table 10: Summary of roles of the public and private sector in the integration of ACTION in the care system

Roles	Public institution	Private	Partnership
Policy	X		
Communication	x	x	
Awareness raising	x	x	
Planning of deployment			x
Diagnosis (individuals)	x		
Control of installation			x
Control of service delivery	x		
Entitlement of service	x		
Funding service	x		
Service delivery			x
Customer support service	x		
Training	X		X

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Interviews:

- Two joint interviews on 10th of June and 15th of July 2014 with Elizabeth Hanson and Lennart Magnusson; case representatives with a dual affiliation to ACTION Caring AB and University College Borås.

3.4 NATIONAL TELECARE DEVELOPMENT PROGRAMME (TDP)

NUMBER	13
TYPE OF TECHNOLOGY-BASED SERVICE	TECHNOLOGY-BASED HOME CARE - TELECARE/TELEHEALTH
NAME OF THE PRACTICE	NATIONAL TELECARE DEVELOPMENT PROGRAMME (TDP)
LEVEL OF NEEDS COVERED	WHOLE POPULATION (BASED ON ASSESSED NEED)
VERIFICATION OF THE CASE:	Case verified by Alistair Hodgson, case representative, on 29th July 2014.
COUNTRY	UK

Brief description: The Scottish Telecare Development Programme (TDP) ran from August 2006 to 2011. Its aim was: "To help more people in Scotland live at home for longer, with safety and security, by promoting the use of telecare in Scotland through the provision of a development fund and associated support". The TDP adopted this definition of telecare: Telecare is the remote or enhanced delivery of health and social services to people in their own homes by means of telecommunications and computerized systems. Telecare usually refers to equipment and detectors that provide continuous, automatic and remote monitoring of care needs, emergencies and lifestyle changes, using information and communication technology (ICT) to trigger human responses, or shut down equipment to prevent hazards.

This case study primarily presents the TDP, which was a national telecare mainstreaming programme between 2006 and 2011. However, the field is continually evolving – not just the technology used but also the approach taken - for instance, efforts are being made to integrate it much more with telehealth. It is therefore also worth discussing briefly the most relevant post-TDP developments in policy, organisational changes and recent data on telecare use.

3.4.1 Business case

MOTIVATION FOR THE PROJECT: The Scottish Government established a telecare national programme called the "Telecare Development Programme (now onward "TDP)", that ran from August 2006 to March 2011.

Before this programme was launched, there had already been a growing body of evidence that the use of telecare services could improve the quality of life and support the independent living in the home environment. As a result, there were indications of reduced use of institutional care, hospital beds and other – e.g. emergency – admissions. Evidence of the benefits poured in from all over the UK, but in Scotland, the West Lothian council area stood out, as more advanced telecare services were in use there and there was comprehensive data about their benefits.

The apparent benefits, combined with the predicted profound effects of the ageing of society persuaded the Scottish Government to launch the *TDP* as a policy initiative to drive the adoption of telecare by local social and health care service providers.

This initiative aimed to respond to the following situation in Scotland (Cenderello et al., 2013):

- The ageing of the Scottish population: it was expected that the Scottish population over 75 would grow by over 25% over the following 10 years. By 2030, a 60% increase was foreseen. (General Register Office for Scotland, 2013).
- The increase in informal carers. In 2008, there were approximately 660,000 unpaid carers, and a number was expected to grow to one million by 2037. 23% of all carers were caring for 50 hours or more per week (IRISS, 2010).

- The high expenses in social and health care systems and services. In 2007-2008, healthcare and social care expenditure for those aged 65 and over stood at £4.5 billion (€5.4 billion)[35], with two thirds of this spend going to hospitals and care homes. Moreover, about one third of the total spend was accounted for by emergency admissions.

In this initiative, the Scottish Government prioritised 'shifting the balance of care' towards prevention and towards the provision of care services in people's own homes and communities. All the 32 social and health care partnerships (or Local Partnerships, based on the 32 territorial authorities + other joined local stakeholders including health) were invited to submit proposals for the use of the TDP funds. Each submission had to be endorsed by the local Community Planning Partnerships[36]. The local proposals had to address at least one of the following eight programme objectives (Chianti et al., 2011):

- Reduce the number of avoidable emergency admissions and readmissions to hospital.
- Increase the speed of discharge from hospital once clinical need is met.
- Reduce the use of care homes.
- Improve the quality of life of users of telecare services.
- Reduce the pressure on informal carers.
- Extend the range of people assisted by telecare services in Scotland.
- Support effective procurement to ensure the growth in telecare services.
- Achieve locally identified outcomes including efficiency savings.

Therefore, over the 2006-2011 period, each partnership developed telecare services in ways which targeted localised need and priorities, supporting a wide range of user groups enabling people to remain safely within their communities with tailored support mechanisms.

Over the period to March 2011, some £20.35 million (€24.6 million) was made available by the Scottish Government under the programme. Of this sum, £75 million (€3.3 million) was used to fund an innovation programme and meet research and programme management costs, while £17.6 million (€21.3 million) was allocated directly to care partnerships to drive service expansion.

SOLUTION DESCRIPTION: Telecare is defined in the Scottish Government telecare strategy as "the remote or enhanced delivery of care services to people in their own home or a community setting by means of telecommunications and computerised services. Telecare usually refers to sensors and alerts which provide continuous, automatic and remote monitoring of care needs, emergencies and lifestyle changes, using information and communication technology (ICT) to trigger human responses, or shut down equipment to prevent hazards" (Scottish Government, 2008).

BENEFITS: Benefits found are based on quarterly reports submitted over the five year period by Scottish local care partnerships (Beale et al., 2009; Chianti et al., 2011; Newhaven Research, 2011; Cenderello et al., 2013):

[35] For the prices reported in pound sterling (GBP) we used the exchange rate of the ECB as of 2 January, 2014 to convert them into EUR (1 EUR = 0.8282 GBP) throughout, unless stated otherwise.

[36] Community Planning is the process by which public services in a local area are planned and provided. Local authorities have a duty to initiate, maintain and facilitate the process. Community Planning Partnerships (CPPs) also typically involve other public, voluntary, community and private sector organisations (Hodgson, 2014).

Independent living of older people at home:

- Service users have reported a significant improvement in their quality of life. 60.5% of users felt that their current quality of life was either "a bit better" or "much better" than before they had their equipment.
- Increased emphasis on at-home care and independent living thanks to, inter alia, medication dispensers, home pod units, diabetes monitoring, fitness of older people and falls management programmes.

Productivity of the carers and quality of care:

- 100% of carers reported that their experience of telecare solutions was positive, quoting benefits such as reduced worries and stress, the ability to retain paid employment, the opportunity to reduce some caring tasks and an improved relationship with the person they cared for;
- 74% of carers reported reduced stress.

Sustainability of the social and health care systems:

- Cost savings generated for the social and health care budget as a result of telecare were significant: the gross value of financial benefits arising from TDP expenditure for the entire 2006-2011 period was approximately £79 million GBP / €95.4 million [37].
- Nearly half of these savings (48%) arose from avoidance of care home admissions. Another 44% derived from avoiding unnecessary hospital inpatient stays.

COSTS: In cases where services are purchased by the Local Authority from a private provider, a revenue-based model is applied. The Local Authority is charged a service-based charge every month. Variable costs include the cost of equipment and staff wages of the response team. The cost of the telecare package is met by the local authority. The table below provides an overview of the costs of some of the equipment included in the Telecare packages, taking the specific example of the Falkirk and Forth Valley Local Partnership (Cenderello et al., 2013).

Table 11: Costs of telecare equipment for the Falkirk and Forth Valley Local Partnership

	Measurement Unit	Cost per unit, GBP (EUR)
Smoke detector	1	55 (66)
Gas detector	1	98 (118)
Door open alert	1	40 (48)
Internal alert system	1	846 (1,021)
Environmental control equipment 1	1	8,752 (10,567)
Environmental control equipment 2	1	2,776 (3,352)
Cognitive support device (PDA + bespoke software)	1	869 (1,049)
Telecare equipment maintenance, installation and removal	Annual	700 (845)

Source: Cenderello et al., 2013

[37] Or €99 million on the average exchange rate for the period 2006-2011, (1 EUR = 0.7968 GBP).

3.4.2 Business model

CUSTOMER SEGMENTS: The main customer segments are (Cenderello et al., 2013):

- People at risk of social exclusion, including mainly older people and especially those with long-term health conditions.
- Young unpaid carers, because the government expects that the TDP will impact mostly on that group.
- Private sector technology companies, willing to participate in funding efforts, in order to internationally position themselves as leaders in this market.

VALUE PROPOSITION(S): The main value proposition of the TDP lies in its approach towards building telecare in Scotland (Cenderello et al., 2013).

Telecare Scotland reduced the need for institutional care (nursing home and acute hospital admissions) among older people. The savings generated could be then reinvested in technologies and services. This attracted the interest of private companies which provide telecare products and service. Indeed, the Scottish government helped technology companies to internationally position themselves as leaders in the field. This support was mainly in form of funds for an innovation centre to increase opportunities for partnerships with and involvement of the private sector.

There was a positive financial balance between investing in telecare and savings on the overall caring expenditures – which might be the all-important proposition for the public authorities. For the potential older users, they were more empowered, and lived more safely, independently, self-confidently, peacefully and for longer in their own home environment are the main propositions. The probable enhancement of their quality of life by using telecare convinced them and – in some cases –helped them to overcome their negative attitudes towards technology and the perceived intrusion to their privacy.

CHANNELS:

The national governmental campaign targeted mostly two groups (Hodgson, 2014):

- Sessions for the politicians to enable them to understand better the system and benefits of telecare. From the viewpoint of the political backing of telecare, these sessions paid off as much as 3-5 years later (about recently), since many of the already informed local politicians (councillors) became members of the Scottish Parliament later, and it did not take much to gain their support for the expansion of telecare on the national stage.
- For the care professionals, the government set up a telecare learning network which provided an information sharing and networking opportunity for them. These like-minded professionals then helped to raise awareness and convince their own colleagues back in their own working environments, and served as local telecare experts and "champions". During the course of the TDP, bi-monthly meetings were organised for them to exchange local experiences and solutions and to seek answers to their problems and concerns. This learning network later became a virtual network and still exists.

In addition to the governmental information campaign mentioned above, a multi-media toolkit with a DVD introducing telecare and digital stories (2008-2009) was issued, and the government also used advertisements through different telecommunication channels (online, TV, radio etc.) to promote technological products at home.

But in general, it was the responsibility of the local authorities to raise the awareness about telecare – and indeed all the services they provided – to the general public during the TDP years and today.

The government mostly has mostly run targeted local campaigns lately, but its current policy action plan, called "A National Telehealth and Telecare Delivery Plan for Scotland to 2015" (Scottish Government, 2012) aimed to "empower people" through awareness-raising and sharing the benefits of telecare (p. 29); and a nation-wide information campaign was planned to accomplish this. The plan recommended the creation of user-focused information materials, the update of the terminology used, and to undertake national media coverage to improve the understanding and the take up of telecare services. In these activities, the government assumed a leading role along with its key organisations, the Scottish Centre for Telehealth and Telecare (SCTT) and the Joint Improvement Team (JIT).

CUSTOMER RELATIONS: The Government publicly discussed the TDP and addressed the professionals. The local partnerships advertised the TDP through public media, collaborative working and word of mouth. These local partnerships were also responsible for local monitoring of telecare at customers' home.

After installation, contact with customers occurred via the monitoring centre (Cenderello et al., 2013).

REVENUE STREAMS: The Scottish government set up a Change fund worth £70 million (€84.7 million) in the financial year of 2011-2012, as part of its Reshaping Care for Older People activity, and extended this to a total of £300 million (€362.2 million) over 4 years to the end of the financial year 2014-2015. The government has repeatedly emphasized the need to gain critical mass through economies of scale hoping to derive savings and reinvestment from it (Cenderello et al., 2013).

When it comes to the users' contribution, Partnership decided whether users had to pay and if so, how much for the service. Some partnerships used TDP money to subsidize the service.

KEY RESOURCES: Key resources include (Cenderello et al., 2013):

- Financial resources: adequate funding. Over the period from August 2006 to March 2011, Scottish Government funded the programme with £20.35 million (€24.6 million). Of this sum, £2.75 million (€3.3 million) was used to fund an innovation programme and meet research and programme management costs, while £17.6 million (€21.3 million) was allocated directly to care partnerships to drive service expansion. The government has set up a Change fund of £70 million (€84.5 million) for 2011-2012 to implement service redesign at scale, including technology.
- Human and intellectual resources: with the participation of different stakeholders (government, local communities, research academics, private sector, higher education institutions, carers, etc) and call centre response team.
- Physical: infrastructure (technology, training, standards and procedures) and the call centre.

Furthermore, each Local Partnership received their third year funded depending on their progress on the outcomes expected: £125,000 (€150,930) for progressing, £200,000 (€241,488) for progressing well and no allocation for those who progressed slowly, although support was offered to identify and overcome the potential barriers.

KEY ACTIVITIES: One of the key activities of the TDP was the setting-up of a high-level action plan that included 5 key steps (Cenderello et al., 2013):

- Articulation of a vision for telehealthcare in Scotland.
- Leading the set-up of appropriate infrastructure (including funding and programme management).
- Establishing technology standards and innovative procurement policies.
- Taking the initiative in R&D (ensure Scotland acts as an international centre of excellence).
- Implementing nationwide telehealthcare at scale.

The action plan to make the vision a reality included (Cenderello et al., 2013):

- Establishment of smarter procurement.
- Establishment of rewards for academic research and adequate intellectual property protection.
- Tackling technological barriers (e.g. network standards, reliability, interoperability and capacity).
- Streamlining/simplifying organisational structure.
- Increasing funding through incentives to favour 'universal ownership' and 'buy-in'.
- Strategic planning from the government as a catalyst for the above activities and to spur 'cross-party support' to work with all stakeholders.
- Driving competition and innovation through critical mass.

KEY PARTNERSHIPS: Telecare services in Scotland are provided by different organizations, depending on how each Local Partnership has decided to structure service delivery in its territory of competence. In general, the main agents involved in the provision of telecare services are: local authorities, housing associations, voluntary organisations and charities (i.e. Age Concern), private providers of health related technologies, and health sector organisations (Cenderello et al., 2013).

Additionally, an integrated model of change to implement telecare based on collaboration from multiple sources has been set up (Cenderello et al., 2013):

- Private sector technology providers (to understand adequate technological needs/standards).
- Care providers (GPs, Nurses, social workers, voluntary organisations etc.).
- Researchers and academics.
- Wider public.

Public sector funding has been identified to support the development of an innovation centre in order to increase opportunities for partnerships with the private sector and its general involvement.

Main stakeholders are:

- Scottish Government:

  Established and funded the telecare action plan "Telecare Development Programme (TDP)" for 2006-2011.

  In charge of raising awareness on the use of telecare.
- Joint Improvement Team (JIT)

  This is an inter-organisational body that consists of representatives of the Scottish Government, NHS Scotland, COSLA (Convention of Scottish Local Authorities) and the third, independent and housing sectors. It was set up in 2004 to provide all sorts of support, guidance and advice for local partnerships in health, housing and social care planning and actual provision/governance, including: developing and implementing a care plan, community capacity building, about equipment and adaptations, performance improvement, care outcomes, knowledge exchange, etc.
- Scottish Centre for Telehealth and Telecare (SCTT)

A governmental body – a part of NHS 24 – that was established to help the development and integration of telehealth and telecare. Its range of activities covering, inter alia, the dissemination of best practices, clinical and technical support, providing evaluation frameworks and developing inter-operable standards and protocols. It provides services to various stakeholders (industry, academia, local authorities, NHS Boards and voluntary and independent sectors).

- The social and health care partnerships (or Local Partnerships: local authorities, housing associations, voluntary organisations and charities (i.e. Age Concern), private providers of health related technologies, and health sector organisations):
  - Developed and provided telecare services.
  - Carried out local monitoring of telecare.
- Scotland Excel (the Centre of Procurement Expertise for the local government sector in Scotland): Set up a procurement framework to source telecare services to improve the participation of private sector technology providers in the local partnerships, provide support for cost effective procurement processes and enhance overall interoperability.

COST STRUCTURE: see details on costs at the section 3.4.1.

3.4.3 Technological components

The general packages used by the partnerships as telecare solutions were composed of (Cenderello et al., 2013):

- A core/basic package, consisting of a telecare hub unit including a neck or wrist pendant complemented by a smoke alarm;
- An enhanced package included the elements of the core package above complemented with any kind of an additional sensors and monitoring equipment, including fall, flood and gas detectors, a bed monitor package or movement detectors among others.

The enhanced packages addressed more specialized care needs, and the typical devices were in this package, inter alia, bed / chair occupancy sensors, bed wetting (enuresis) sensors, carbon monoxide monitors, video or door entry alerts, electric window / door openers, automated reminders, epilepsy monitors and movement monitors.

At the beginning of the service provision, mobile assessment kits were in use. They were easy and quick to be installed and monitored users to determine their personal telecare equipment needs. The kits contained some alarms which used a SIM card and could be fitted on a short-term basis in properties without a telephone landline.

In general, the technological components of telecare solutions varied greatly, mostly because the decision on the technical implementation depended on the Partnerships and it was not coordinated centrally.
Certain guidelines were provided initially which highlighted the importance of certain considerations, for example:

- Easiness of fit into the home environment (e.g. wireless technology)
- Leveraging mainstream technology (TV, computers, smartphones, etc.)
- Data transfer and management enablement
- Modular and sensory architecture
- User friendliness
- Meeting individual user needs (customization and configuration).

3.4.4 Technical standards and norms

The telecare devices' and systems' technological properties and their standards and norms were very varied as the partnerships had the freedom to choose their own technological solutions. The equipment used differed both across and within the partnerships. As no manufacturer(s), norm(s) or standard(s) were prescribed by the TDP scheme, the decisions about them and the eventual procurement procedures and suppliers were decided on a partnership level without coordinating across the partnerships. As well as this cross-partnership variance, there was sometimes considerable internal variance within partnerships, because combining different suppliers' devices made it possible to tailor the deployed system according to to the diverse needs of their individual users.

The different manufacturers and products, however, sometimes raised questions about the interoperability of the devices, and occasionally did not help the reliability and the maintenance of the systems. Some partnerships also had issues about the reliability of the suppliers.

According to the comprehensive impact analysis that was conducted, one of the impacts on the private sector providers was the development of standards (Cenderello et al., 2013). Also, a main lesson learned from the TDP was that standards and procurement procedures should be more harmonised / standardised for successful and sustainable mainstreaming of a reliable telecare service delivery. Additionally, as the Scottish government wants the inherent synergies of telehealth and telecare to prevail and the two areas to merge into "telehealthcare", it must be ensured that the standards of the two areas are compatible.

3.4.5 Quality of the service

Quality assurance methods were applied and suggested in order to ensure quality in the service provided. Three actions can be distinguished (Scottish Government, 2010a):

1. The application of a framework of recognised standards was requested, although it was not mandatory. The Telecare Service Association's (TSA) recognised framework was one of those suggested initially, and in November 2008 a new TSA framework – adapted to the Scottish context – was launched. By March 2010, 19 Partnerships were members of TSA, and 5 partnerships were fully accredited and 10 were working towards it.
2. The Care Commission – that regulated the care services – and the Social Work Inspection Agency – that provided quality controls on the care services – were informed about the telecare services and were encouraged to extend the scope of their investigations to telecare services as well.
3. The Scottish Social Service Council – the body that registers people who work in social services and provides them with training and education – were involved in making telecare service providers' status clear and working on telecare personnel training standard recommendations.

3.4.6 Training actions

Training of health and social care staff was not implemented in the early stages of the TDP, and it became a key issue in 2008 in a redefinition of the TDP strategy. Training was a global TDP strategic action in the “Seizing the Opportunity” plan, published in May 2008 and covering the period 2008-10 (Scottish Government, 2008). Moreover, a specific education and training strategy covered later the period 2010-2012.

Partnerships nevertheless provided some training for their staff, chiefly for their frontline staff, i.e. carers and operators, which consisted primarily of awareness raising and assessment competences. Although the training for the frontline staff was universal, other informing and awareness-raising

campaigns and similar activities were more varied by nature and comprehensiveness across the partnerships. Other potential stakeholder target groups for training and information campaigns were: other professional carers, local politicians / policymakers, older (potential) telecare users, informal carers and, indeed, the general public.

Some of the partnerships set up demonstration flats for training purposes, and some even made it accessible to a general audience, not just their own staff. There were a few digital smart flats with a combined purpose: respite, training, assessment and community events, and there were a couple of portable demonstration flats as well.

Some of the partnerships actively involved users and carers as trainers in their training activities, and according to the self-assessment of the partnerships, some training approaches concentrated on the positive sides of telecare, while others opted for a more balanced approach in presenting of the telecare services. Some of the partnerships also created promotional materials, leaflets, information packs, newspaper articles, websites, roadshows and even DVDs, following the original DVD issued by the JIT in 2009 (Sergeant, 2010).

It soon became apparent to the JIT that, for successful telecare implementation, a more comprehensive approach is needed to training and awareness-raising.

The most advanced approach to this (that of the Joint Improvement Team and Scottish Centre for Telehealth, 2010) acknowledged that the training and education requirements should be the part of the activities of developing the workforce in order to serve the policy goals best. The strategy concentrated therefore on training the staff working with tele-healthcare in a community-based setting, i.e. social and healthcare staff and housing staff. This emphasis alone was a good indicator that in Scotland by this time they moved towards more integrated tele-healthcare services. The comprehensiveness of the approach embraces the housing services as well, given that these community-based services are provided in a private home environment. It can be considered a further step towards integration: creating a common knowledge base with the topics and terminology in education and training for professionals with different backgrounds and fields of operation.

The identified target stakeholder groups, the types of training they required and the formats of training delivery were identified by the strategy-planners. These are presented in the following 3 tables (Joint Improvement Team and Scottish Centre for Telehealth, 2010):

Stakeholder Group	Description
Elected Members, Board Members, senior strategic and operational managers	In health, social care and housing services (public, private and voluntary sector providers)
Assessors	GPs, nursing professionals, allied health professionals, social workers, housing staff
Equipment installers	Support workers, home carers, technicians
Call handlers	Support workers
Responders	Support workers, home carers, unpaid carers, volunteers
Service users	Service users of all ages
Carers	Carers of all ages

Training type	Stakeholder group
Awareness raising	All stakeholders
Telehealthcare installations and programming	Staff involved in installations, equipment maintenance, asset management
Assessment and prescription (of packages)	GPs, SSA assessors (in health, social care and housing), care managers, etc.
Call handing and reporting	Call handling staff
Response	Responders, emergency services, re-ablement teams, etc.

Training format	Description
Induction training	based on nationally agreed core content, locally delivered and non-accredited
Vocational skills training	various delivery methods and accredited, i.e. validated by the Scottish Qualifications Authority (SQA)
Continuing professional development	various delivery methods and SQA accredited
Topic specific training	e.g. use of technology in dementia care, etc. various delivery methods and accredited, where possible

The Strategy emphasizes 2 key elements: 1) training in telehealthcare should be a part of the curriculum of the emerging telehealthcare workforce, and 2) accredited materials should be available for current telehealthcare workers for their training and continuing professional development programmes.

Moreover, the strategy identified the following areas where the following developments were needed:

- A continuing national programme of awareness raising for key stakeholders;
- Working with regulatory bodies to establish a National Occupational Standards (NOS) framework for telehealthcare;
- Working with academia to promote the inclusion of tele-healthcare in the core curriculum of existing vocational training courses for professional staff;
- Working with regulatory bodies and Higher Education Institutions (HIEs) to develop a range of new accredited training opportunities for tele-healthcare staff;
- Exploring funding opportunities, including European funding, to support the delivery of training to the tele-healthcare workforce;
- Scoping the development of different delivery mechanisms to address the needs of a 21st century workforce e.g. interactive online training tools, etc.

We summarise in the table below the main characteristics of the training activities of this solution.

Table 12: Summary of training actions for TDP

Programme/Strategy	**Strategy 1: Assume at the beginning of the TDP by the local partnerships – not global strategy.**
Aim	Ensuring telecare awareness
Target	Health and social care staff: frontline staff
Content	Awareness training, and demonstration flats.
Timing	No specific timing
Training method	Promotional and supportive material, digital stories and DVD with partnership experience.
Certification	no
Funders	Scottish Government
Programme/Strategy	**Strategy 2: A global strategy in the 2008-2010 document "Seizing the opportunity" (redefinition of the TDP).**
Aim	Accredited training in telecare and ensure a continuous training development.
Target	Health and social care staff: staff from housing, health and social care services, and call handlers.
Content	• Training for staff from housing, health and social care services includes to acquire knowledge in telecare equipment; the relationship between common individual needs and the range of equipment that will help enable those needs to be met; some basic technical information about what can and cannot be installed; and to explain to potential service users and their carers the part that telecare can play in a package of care and support. • Training for call handlers include to learn skills such as prompt response, courtesy, and accurate recording, to 'filter' information, to choose correctly the procedure to activate or the protocol to follow. They also need to know how to reassure a confused caller and to give an appropriate response.
Timing	No specific timing
Training method	Telecare learning network for staff, continuing professional development.
Certification	Yes
Trainers/responsibility	For the specific case of continuous training, the Scottish Government created a telecare training group.
Funders	Scottish Government
Programme/Strategy	**Strategy 3: Strategy for education and training for 2010-2012.**
Aim	To support the development and delivery of high quality, effective and integrated telehealthcare services.
Target	Elected members, board members, senior strategic and operational managers, assessors, equipment installers, call handlers, responders, service users, carers.
Content	Awareness raising, telehealthcare installations and programming, assessment and prescription of packaging, call handling and reporting, and response.
Timing	No specific timing
Training method	Induction training, vocational skills training, continuing professional development, and topic specific training.
Certification	No
Trainers/responsibility	The Scottish Government with the Scottish Centre for Telehealth
Funders	Scottish Government

The Scottish Government realised that besides the predominantly formal education and training approaches, network-based horizontal communication channels also had considerable potential in awareness-raising and generating a common knowledge base among professionals (Hodgson, 2014). They facilitated the formation of a telecare learning network, in which monthly events provided a chance to share professional experiences – and uncertainties – among tele-healthcare staff, amassed in different areas of telecare and in different locations throughout the nation.

This, by now – i.e. in the post-TDP years – has become a virtual network that has grown to encompass the telehealth community – Integrated Telehealth and Telecare Learning Network – with regular monthly webcasts and an annual conference. The two main widely accessible knowledge bases are:

- The Scottish Centre for Telehealth and Telecare's online video channel (http://www.video3uk.com/sctt), which contains interviews, presentations and snapshots from experts – both within Scotland and beyond; and
- The Telehealthcare Community portal (www.knowledge.scot.nhs.uk/telehealthcare), a knowledge network that contains a lot of open access materials as well as those available only for registered professionals of various stakeholder groups (Scottish NHS and social care professionals, researchers, Scottish Government's and local authorities' employees, affiliates of certain NGOs, researchers, etc.).

3.4.7 Scaling and market creation

The development and integration levels of the telecare services were rather uneven among the 32 Partnerships when the programme begun in 2006. The funds that the TDP offered could eventually be taken up by all of the Partnerships, although there were significant variations due to their "readiness" measured by the JIT.

Altogether 43,665 people received telecare service across the span of the project, and over 30 thousand – 69 % – still used it when the Programme officially came to a close in March 2011. The distribution of the core and enhanced telecare services were remained similar during the latter years of the Programme, around 55 % and 45 %, respectively. The following table 13 shows the changes in the size of the user base.

Table 13: TDP Funded Telecare Service Users

YEAR	2007-8	2008-9	2009-10	2010-11	Total
New Clients (gross)	7,902	8,580	12,807	14,376	**43,665**
Stopped receiving a service	679	1,819	4,861	5,968	**13,327**
Net new clients	7,223	6,761	7,946	8,408	**30,338**

Source: Newhaven, 2011,

The vast majority of the users (around 86 %) that started receiving telecare services under the TDP scheme, had never used telecare before. For the available data about the programme's last two years, a good half of the users (55%) received the basic telecare service which was defined as a social alarm and an integrated smoke alarm, while the remaining 45% of the users received an enhanced package: i.e. the basic service plus at least one additional sensor or monitor.

Putting the figures above into the general Scottish context, we can add that by around the end of the TDP (in March 2011) the number of telecare users of 65 or older was almost 93,000 (10.4% of the total 65+ population) nationwide.

We have, however, more detailed data available for March 2013. By then, the size of the 65+ user base almost reached 97,000 (10.9% of the total 65+ population); out of which 81% used the community alarm only, 15% used additional telecare services as well, and the remaining 4% used other telecare services exclusively (without the community alarm). The table 14 below shows the entire Scottish telecare user base broken down by age groups (85 % of them were 65 years old or older).

Table 14: TDP clients, 2013

Age category	Number of Clients	Percentage
0 – 64	17,159	15.0
65 – 74	18,909	16.6
75 – 84	40,990	35.9
85 +	37,021	32.5
Total	**114,079**	**100.0**

Source: Scottish Government, 2014

In order to understand just how mainstream the telecare service was in Scotland in 2013, the following table presents aggregated data on all the main social service categories. Since one person can use more than one type of service, the total in the last column is not equal of the sum of the individual service columns. But it is striking that out of the almost 122,000 65 year olds or older social care recipients, 80% of them, 9roughly 97,000 thousand) use community alarms and / or other telecare services (as well).

Table 15: Number of social care clients by types of care used, 2013

Age group	Home Care	Community Alarm / Telecare	Meals Services	Housing Support	Direct Payments	Social Care
Under 65	10,596	17,159	637	7,600	3,467	**30,889**
65 and over	50,354	96,920	7,408	10,819	1,936	**121,739**
Total	**60,950**	**114,079**	**8,045**	**18,419**	**5,403**	**152,628**

Source: Scottish Government, 2014

3.4.8 Policies and the role of policy in creating, implementing and scaling-up good practice

The Telecare Development Programme was indeed initiated by the Scottish Government in 2006. It was a materialisation and perhaps the highlight of the switch in the policy approach – in their words: "shifting the balance of care" – to the challenges that the ageing of the population is posing to the caring systems.

Facing the reality, the Scottish government made fighting dementia one of the primary aims of care, and understood the importance of adapting its systems to the long-term caring needs because of the prevalence of chronic conditions. It also made steps to facilitate the integration of types of care to improve the existing fragmented and thus less efficient ways of provision. It also declared that emphasis should be put on prevention as well as on providing the care for older people primarily in the home environment and in the local community so long as this meets with their wish and the caring services / systems are able to carry this out. Realising that adaptation of the caring systems was necessary for sustainability and suitability, the Scottish government gave priority to innovative, forward-looking solutions like telecare. The fund made available for the TDP was primarily designed to boost the spread of the telecare services, both in terms of the varied problems that such solutions could tackle and the number of telecare service recipients. The TDP initiative was driven by concerns about the care budgets, thus the Government allocated money for a programme that could have a measurable and verifiable positive overall balance. As a return for the public money invested telecare, the Government expected savings in the healthcare or the social care sector (Cenderello et al., 2013).

As a "collateral" economic policy aim, the Scottish government expected their investment into telecare to boost the business side of telecare (private companies in research and development,

commerce, service provision). It was also expected to help Scottish companies to enter the global market and the sector to become highly competitive and a leader in the telecare market.

The government not only provided the funds for the TDP, but also commissioned governmental bodies to be involved in the overview / quality assurance (Joint Improvement Team (JIT)). Besides this, the government helped to keep the programme's profile high, for instance by publishing JIT brochures and evaluation reports, and indeed the forewords of some reports were written by government ministers.

Besides the national governmental setting of the overall targets, local governmental bodies were invited to apply for TDP funds – in collaboration with other local stakeholders, hence the partnership-form – for mainstreaming telecare into practice.

The approach to caring for older people got a new impetus in 2010 and 2011, when a series of new strategic policy directions and policy-related documents were published by the Scottish Government, all connected to some important element(s) of caring for older people (JIT, 2011). These documents represented a coherent and consistent approach to the caring for older people and the role of the telecare in it.

For example, "The Healthcare Quality Strategy for NHS Scotland" (Scottish Government, 2010d) highlighted the importance of preparing for the challenges of the ageing of society and the opportunities that ICTs might provide in its foreword. It also and presented also a good practice case of the use of telecare by older COPD patients later.

Another policy-related document was entirely dedicated to the special needs of older people, entitled: "Reshaping Care for Older People: A Programme for Change 2011 – 2021" (Scottish Government, 2011a). It says that technology should be an everyday, integral part of caring for older people, especially as there is sound evidence that technological solutions can indeed make the care more efficient and increase the quality of life of their users. Scotland's aim is to be world leader in the development and use of technology in care for the elderly. These claims were supported by the lessons learned from the National Telecare Development Programme (TDP). The Government committed itself to providing older people above 75 with telecare solution packages to meet their assessed caring needs in the future.

"Scotland's National Dementia Strategy" (Scottish Government, 2010c) also highlighted the importance and opportunities that telecare services can offer to older people living with dementia at home, and the TDP was cited as a proof for these statements.

In the report "Caring Together. The Carers Strategy for Scotland 2010 – 2015" (Scottish Government, 2010b), a chapter was dedicated to assistive technology / telecare. The Government argued in favour of further support for telecare, including actively mainstreaming it; ensuring the training of the caring professionals and informal carers; integrating telecare into care assessment and provision; paying special attention to potential care recipients in more rural areas and helping young carers in using this type of service.

"Scotland's Digital Future. A Strategy for Scotland" (Scottish Government, 2011b) featured the telecare as one of the strategic / important areas of public service delivery. It proposed integrating it with healthcare and referred to the integrated approach as "telehealthcare",. The Government committed itself to playing a leading role in the sector in the future. Admittedly (Hodgson, 2014), the integration of the two areas are facing a lot of challenges (see the section 3.4.10 on the organisational change), and recently the term "technology-enabled care" started to take over, as it seems to reflect better to the supporting role of technology.

The latest policy document dedicated entirely to telecare and telehealth was published by the Scottish Government in December 2012. It is entitled "A National Telehealth and Telecare Delivery Plan for Scotland to 2015" with the subtitle: "Driving Improvement, Integration and Innovation". It summarizes the changing social context, the achievements realised in the field (including the main results of the TDP), the changes in policy and the organisational set up of the governance and promotion of telecare / telehealth. The document stipulates work streams (areas) and for each certain objectives that should be attained by 2015 in order to contribute to "long-term, sustainable progress to fully embed telehealth and telecare within an integrated system" (Scottish Government, 2012, p. 21). As it is an action plan, for each objective the strategy also lists 1) priority activities, 2) recommended action areas and timescales, and 3) organisations/stakeholders with leading roles. It is useful to present at least the work streams and their objectives just to demonstrate the magnitude and comprehensiveness of the strategic approach this Delivery Plan outlined (p 25-34):

Workstreams	**Objectives**
1: Improve and integrate health and social care	1.1 Help people with long-term conditions to live independently at home, by supporting them to manage their own health and care
	1.2 Embed telehealth and telecare within whole system pathway redesign to enable people to move smoothly through transitions between services
	1.3 Use telehealth and telecare within preventative care approaches
	1.4 Ensure appropriate synergies with the technical architecture identified within the national eHealth Strategy, including standards, principles and access to enabling technologies
2: Enhance wellbeing	2.1 Expand innovative service models for community based support and wellbeing
	2.2 Support people to be active participants in the design and delivery of their technology-enabled services
3: Empower people	3.1 Raise awareness, evidence and share benefits for users and patients
	3.2 Recognise the crucial role provided by unpaid carers and develop solutions to meet their needs and wellbeing
4: Improve sustainability and value	4.1 Establish a baseline, and develop consistent impact and outcomes measures on efficient working practices, productivity and resource use
	4.2 Realise greater efficiencies in procurement, contact centre/ responder services, and specialist advisory resources
5: Support economic growth	5.1: Strengthening partnerships between users, practitioners, service providers, industry and academia to meet the needs and aspirations of our citizens and help grow the economy through targeted innovation and development
6: Exchange learning, develop and embed good practice	6.1 Recognise and meet the needs of health, housing, social care, independent and third sector providers for new skills, education and training
	6.2 Support leadership capacity and capability
	6.3 Raise awareness, independently publish and promote innovative approaches, good practice and illustrative user/patient experiences

Source: Scottish Government, 2012

In addition to thorough policy reviews, the Scottish Government launched the Scottish Assisted Living Programme in 2012. This was, in their words, "the next stage of strategic telehealthcare development" and was directly inspired by the results of the TDP. Its first phase was implemented with resources from a UK-wide telecare initiative called DALLAS (Delivery of Assisted Living Lifestyles At Scale), led by the UK-wide Technology Strategy Board. In Scotland alone DALLAS has invested £10 million (€12 million) into their Living it Up programme between 2012 and 2015. This programme could reach up to 55,000 people living with a long-term condition. It is important to emphasize in the context of our study, that these initiatives target people living with long-term conditions regardless of their age (i.e. not only older people, and not only long-term conditions usually associated with older age).

3.4.9 Evaluation process of the effectiveness of the good practice

Final objective of the evaluation process: The Joint Improvement Team (JIT) commissioned an evaluation of the Telecare Development Programme. The evaluation focused primarily on considering the extent to which the eight TDP objectives were achieved during 2006-2008 and in the whole period, 2006-2011 (Beale et al., 2010). The TDP was first evaluated by researchers at York Health Economics Consortium (YHEC), a health economics research and consultancy company owned by the University of York. Later it was evaluated by Newhaven Research Limited.

Definition of the evaluation process: The evaluation considered the impact of the TDP as a whole rather than the performance of individual projects. It comprised three main elements: use of data provided by the partnerships via quarterly returns, postal questionnaires that were distributed to service users and informal carers, and case studies.

Research design: Benefits found are based on 1) the growth of telecare through TDP funding, and 2) quarterly reports submitted over the five year period by Scottish local care partnerships (Beale et al., 2006, 2009; Chianti et al., 2011; Newhaven Research, 2011; Cenderello et al., 2013).

Variables and instruments: Information on variables was obtained through quarterly reports, questionnaires and 5 case studies:

Quarterly Returns:

- Reduction in emergency admissions to hospital, performance information identified by the JIT.
- Reduction in delayed discharges from hospital, performance information identified by the JIT.
- Reduction in care home admissions, performance information identified by the JIT.
- Estimate of the duration of each admission or delayed discharge avoided, based on local knowledge (including clinical knowledge) of the circumstances of individuals. Where only the numbers of admissions or discharges avoided were supplied, the researchers derived an estimate of the length of such episodes from aggregated national data.
- Estimates of the financial savings resulting from avoided admissions and discharges. These data were derived by applying unit costs to health and care home admissions. Where local costs were not available costs were extracted from the "Costs Book 2008" (ISD Scotland, 2009) or estimated based on data submitted by other partnerships.
- Local outcomes and efficiencies (e.g., sleepover care, home check visits, waking night cover).
- Demographic details of clients.
- Information about the telecare equipment procurement process.

Questionnaires (developed for this study):

- Users' perceptions of the impact of telecare on their health and quality of life.
- Change in pressure on informal carers.

Case Studies:

- Detailed assessment of how TDP funding had been used to help people to live at home for longer with safety and security.
- Detailed feedback on local experiences of developing and implementing telecare services.

Procedure for data collecting:

For the quarterly returns, the partnerships in receipt of TDP funding were required to submit information on performance toward TDP objectives and locally identified outcomes and efficiencies to JIT on a quarterly basis. The quarterly returns asked them to evaluate individual user-level data to determine whether the presence of telecare had resulted in improvements in care.

In case of the questionnaires, they were distributed toward the end of the evaluation period. In some instances partnerships distributed the questionnaires along with additional questions that sought information to inform local telecare related planning decisions.

For the case studies, five partnerships, implementing a range of different projects, were invited to participate in the case study research. Site visits allowed the researchers to carry out face-to-face interviews with a range of local managers and operational staff, met some service users and their carers, and saw local facilities for demonstrating relevant equipment.

Findings showed that TDP improves the independent living of older people at home, the productivity of carers and the quality of the care they provide, and the sustainability of the care system.

Regarding independent living for older people at home, users of telecare reported a significant improvement in their quality of life. 60.5% of users felt that their current quality of life was either "a bit better" or "much better" than before they had their equipment. Moreover, they maintained or improved their health, felt safer and more independent. Concretely, over half (55.2%) felt that their health had not changed, while slightly more than half of the other respondents (27.1% of the total) thought that their health had improved. Almost all (93.3%) respondents felt safer and over two thirds (69.7%) felt more independent.

Moreover, TDP increased the productivity of carers and the quality of care they provide. 100% of informal carers report positive experiences of telecare solutions, quoting benefits such as reduced worries and stress, the ability to retain paid employment, the opportunity to reduce some caring tasks and an improved relationship with the person they cared for. 74% of carers reported reduced stress.

The study also found that TDP reduces the use of health and social care services and therefore generated cost-savings. TDP discharged patients faster from hospital, reduced the number of hospital admissions, and avoided the number of admissions to care homes. Data showed that, during 2006-2011:

- Over 2,400 delayed discharges were avoided as a result of telecare, leading to an estimated saving of over 27,000 bed days.
- Over 8,700 unplanned hospital admissions were avoided as a result of telecare, and the duration of avoided admissions ranged from 2 days to 30 days. Over 109,000 hospital bed days were avoided through facilitated discharges and the reduction in unplanned admissions.
- 3,814 admissions to care homes had been avoided over the course of the programme. These were associated with a significant reduction in length of stay and also in care home beds purchased – a total saving of close to 546,000 bed days.

These were the highlights of the outcome and efficiency indicators used to measure the impact of the TDP-funded interventions. The aggregated data on each indicator – original expectations as well as actual achievements – covering the full span of the project and all the 32 partnerships can be seen in the tables 16 and 17, below.

Table 16: TDP Outcomes 2006-11

	Expectations	Achievements
Reduction in delayed discharges from hospital	2,657	2,479
Reduction in the number of unplanned hospital admissions	5,561	8,740
Reduction in the number of care home admissions	3,940	3,814

Source: Newhaven Research, 2011

Table 17: TDP Generated Efficiencies 2006-11

	Expectations	Achievements
Number of hospital bed days saved due to reduction in number of delayed discharges	53,893	27,292
Number of hospital bed days saved due to reduction in number of unplanned hospital admissions.	62,343	82,106
Reduction in number of care home bed days purchased	317,224	545,943
Number of nights sleepover care saved	80,857	48,182
Number of home check visits saved	779,764	443,969

Source: Newhaven Research, 2011

On the other hand, telecare generated a gross value of financial benefits of approximately £79 million / €95 million arising from TDP expenditure. The majority of savings resulted from avoiding unplanned hospital and care home admissions, although notable savings also resulted from a reduced demand for home check visits and the reduction in delayed discharges.

Table 18: Estimated Value of TDP Funded Efficiencies in GBP (EUR), 2006-11

Increased speed of discharge from hospital	9,988,754 (12,060,799)
Reduced unplanned hospital admissions	24,289,642 (29,328,232)
Reduced care home admissions	37,816,787 (45,661,419)
Reduced sleepover/wakened nights care	2,776,270 (3,352,173)
Reduced home check visits	2,979,088 (3,597,064)
Procurement efficiencies	753,569 (909,888)
TOTAL	78,604,110 (94,909,575)

Source: Newhaven Research, 2011

All the 32 Partnerships were required to report data using similar methods on the same indicators above. In addition, one of them, Renfrewshire Community Health Partnership was selected for further, specific impact assessment of telecare, used by people living with dementia (YHEC, SCTT and JIT (2013)). There was a lack of sufficient evidence for policymaking in this special domain, and Renfrewshire was selected because 30% of their TDP-funded telecare users were diagnosed with dementia – a much higher figure than the 10 % national average. Altogether 325 people were diagnosed with dementia, and this sizeable sub-population made this special analysis possible.

Though the TDP ran between 2006 and 2011, the data collection in the Renfrewshire Project covered the period from 2007 until 2012, and the telecare services in use were set up predominantly – but not exclusively – with the support of TDP grants. Overall, the methodology of the impact assessment was very similar, although some adjustments and adaptations were made. Most importantly, clients diagnosed with dementia usually stayed longer in care homes and hospitals, and in the assessments calculations were made with the actual corresponding Renfrewshire figures. The median length of stay avoided in the care home was 606 days (instead of 63), and the mean inpatient stay was 19.5 days (instead of 11.9).

By providing telecare support, the Renfrewshire Partnership saved approximately £8,650 (€10,444) per care recipient living with dementia over the 5 year period. This amount for all 325 telecare users added up to net £2.8 million (€3.4 million): 65% of this was saved by avoided care home admissions and 31% from avoided or shortened hospital admissions (YHEC, SCTT and JIT (2013)). This estimation is a net figure, because the costs of providing community services, equipment and supporting call-out services were already deducted from it. Also, this was the *central scenario* in

their sensitivity analysis; the net savings of the *low* and *high case scenarios* were £1.6 and 3.8 million (€1.9 and 4.6 million) respectively, differing from the central case mainly in their assumptions about the proportion of telecare users who could avoid care home admissions using telecare. In the central scenario it was 27%, while the low and high case scenarios calculated with a 30% more and 30% fewer admissions to the central case, respectively. These savings per capita are more than seven times higher on average than the savings made by all client groups within the whole of the TDP programme.

The analysis, however, did not take all the costs and savings into account. Some extra costs wore borne by the public authority, like re-enablement services on discharge, the costs of home care provided and meals on wheels. On the other hand, in the longer term, care home and hospital beds could be decommissioned due to lower demand, and caring capacities could be freed up / rearranged. Also, the freed-up time of the carers were not taken into account in the analysis.

Furthermore, some of the "softer" but nonetheless important and verified benefits could not be monetized, like certain aspects of the overall subjective quality of life of care recipients and their informal carers: perceived higher personal safety, mitigated stress and anxiety, greater independence, etc; along with their convincing satisfaction with the services.

Overall, in Scotland it was known that there was a relatively high level of latency in diagnosing dementia, especially in its early staget. Similarly to the efficiency of medical treatments, the earlier the stage of dementia, the better the chances are for successful telecare intervention that could provide substantial support for people with dementia to prolong independent in their own home environment (YHEC, SCTT and JIT, 2013).

3.4.10 Organisational change: integration of the technology – based service in the delivery chain of care.

One interesting aspect of the organisational change lies with the integration of telehealth and telecare, i.e. telehealthcare, mentioned earlier several times. The notion reflects an attempt to merge the two areas. This would probably have overall benefits, but would be a real challenge to accomplish for several reasons. For example, these services are provided by different organisations (traditionally, the NHS provides telehealth, and telecare belongs to the social services)., In addition, they have separate governances, operating budgets, different legal frameworks and protocols, data handling practices, assessments and referral procedures, locations, staffs and indeed organisational cultures.

As a mainstream service, i.e. being part of everyday service delivery which covers peoples' service needs and access, telecare is more successful than telehealth. One of the aims of the Scottish Government is to get telehealth to catch up. Integrating the two could be the way forward, and the envisaged pulling force of telecare is one of the reasons behind the efforts to merge the two areas as far as possible. In 2015-16, more funding is expected to embed and extend the use of technology-enabled care and tackle some of the barriers mentioned earlier (Hodgson, 2014).

The key organisations in developing telecare in Scotland were the local health, housing and social care partnerships. All partnerships reported that efforts were made to move telecare services from a project basis to mainstream provision, with integration of telecare into day-to-day local service options. Some partnerships reported they have benefitted from using the "Implementing Telecare – An Action Guide 2009" (Boddy and Henderson, 2009), which was trialled during 2008 with 9 partnerships. This provided a simple toolkit to support change management processes.

Operationally, the majority of partnerships (94%) reported that they used the Single Shared Assessment[38] (SSA) as the principal route to accessing telecare services assessment.

Interestingly, the role of "tele" services was not immediately clear within the social care services during the early years of the TDP. It was often seen by the care professionals (e.g. assessors) as a different, additional service - as if the recipient would need social care as well as telecare - and therefore a separate assessment was needed for both (Hodgson, 2014). The idea is obviously to assess the person's needs in their complexity as a "unit", and find the most appropriate caring services for him or her. These services could be telecare, "conventional" care, or a combination of the two, so long as they cover the patient's needs and there is no overlap between the care services delivered.

The initial focus for the implementation of telecare for many partnerships was Older People's Services. All partnerships reported their telecare programmes provided services to older people and those who had been diagnosed as having dementia. Over the first three years of the TDP all partnerships have explored additional applications of telecare, to support a wide range of user groups. These services then became part of day-to-day practices within a number of areas.

For instance, 59% of partnerships (19) report that they have storage and tracking systems in place, to ensure effective management of telecare equipment. 69% of partnerships (22) have established in-house mechanisms for installation and maintenance of most telecare equipment used, as part of an integrated telecare service, building on existing call handling and responder provision.

Core to the effective provision of telecare services is robust call handling and response provision. The majority of partnerships which established Community Alarm Services, had pre-existing call handling arrangements in place, before the TDP. As partnerships rolled out their telecare programmes, some took the opportunity to review the structure of their call handling arrangements and response provision. Some partnerships had in-house arrangements, some of which dealt with both corporate calls and community alarm calls, and sometimes on behalf of neighbouring partnerships. There are economic benefits in sharing call handling resources, but there is a need for robust contracts to be in place to ensure that service and data requirements are fully met, as this was reported as an issue for some.

Traditionally the response linked to Community Alarm Services was provided by a nominated 1st responder, usually a relative, neighbour or friend. 17 partnerships reported having established in-house provision over the last 10-15 years in response to changing demographics and demand.

Scotland Excel (the Centre of Procurement Expertise for the local government sector in Scotland) set up a **procurement framework** to supply telecare services which would incorporate private technology providers in the partnership and increase efficiency gains. The forecast spend is about £3.4 million (€4.1 million) a year, equating to £10.2 million (€12.3 million) over the term of the framework (Cenderello et al., 2013). The aim is to provide yearly cost efficiencies worth £300,000 GBP (€362,231) overall. During the first six months of the framework, evidence showed an 8.8% saving in procurements (Scottish Government, 2012). All 32 Scottish councils, plus two of the country's largest housing associations, confirmed that they will use the contract and six suppliers won places: Chubb Systems, ICare, Jontek, Possum, Tunstall Healthcare and Tynetec. The benefits of this system include helping to address some longstanding interoperability issues, improving procurement process efficiency and providing more flexibility in the choice of equipment (Cenderello et al., 2013).

[38] Single Shared Assessment is a streamlined, person-centred assessment that aims to provide users of health and social care services faster access to the services they need by co-ordinating access to services via one lead professional. More information on: http://www.jitscotland.org.uk/downloads/1208951364-Single%20Shared%20Assessment.pdf

We can see below (table 19) a summary of the role of the public and private sector in the integration of the solution in the care system.

Table 19: Summary of roles of the public and private sector in the integration of the Telecare Scotland in the care system

Roles	Public institution	Private	Partnership
Policy	X		
Communication	X		X
Awareness raising	X		X
Planning of deployment	X		
Diagnosis (individuals)	X		
Control of installation			X
Control of service delivery			X
Entitlement of service			X
Funding service	X		
Service delivery			X
Customer support service			X
Training	X		X

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Interview:

- An interview on 2nd July with Alistair Hodgson, a Partnership Improvement Officer at the Joint Improvement Team.

3.5 ROBOT SUIT HAL

Robot Suit HAL is a device used in institutional settings for neuro-rehabilitation. It is not currently used in caring or rehabilitating older people, or in a private home environment. This case is therefore beyond the overall scope of this paper. Nevertheless we decided to include it because it represents groundbreaking technology. We can learn from the fact that this technology is imported from outside the EU and even Europe (Japan); and the technology – if not in its current version – might be used in a private home environment in the future, assisting older people's everyday life. Our assessment of the technology and its prospects is not necessarily matching that of the developer and manufacturer, Cyberdyne Inc.

NUMBER	4
TYPE OF TECHNOLOGY-BASED SERVICE	ASSISTIVE TECHNOLOGY (ROBOT)
NAME OF THE PRACTICE	Robot Suit HAL (Hybrid Assistive Limb)
LEVEL OF NEEDS COVERED	PARAPLEGIA PATIENTS, FRAIL OLDER PEOPLE
COUNTRY	JAPAN
VERIFICATION OF THE CASE:	The European implementation and the feasibility study verified by Grit Braeseke, on 4th July 2014.
Brief description: *Robot Suit HAL was launched in 2005 by a Japanese company Cyberdyne Inc. HAL is an exoskeleton – a wearable robot suit – which has been developed to help paralyzed people with limited physical abilities to enhance their physical capacities. HAL works by transforming brain signals sensed through the skin into motion.* *Cyberdyne Inc. is located in Tsukuba, Japan, but has established branch offices in Europe, most importantly in Bochum, Germany.*	

3.5.1 Business case

MOTIVATION FOR THE PROJECT: The Japanese exoskeleton Robot Suit HAL is a product of a private company, Cyberdyne Inc. Prof. Yoshiyuki Sankai of the University of Tsukuba is the main developer of the device and also the CEO of the company. Cyberdyne was launched by the university as a venture company in 2004, and by 2014 its shares became listed on the Tokyo Stock Exchange.

Yoshiyuki Sankai started the development of HAL to aid people who have degenerated muscles or those paralyzed by stroke, brain hemorrhage or spinal injuries (paraplegia), to use the device in their neuro-rehabilitation.

Currently the 5th generation of the HAL Lover Limb Model is the only product of the company advanced enough to be marketed and certified for everyday mainstream use. Therefore this case study focuses on this model exclusively.

The current HAL Lower Limb Model is the 5th generation of the device, and the only product of the company has marketed to date.

Other versions are under research and development, e,g.:

- HAL for a Single Joint, for rehabilitation of any arm or knee joint,
- HAL for the Whole Body, reinforcing the whole body of the user in a working setting,
- HAL for Disaster Recovery, reinforcing the body and covering it with a special shielding technology,
- HAL for Back Load Reduction, reducing the load to the lower back when lifting heavy weights.

In addition to the therapeutic use of HAL in a healthcare setting, HAL is also used in Japan for rehabilitation in predominantly commercial training centres. HAL FIT is the name of the programme, which is, according to the Cyberdyne website: "a scientific fitness training, in which the wearer in Robot Suit HAL pleasantly performs leg exercise, standing-up, sitting-down, gait training, etc. in accordance with his or her will." These services are personalized and trained staff take care of the people using the suit. Robo Care Centers provide these services, and there are at least 3 of these centres in Japan (Suzuka, Shonan, Oita).

HAL, however is not without competitors on the global civil (i.e. non-military) exoskeleton market. ReWalk Robotics – an international consortium – is already on the market with two versions of ReWalk. The ReWalk Rehabilitation system is used in a clinical setting, but the Rewalk Personal System is for individual use at home.[39] It has just received (June 2014) the U.S. Food and Drug Administration's clearance for distribution all over the US. The price of the device is US$69,500[40] (€50,886) (Wired, 2014). Another competitor is Lokomat, which is made by the Swiss company, Hocoma and used in a clinical facility setting. Ekso Bionics is also producing a therapeutic exoskeleton called the Ekso bionic suit for the civilian health market primarily in North America and Europe. (Ekso Bionics is also the developer of HULC (Human Universal Load Carrier), the first exoskeleton, developed in 2001 for military purposes and paid for by DARPA (Defense Advanced Research Projects Agency). HULC helps soldiers carry heavy loads (up to 90 kg) over all terrains for long periods of time (or up to 20 kilometres).

Exoskeleton technology in general received a boost to its global public profile when, during the opening ceremony of the 2014 FIFA World Cup Brazil, a paraplegic man performed the tournament's symbolic kick-off. This exoskeleton is still under development in the Walk Again project, a collaboration of several universities and institutions in Europe, Brazil and the United States, and led by Miguel Nicolelis. NASA is also developing an exoskeletoncalled X1 Robotic Exoskeleton, for their astronauts as well as paraplegic patients, in collaboration with IHMC (a Florida University Affiliated Research Institute).

SOLUTION DESCRIPTION: HAL is a wearable robot suit that helps paraplegic patients in their neuro-rehabilitation and training by transforming brain signals sensed through the skin into motion.

As Hanlon and Ferulli (2011) describe the Robot Suit HAL (Hybrid Assistive Limb) as a wearable exoskeleton consisting of two robotic legs able to sustain the whole weight of the wearer and implement in real time the movements he or she desires to do, just interpreting the brain signals sensed through the legs' skin. It is composed of mechanical braces, motorised joints controlled by actuators, electronic sensors, a computer processor that synchronises the movements and a battery power source. Sensors are attached to the surface of the wearer's skin, and braces and joints are attached to the wearer.

Each time a person attempts to move, his brain sends a signal to the muscles to carry out the movement through nerve communications. The muscles transform the received signals into movement by applying their contracting strength to the skeleton system. HAL sensors along the skin of the wearer detect these weak bio-signals and the processor elaborates them in real time in order to control the power unit and move the joints simultaneously with the wearer's muscle movement

[39] The corporate website of ReWalk promises that its Personal System can effectively assist people living with spinal cord injury to be able to "stand and walk independently" and "designed for everyday use by individuals at home and in their communities, is custom-fit for each user. The system is designed for daily use in a range of environments such as in the home, at work, at social events, indoors as well as outdoors, as well as on different surfaces or terrains. This revolutionary, cutting-edge technology allows users to stand, turn and walk with independent control of the system." (ReWalk, 2014) This could also lead us to imagine an exoskeleton to be used by older people with reduced physical capacity to assist them in their everyday activities at home in the future.

[40] For the prices reported in US dollar (USD) we used the exchange rate of the ECB as of 2 January, 2014 to convert them into EUR (1 EUR = 1.3658 USD).

(or potential movement). In other words, the CPU interprets the wearer's intentions and the exoskeleton carries out the desired movement through the electro-mechanical structure.

If the bio-electrical signals are no good or not detectable due to some problems in the central nervous system, the brain or the muscles, HAL will automatically use, once the user starts moving, a particular control system called Robotic Autonomous Control System. In this alternative control, the wearer's intended movements are assembled as a mosaic of small parts (elemental movements) from the HAL internal database which is automatically augmented by the little information that sensors are able collect from the body. Using the database, HAL autonomously coordinates each motion assisted by power units. This hybrid control gives the suit its name, i.e. HAL or Hybrid Assistive Limb.

In the HAL suit two systems work closely together:

- The first one is dedicated to monitoring electric currents known as electromyogram, or EMG, signals on the wearer's body. It collect signals flowing along muscle fibres, when a person intends to move, through the sensors attached to the wearer's skin near the shoulders, hips, knees, and elbows, and sends them to the control computer, which then triggers the actuators in the joints to move the robotic limbs.
- The second control system is dedicated to the movement of the suit. It stores walking patterns generated the first time a new user tries out the suit and uses that information to synchronise the suit's limbs with those of the wearer. The fine tuning of this system is essential to tailor HAL to the user, and it can take 2 months of continuous calibrations, particularly with people who have one leg less capable than the other (Hanlon and Ferulli, 2011).

HAL is available for institutional use only and can only be rented from Cyberdyne Inc., which retains ownership of the devices. It is currently only operational in hospitals, care home settings and Robo Care Centres in Japan. Clinical testing of the device and implementation feasibility studies are being carried out in Europe, and is most advanced in Germany.

FEASIBILITY: Exoskeletons are an emerging technology, and HAL considerably changes the way paraplegic patients are treated. In order to create sufficient and reliable data on the possible benefits of the implementation of HAL, a feasibility study, called MMRI (Man-Machine-Interface Robot Suit) gained support from the North-Rhine Westphalia research funds in Germany. Bergmannsheil Clinic, IEGUS (European Institute for Healthcare Research and Social Economy) and Contec GmbH are all collaborating in this ongoing project (February 2013 – June 2015). For the feasibility study, the consortia are using 3 devices in Germany.

The project aims to explore the potential of the clinical use of biomechanical exoskeletons (using the example of HAL) and the clinical benefits of HAL in therapy for paraplegic patients (affecting their neurological and motor functions). A clinical study is running in parallel with a socio-economic study. The latter uses in-depth interviews and questionnaires, and a follow-up approach with data collections before, during, and after the therapy. Both patients and healthcare professionals are participating in the research. According to the initial results the therapy is more efficient – apparently shows improvements in the functional capacity – than the standard therapy (Aach et al., 2014).

According to Dr. Grit Braeseke, the head of IEGUS, the three key factors for successful introduction of HAL into the European market are:

- Public funding for infrastructure (therapeutic centre with treadmills, HAL devices);
- Knowledge exchange with Cyberdyne (adjusting and further developing the technique);
- Development of validated standard therapies – training and further education for physicians and therapists, and quality assurance of the therapies.

BENEFITS: The physical capacity of paraplegic patients could be improved through using the device in the rehabilitation / training:

- Improvement of the walking speed. A study with 10 patients who trained for 20-30 minutes with HAL showed their 10-meter walking speed times (Watanabe et al., 2012).
- Improvement in the walking ability. A case study with a patient who was rehabilitated with HAL during 8 weeks, 20 minutes per session showed an increase in gait speed, and a decrease in the number of steps after the HAL training (Yamawaki et al., 2012).

COSTS: According to Cyberdyne policy, HAL may not be purchased. It can be only rented from Cyberdyne by domestic medical / welfare facilities in Japan. The monthly rents are respectively about (Hanlon and Ferulli, 2011):

- US$2,000 - 2,200 for the two-leg solution (€1,464-1,611)
- US$1,500 for the one-leg version (€1,098).

3.5.2 Business model

CUSTOMER SEGMENTS: Customers in Europe are health and social care facilities (nursing homes, etc.). In Japan, health-fitness studios are also customers.

VALUE PROPOSITION(S): Using HAL in rehabilitation and training activities helps patients to regain some of their lost physical capacity, like gait speed and stamina. The ongoing feasibility study in Germany concentrates on the following value propositions primarily for paraplegic and stroke patients as the primary customer segments:

- Improvement of mobility (walking distance and speed),
- Improvement of physiological parameters (digestion, wound healing etc.),
- Improvement of health-related quality of life (social inclusion, independent living).

Using HAL may be beneficial primarily for those with incomplete paraplegia, who have completed rehabilitation and for those who have been injured recently (in these cases, HAL can be incorporated into their rehabilitation from the outset). Stroke patients could also benefit from using HAL in their rehabilitation, and it is planned in Germany for the future.

CHANNELS: Although the main market of Cyberdyne is Japan, it foresees considerable potential in exporting the device to Europe. Cyberdyne has therefore set up several subsidiaries in Europe, most notably in Bochum, Germany, where their two subsidiaries (Cyberdyne Germany GmbH (2011) and Cyberdyne Care Robotics GmbH (2013)) can be regarded as the spearhead of their expansion plans to the European market. Other subsidiaries in Europe are:

- Cyberdyne Denmark ApS (Odense, Denmark),
- Cyberdyne EU B.V (Amsterdam, the Netherlands),
- Cyberdyne Sweden AB (Västerås, Sweden).

As the exoskeleton technology is arguably still "emerging", awareness raising and other disseminating campaigns can be vitally important, like participation and speeches at tech and health exhibitions, fairs and shows. NHK, Japan's public broadcasting organization regularly issues reports about HAL and the company behind it.

CUSTOMER RELATIONS: HAL is only available for institutions to rent, Cyberdyne retains the ownership. Mandatory training for the operators of the device is provided by the manufacturer and it also provides regular / ad hoc maintenance services.

REVENUE STREAMS: At the end of 2013, 361 welfare (non-medical) suits were operational in 163 health- and care facilities in Japan, at approximately 1.8 million yen[41] (€12,516) renting fee per suit per year.

As an accredited rehabilitation treatment in Germany, Deutsche Gesetzliche Unfallversicherung (German Statutory Accident Insurance) fully covers the HAL treatment for workmen's accidents for up to 60 sessions, worth €500 per session (Cyberdyne, 2014). Other occupational health insurance clinics are now in the process of establishing HAL therapy (for instance in Berlin), according to the case representative.

In Europe, a total of 39 HALs for Medical purposes were being used operationally and under clinical tests and trials at the end of 2013. Use of the device was eligible for funding from Germany's public labour insurance scheme. The use of 24 HAL units in clinical trials was funded in Germany by the Ministry of Economic Affairs in Japan (€2.3 million).

KEY RESOURCES: In July 2008, to respond to increasing demand from the market (now including also Europe), Cyberdyne started building a larger research and development laboratory and manufacturing centre, able to produce more than 500 robot suits per year. The new site is near Kenkyu Gakuen station of Tsukuba Express, and became operative in October 2008.

KEY ACTIVITIES: In order to obtain further funds, Cyberdyne Inc. went public recently (March 2014). Their shares are available at the Tokyo Stock Exchange's "Mothers" section (market of the high-growth and emerging stocks).

According to their own assessment (Cyberdyne, 2014a), a key activity is to expand the market opportunities in the USA and Europe. These represent an enormous share of the global healthcare market, and the involvement of private insurance companies in these countries makes it much easier for HAL to actually get into the market. In Japan, the public insurance scheme market is working with a lot of intermediary actors, and these aspects make the market there less flexible and more expensive (Cyberdyne, 2014a).

HAL became the first exoskeleton to earn the certificates of standards conformity in Europe (medical robot, CE-mark), that were necessary for the HAL's introduction to the market. Cyberdyne is now preparing an application for the US Food and Drug Administration's approval for the US market (see the chapter on the Technical standards for more details).

KEY PARTNERSHIPS:

Main stakeholders are:

- Cyberdyne Inc:
  Actual manufacturer and provider. A venture company, launched by University of Tsukuba, with which Cyberdyne collaborates closely on research and development.
  Maintenance.
  Training.

- Yoshiyuki Sankai:
  Main author of HAL and professor at the University of Tsukuba.
  He started the development of HAL to aid people who have degenerated muscles or those paralyzed by brain or spinal injuries.

[41] For the prices reported in Japanese yen (JPY) we used the exchange rate of the ECB as of 2nd of January, 2014 to convert them into EUR (1 EUR = 143.82 JPY).

- Committee on Social Welfare Corporation Yoshimitsu and the Japanese Ministry of Education, Culture, Sports, Science and Technology:
  Promotes facilities and rehabilitation services by HAL since 2007.

- NEDO – New Energy and Industrial Technology Development Organization (Japan's Ministry of Economy, Trade and Industry)
  Funding of 24 Robot Suit HAL devices for testing in Germany

- Cyberdyne Care Robotics GmbH (Bochum, Germany)
  Operating company for Zentrum für Neurorobotales Bewegungstraining (ZNB – Neuro-robotic Rehabilitation Centre), which provides the training and rehabilitation programmes "aimed at treatment for functional improvement of patients with cerebral, nervous and muscular system disorders including spinal injury and cerebral embolism". CCR is a joint venture, besides Cyberdyne Inc., a German industrial accident insurance fund BG RCI (Berufsgenossenschaft Rohstoffe und chemische Industrie) is the other stakeholder in it.

- Rehabilitation Centre (Odense, Denmark):
  Collaborator to testing HAL, with the funding of ABT fund of Denmark Government.

- The Danderyds Hospital in Sweden:
  Collaborator to testing HAL

COST STRUCTURE: No data available

3.5.3 Technological components (devices)

Currently the robot suits available on the market are only the bipedal or the single leg model.

Source: Cyberdyne website

Three sizes are available so that HAL can adjust to the wearer. The full specifications are reported in the table below.

	Small	Medium	Large	Adjustment Range
Applicable height	145~165cm	150~170cm	165~185cm	—
Upper thigh length	35.0~39.5cm	36.5~41.0cm	39.5~44.0cm	4 steps of 1.5cm
Lower leg length	33.0~40.5cm	34.5~42.0cm	37.5~45.0cm	6 steps of 1.5cm
Shoe Size*	22~28cm			
	Male		**Female**	
Hip Width	31.0~35.0cm		37.0~42.0cm	
Movable Range	Hip Joint: Extension 20°, Flexion 120° Knee Joint: Extension 6°, Flexion 120°			
Weight	Appx. 12kg (without battery pack)			
Operating time	About 1 hour (standard operation time), but varies with the conditions			
Operating Environment	Temperature: 5°C~35°C Humidity: <75% (no condensation allowed)			
Battery	Lithium Polymer Battery			

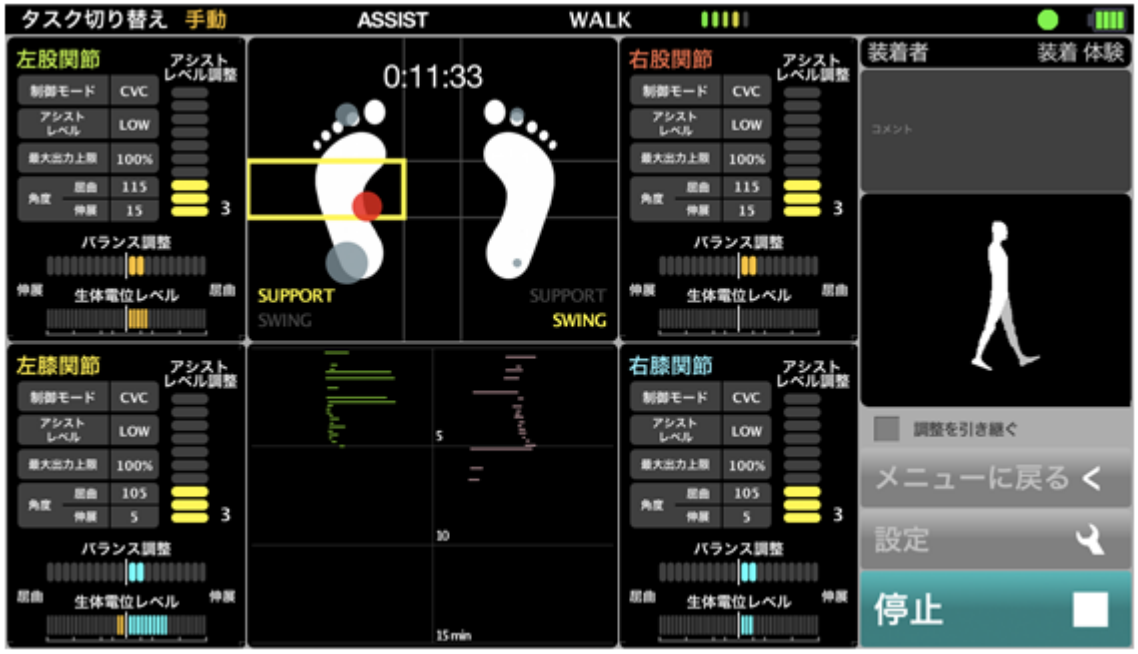
Source: www.cyberdyne.jp

*Note: The shoe sizes probably better understood using the other systems, so the shoe size range can be translated as approximately 35-45 in the European or 3-11 (male) / 2.5 -10.5 (female) in the UK system.

Moreover, the exoskeleton has the following characteristics:

body weight limit:	lower than 80kg
accessories:	belt for fastening, hip supporter, pad, sensor cable, electrode cable, leg cuff, custom shoe, leg module, custom PC, cover for battery connector, custom battery charger, maintenance tool

The device has a control panel that enables the user to understand and command the device (see the picture below).



Source: Cyberdyne website

HAL is also delivered with a PC that can communicate both with the local HAL system and the Cyberdyne Headquarters. The PC is used for configuring, monitoring and maintaining the local HAL unit. The PC also contains the training programme.

3.5.4 Technical standards and norms

In June 2013, TÜV Rheinland issued the EC Certificate of Conformity (CE marking) for HAL. A conformity assessment under the Medical Device Directive (MDD) found the device compliant with all the relevant harmonized standards. With CE marking (CE 0197), HAL for Lower Limb can be offered as a medical device for the European market, which, according to the press release about the certification by TÜV Rheinland, represents "about 34% of the global medical device market" (TÜV Rheinland, 2013). HAL also has the ISO 13485 certificate (quality management systems for medical devices), the first of its kind awarded to a robotic device. HAL, is still without a similar qualification in Japan,

Cyberdyne Inc. will apply for a U.S. Food and Drug Administration certificate in order to be able to introduce the device into the US market in the near future.

3.5.5 Quality of the service

There is no data available.

3.5.6 Training actions

The HAL suit includes a dedicated PC which hosts the Safe Use Training Program. When the robot is delivered, the user completes this training programme. The "Robot Suit HAL" system may only be utilized (for training or attaching HAL on a wearer) by a person who has successfully completed the training programme. The training programme is individually designed depending on the users' ability. They can include for example: extension/flexion of a knee while in a seated position; walking training using a body weight support system; walking training using canes, a walker, parallel bars; fitness training, etc. (Hanlon and Ferulli, 2011). Using an exoskeleton is neither easy nor automatic.

We summarize below in table 20 the main characteristics of the training activities of this solution.

Table 20: Summary of the training actions for HAL

Programme/ Strategy	There is a training programme for the user of the robot (Safe Use Training Program)
Aim	The Safe Use Training Program aims to give people the competences to use the robot.
Target	The Safe Use training Program is targeted at care staff.
Content	The Safe Use training Program consists of software on how to use the robot.
Timing	The timing depends on the user.
Training method	The Safe Use Training Program is software, so the training is done directly from the computer.
Certification	No certification
Trainers/ responsibility	The responsibility for training always belongs to the private company that sells the product: Cyberdyne
Funders	The cost of the Safe Use Training Program is included in the rental of the robot.

3.5.7 Scaling and market creation

At the end of 2013, 361 welfare (non-medical) suits were operational in 163 health and care facilities in Japan (Cyberdyne, 2014a).

Since August 2007, Cyberdyne has established several branches in Europe. The first, Cyberdyne EU B.V in Amsterdam, the Netherlands, then in Denmark (Cyberdyne Denmark ApS in Odense) and later in Sweden (Cyberdyne Sweden AB in Västerås), but HAL has not been used in a mainstream clinical practice in any of these countries.

Despite Cyberdyne's relatively late entry into Germany (2011), the expansion to the European market is most advanced there. The two Cyberdyne-subsidiaries in Bochum (Cyberdyne Germany GmbH and Cyberdyne Care Robotics GmbH) together with the first European Neuro-robotic Rehabilitation Centre – ZNB (where training for using HAL is offered,) can now be considered the European "stronghold". Cyberdyne Care Robotics GmbH also aims to help tailor the device to European demands and contexts, especially for other German speaking countries, Austria and Switzerland.

In 2013, Japan's Ministry of Economy, Trade and Industry (via its New Energy and Industrial Technology Development Organization, NEDO) subsidized the export of 24 HAL devices to Germany for clinical trials and implementation with €2.3 million. These devices are being used in different fields, for instance occupational health insurance clinics use them for rehabilitation purposes in work-related accidents. This set of subsidized devices, along with the 3 being used in the MMRI feasibility study, brings the total number of devices currently (summer of 2014) in Germany to 27.

3.5.8 Policies and the role of policy in creating, implementing and scaling-up good practice

As mentioned in the previous paragraph, NEDO subsidized the export of 24 HAL devices to Germany for clinical trials with €2.3 million.

North-Rhine Westphalia by offering a well-developed R&D infrastructure, healthcare-related knowledge and practice, a sizeable healthcare market, clear political support and a business plan developed by Contec eventually convinced Cyberdyne to set up subsidiaries in the state. The various stakeholders expected many benefits: it could create jobs, could lure cutting-edge technology to the region, German professionals could be involved in the further development and knowledge-generating, local companies could step in as suppliers in the development / production of the HAL devices, and indeed this state-of-the-art technology could be used to treat paraplegic patients.

Also, for the introduction and implementation process of the HAL into the German market, Cyberdyne has received the support of the North Rhine-Westphalia state's Ministry of Economics and its economic development agency, North-Rhine Westphalia, INVEST GmbH.

3.5.9 Evaluation process of the effectiveness of the good practice

FINAL OBJECTIVE OF THE EVALUATION PROCESS: Two studies have evaluated the following aspects of the impact of HAL:

- The efficacy of HAL locomotor training for a chronic stroke patient (Yamamaki et al. 2012).
- The possibility of using HAL for clinical rehabilitation (Watanabe et al., 2012).

In both cases, the evaluation of the robot was done by the team of Prof Sankai, the CEO of Cyberdyne, the company in charge of the production and commercialisation of the robot. For the first objective, the study was supported by the "Funding Programme for World-Leading Innovative R&D on Science and Technology (FIRST Programme)", a Japanese governmental programme to support the research and development of cutting edge technology and enhance Japan's international competitiveness as well as to use the result to better people's quality of life.

DEFINITION OF THE EVALUATION PROCESS: Yamawaki et al. (2012) applied HAL to a 74 year old male patient with hemiplegia on the left side due to a cerebral infarction that had occurred three years previously. They studied the effect on this patient of locomotor training with the HAL twice a week for eight weeks. The duration of each training session was around 20 minutes.

They evaluated the following variables:

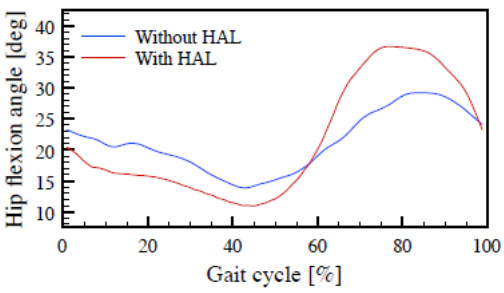
- Mean angles of the left hip joint with and without the HAL for a gait cycle, calculated as the average of ten gait cycles. The angle was set to 0 degrees in the standing posture and considered positive during flexion.
- Walking ability was evaluated by means of a 10 metres walking test (10MWT).
- Balance ability was assessed using a functional balance scale (FBS)

These variables were collected before and after the eight week rehabilitation period with the HAL.

Watanabe et al. (2012) selected ten patients to participate in his study. Individuals performed gait training for 20-30 minutes using HAL. Ten-meter comfortable and maximum walking speed times were measured before and after HAL training.

FINDINGS showed an improvement in physical functioning, which helped the older patients to be more independent. The authors found an improvement in walking ability. Wearing the HAL increases the motion range of the left impaired hip joint (Figure 7) (Yamawaki et al., 2012).

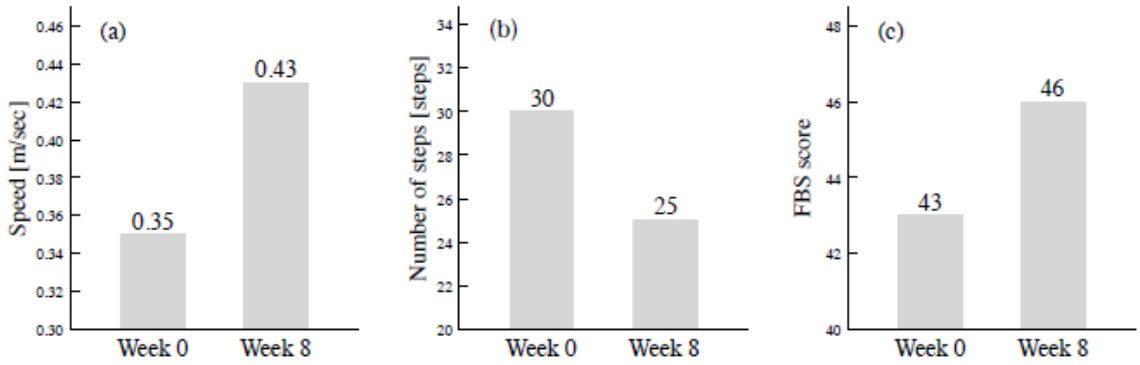
Figure 7: Left hip joint angles with and without the HAL during walking



Source: Yamawaki et al. 2012

The case study of a patient who undertook rehabilitatation with HAL for 8 weeks, 20 minutes per session, also showed an increase in gait speed, a decrease in the number of steps after the HAL training, and greater walking balance – Figure 8 - (Yamawaki et al., 2012).

Figure 8: Change in walking speed (a) and number of steps (b9 for 10 MWT, and FBS score (c) before and after the 8-weeks locomotor training period with HAL



Source: Yamawaki et al. 2012

Watanabe and colleagues (2012) also found an improvement in 10-meter walking speed times among 10 patients who had trained for 20-30 minutes with HAL (Watanabe et al., 2012).

Initial results were published by the German clinical trial team (Aach et al., 2014). They found "promising preliminary results" (p. 236), and that the walking capabilities of spinal cord injury patients were improved by a three month period of HAL training, combined with the "conventional" treadmill treatment.

ONGOING EVALUATIONS: There is an ongoing feasibility study in Germany (Man-Machine-Interface Robot Suit). The aim of this study is to consider the HAL's introduction into the German healthcare market in order to:

- Improve therapeutic outcome for patients with paraplegia and stroke,
- Improve in patients' health-related quality of life and participation,
- Indirectly generate cost savings for social insurances (over the whole life-cycle, from the social perspective).

Contec GmbH, Bergmannsheil Clinic and IEGUS are the participating in the feasibility study, and it is funded by the research fund of North-Rhine Westphalia. It explores both the possible clinical benefits and the socio-economic perspectives, (the latter is being carried out by IEGUS). The Health- and socio-economic evaluation covers the following aspects of HAL in a clinical setting: health economic effects; acceptability; usability and safety; gender specific issues; premarket approval and financing (Braeseke, 2014). The research team uses interviews and questionnaires as tools, and collects data from patients and healthcare professionals alike, before, during and after the therapy.

The following table summarises the factors covered in the standardised patient questionnaire (128 items altogether) (Braeseke, 2014). Observation schedule: start of training, week 6, 12, 24.

No.	Part	Example	Items
1	General Information	Date, Patient-ID, therapist/attending physician	3
2	Personal data	Sex, date of birth, family status, education, profession, ability to work, etc.	8
3	Health and life style	subjective well-being, secondary diseases, private expenses, number of consultations etc.	10
4	Technical acceptance	General acceptance and therapy-specific	21
5	Body functions	Mental functions, pain, functions of the immune and respiratory system, metabolism, etc.	41
6	Activities and participation	General activities of daily living, mobility, self supply, partnership etc.	35
7	Environmental factors	Products and technologies, support and relationships	10

Source: Braeseke, 2014.

The project is running between February 2013 and June 2015. Nevertheless, according to the preliminary, interim results HAL seems to be more effective in improving the physical capacity of the patients than standard therapies (Aach et al., 2014).

3.5.10 Organisational change: integration of the technology – based service in the delivery chain of care

Table 21 presents a summary of the role of the public and private sector in the implementation / integration of the solution in the care system in Germany.

Table 21: Summary of roles of the public and private sector in the integration of HAL in the care system

Roles	Public institution	Private	Partnership
Policy	x		
Communication	x	x	
Awareness raising	x	x	
Planning of deployment		x	x
Diagnosis (individuals)	x	x	x
Control of installation		x	
Control of service delivery	x	x	
Entitlement of service	x	x	
Funding service	x	x	
Service delivery	x	x	
Customer support service		x	x
Training		x	x

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Annex 1. Template for data collection

ICT-AGE: TEMPLATE FOR COLLECTING DATA FOR THE CASE STUD

1.- BUSINESS CASE

For the business case, we have used the following relevant variables according to the interest of starting and developing the services for public authorities. Some of them are based on general business cases, and the variable of feasibility has been adapted from the business case tool for innovation in long-term care developed by TNO http://www.businesscase-longtermcare.com/Introduction.aspx

VARIABLES	DEFINITION	INDICATORS
MOTIVATION	Reasons to start and invest in the service	**Drivers for creating the business case:** ☐ What are the drivers/motives for creating the business case and to invest and develop the service (e.g. cost savings, efficiency, improve quality of care, improve quality of work, other) ☐ Who do you want to convince? (e.g. insurers, network partners, other)
SOLUTION DESCRIPTION	It describes the service	**Description of the service:** ☐ What are the most important objectives of the service ☐ Describe the service/s provided ☐ Status of implementation
FEASIBILITY	It refers to the feasibility to create the service, identifying the risks or potential hindrances	**Content-related feasibility:** ☐ Is the service accepted by the professionals, customers, parties involved society? Describe the success factors and hindrances to make to be accepted by them (If any) **Organisational feasibility:** ☐ Which are the professionals, skills and resources needed? Describe the success factors and hindrances to find and develop them (If any) ☐ Do you need legal authorisation to implement the service? Which one? Describe the success factors and hindrances to obtain this authorisation (If any)

		Economic feasibility: ☐ Is the service sufficiently distinctive, does it offer clear added value and does it have sufficient commercial power? ☐ Does the service sufficiently suit the needs of the clients? ☐Is the service sufficiently competitive with regard to others who offer the same or similar care/service? ☐ Is the service supported by a sufficient financial structure? Describe the success factors and hindrances for this financial structure (If any) ☐ Is the service sufficiently underpinned by a financial model or business model? **Feasibility regarding the quality of life:** ☐ Describe if and in which indicators the service affect the quality of life of the end-users (older people and informal carers). **Own estimates:** ☐ Are there any other factors that could undermine the success of the service? ☐ Is the time right to implement the service? ☐How would you rate the feasibility?
BENEFITS	Identify the impacts of the technological service found in scientific studies, and according to the policy objectives of increase of independent living, productivity of carers, quality of care and sustainability of care systems	
COSTS	This section identifies all the costs related with the design and development (initial investment) and the running of the service. These are all investments that have been necessary for the creation of the product/service or the group of products/services, as well as the on-going (operating) costs	☐ Detail the investments needed for the creation of the service/s by the public authority, concretely regarding • one-off funding (such as from a national or European programme). • Purchase hardware and software applications (including licenses) • Installation, placement of all hardware and software • all hardware and software upgrades

		• any medical or specific applications or tools, • marketing and communication activities dedicated to the launch of the service, • R&D and investments for any test phase • Consultancy fees • One-off human resources investment • One- off intangibles investment (like IPR) • Any other investment not included above ☐ Detail the operating costs for running the service Detail these data as much as possible, if not, provide at least a general information of these data.

2.- BUSINESS MODEL

We have used the same templates of the previous projects: "study in business and financing models related to ICT for ageing well (Technolage)"[42] (Cenderello et al., 2013) and the COMODAL project.

VARIABLES	DEFINITION	INDICATORS
CUSTOMER SEGMENTS	Customer segments describe the different groups of people or organizations that the public authority aims to reach and serve with the service.	☐ Describe the profile of the customers that the public authority wants to reach
VALUE PROPOSITION(S)	The value proposition describes the bundle of products and services that create value for a specific customer segment. A value proposition creates value for a customer segment through a distinct mix of elements catering to that segment's needs. Values may be quantitative (e.g. price, speed of service) or qualitative (e.g. design, customer experience).	☐ Describe the value propositions develop by the public authority to reach each customer segments ☐ Describe the success factors and hindrances to create value propositions found by the public authority
CHANNELS	Channels describe how the public authority communicates with and reaches its customer segments to deliver a value proposition.	☐ Describe the channels used by the public authority to communicate and reach the beneficiaries of the service ☐ Describe the success factors and hindrances to create value propositions found by the public authority.
CUSTOMER RELATIONS	Customer relationships describe the types of relationships the public authority establishes with specific potential beneficiaries segments to achieve beneficiaries' acquisition and retention and to possibly increase the number of beneficiaries. The relationship established with the possible beneficiaries could be: • Personal assistance (e.g. i through call centres, by email), • Dedicated personal assistance (e.g. recognizable repeat advisors, carers). • Self-service (e.g. no direct relationship).	☐ Describe the relationships with potential beneficiaries by the public authorities to reach, retain and increase them. ☐ Describe success factors and hindrances for these relationships to reach beneficiaries retain and increase them.

[42] www.technolage.org

	• Automated services (e.g. no direct relationship, but prompted suggestions based on user profiling). • Communities (e.g. facilitating customer to customer contact). • Co-creation (e.g. user involvement in product/service development).	
REVENUE STREAMS	Revenue streams describe the cash flows the public authority generates from beneficiaries or intermediaries	☐ Describe the different sort of revenues obtain by the public authority from the service: concretely: a) Operational Revenues coming from the provision of the product/service or group of products/services. They are of two types: 1) variable, such as beneficiaries payments, or 2) fixed like monthly or annual fees paid by beneficiaries. b) Revenues can also come from intermediaries (like organisations representing older people) or can even be funding streams which are regular or continuous; in this case we name them Recurring Fundings. ☐ Describe success factors and hindrances to obtain these revenues
KEY RESOURCES	Key resources describe the most important assets required to make the business model work. It is possible to distinguish between physical (e.g. production facilities, logistics), intellectual (e.g. brand, patents, partnerships, customer database), human (e.g. engineers, designers, sales force) and financial (e.g. cash, credit line) resources.	☐ Describe the key physical, intellectual, human and financial resources of the services, put in place by the public authority to make the services work. ☐ Describe success factors and hindrances in relation with these key resources.
KEY ACTIVITIES	Key activities describe the most important things the public authority has developed to make its business model work. It is possible to distinguish between production (e.g. designing, making, delivering in size and quality), problem solving (e.g. knowledge management, continuous education and training) and platform/network activities (e.g. platform management, service provisioning, platform promotion).	☐ Describe the key activities developed by the public authority to make the service work. Production, problem solving and platform/networking activities. ☐ Describe success factors and hindrances in relation with these key activities.

KEY PARTNERSHIPS	Key partnerships describe the network of suppliers and partners that make the business model work by the public authorities.	☐ Describe the main stakeholders involved in the service and their role ☐ Describe the partnerships to create and implement the services. ☐ Describe success factors and hindrances in relation the involvement of stakeholders ☐ Describe success factors and hindrances in relation with the creation of the partnerships
COST STRUCTURE	The cost structure describes all costs incurred by the public authority to operate the business model. These are all costs necessary to provide the product/service or the group of products/services.	☐ Describe which are the operational costs of the public authority, concretely: a) Describe the fixed costs, including: • Personnel, • Infrastructure (including the network costs), • Maintenance, • Marketing costs, • Costs related to call centers and customer satisfaction programs (if any) • Any other fixed cost related to the product/service. b) Describe the variable costs: • The procurement of sub-systems, • Consumables, • Internal or external fees paid for the specific service package • Any other variable cost related to the product/service. Detail these data as much as possible, if not; provide at least general information of these data.

3.- THE TECHNOLOGICAL COMPONENTS (DEVICES).

The technical components of the independent living systems can be described as a remote hardware/software system. These variables are based on the structure for an Ambient Assisted system model proposed in the the report of DKE German Commission for Electrical, Electronic and Information technologies of DIN and VDE (2012) on Ambient Assisted Living systems.

VARIABLES	DEFINITION	INDICATORS
Technological components of the service	Hardware, software and applications used in the service	☐ Detail the components of the system available **at home**, such as: • The user interfaces (monitor, keyboards, mouses, television, touch panels, etc.) • The sensors (installed in the home or carried out by the users) • Actuators: components that permit the system to carry out actions in the home (e.g. controlling light, opening windows, etc.) • House bus: bus system to which sensors and actuators are connected (through cable or cordless connection) • Gateway: IT system that acts as execution environment for the software components, interprets the sensor data, interacts with the user, sends messages to the service provider or third parties or controls actuators and thus performs the actual assistance function. Examples are set-top boxes, routers or compact PCs. ☐ Detail the components of the system available for the users when they are **outside the home**, such as: • Mobile gateway: It system that performs gateway tasks for the users when they are outside the house, such as smart phones or personal digital assistants. • Mobile aids (e.g. electric wheelchairs, etc.) ☐ Detail the network types used for the service for communication between gateway, service provider and possible third parties (e.g. DSL internet links, television cables or UMTS and dialling connections by phone, ISDN or GSM). ☐ Is the service include communication between the users and an operator by phone or videophone, such as a call centre run by a service provider or a third party, If yes, detail it.
Costs	Costs of the technological components	☐ Which is the cost of these technologies for the public authority, in terms of: - acquisition - installation - maintenance

4.- TECHNICAL BARRIERS

We will collect information on:

- ☐ Which are the standards applicable with the technology components of the service?
- ☐ Is the service compliant with these standards?
- ☐ Is the service interoperable in the region and country? And outside the region or country?
- ☐ Which have been the barriers to interoperability and solutions develop to make the components interoperable?
- ☐ Do/did you encounter with other technical barriers? If yes, how do/did you address them?

5.- QUALITY ASSURANCE OF THE SERVICE

VARIABLES	DEFINITION	INDICATORS
Quality of service delivery	How the quality of service delivery is managed and assured	☐ Are you applying a method to ensure and improve processes, structures and results/outcomes of care? Can you detail it ☐ Which organisation is responsible for quality assurance/certification (if any) ☐ Is there a law or standards and guidelines to ensure quality at national/regional level?

6.- TRAINING ACTIONS

It refers to the strategy to provide and to transfer skills and competences to use the service. The following information will be collected:

☐ Detail training strategies for the implementation of the service, concretely:

- The target group.
- Stakeholders involved
- Competences trained and the material available
- Training methodology
- Delivery channel and actors
- Link to formal/vocational training programmes

7.- SCALING AND MARKET CREATION

This section is related on how the public authority has implemented the service creating and implementing a new market. Concretely, we will identify from the public authority perspective:

☐ How the public authority has implemented the service creating and developing a new market.

☐ Which have been the enabling factors and barriers to the market creation?

☐ Which have been the enabling factors and barriers to the market implementation?

☐ Has the service been replicated outside local area or country?

- If yes, which has been the strategy developed?
- Have you identified another potential market in which to replicate the product/service outside the local, regional or national area? What are the enabling factors to carry out the replication and the barriers?

8.- POLICIES AND THE ROLE OF POLICY TO CREATE, IMPLEMENT AND SCALE-UP GOOD PRACTICE

It refers to the policies developed to create, implement and scale-up the service, concretely:

☐ Which policies at local, regional, national and European levels intervene?
- To create the service
- To implement the service
- To scale-up the service
- the sustainability of the service

☐ Which of these policies were successful or which were not?

☐ Detail the role of policy at local, regional, national and European level in:
- creation of the service
- implementation of the service
- scaling-up of the service
- the sustainability of the service

☐ Detail the role of the public authorities at local, regional, national and European level in:

- creation of the service
- implementation of the service
- scaling-up of the service
- the sustainability of the service

☐ Detail also the facilitators and barriers found in developing this role

9.- EVALUATION PROCESS OF THE EFFECTIVENESS OF THE GOOD PRACTICE

The case study analyses and elaborates the information on the social, health and economic impact of the technology-based services on the four policy objectives for long-term care: independent living, productivity of carers, quality of care, and sustainability of the care systems. That is if the use of ICT means quality improvement and better quality of life (and not only cost reduction). Moreover, this section also states the final objective of this impact evaluation, as well as the methodology applied: the sample, the research method, variables and instruments used, and the process to collect the data.

VARIABLES	DEFINITION	INDICATORS
FINAL OBJECTIVE OF THE STUDY ON EFFECTIVENESS		
DEFINITION OF THE EVALUATION PROCESS FOR EFFECTIVENESS		☐ The sample ☐ The research design ☐ Variables and instruments ☐ Procedure for data collecting
FINDINGS ON EFFECTIVENESS		☐ Detail the effectiveness in relationship with the 4 policy objectives
ONGOING EVALUATIONS		☐ Refer to study on evaluation of effectiveness that are currently being developed and for which data are not already available.

10.- ORGANISATIONAL CHANGE: INTEGRATION OF THE TECHNOLOGY-BASED SERVICE IN THE DELIVERY CHAIN

We elaborated the information around the change in the organisation to integrate the service in the formal existing system, based in the operational processes detected in the project EBM (FAST, 2013) and adapted for the purpose of this project

VARIABLES	DEFINITION	INDICATORS
POLICY FRAMEWORK	Does a policy framework exist behind the integration of the service?	☐ Describe the policy framework/s develop to integrate the service in the care delivery chain.
DEPLOYMENT PLAN	If there was a roll out plan and how it was defined	☐ Describe the deployment plan developed by the public authority to implement the service in the care delivery chain ☐ Describe the facilitators and barriers of this development plan.
REFERRAL	How older people are referred to the service/become beneficiaries	☐ Describe the process and responsibilities for older people selection/entitlement and assessment to become beneficiaries of the service.
PROCUREMENT	It refers to the acquisition of goods, services or works from an outside external source	☐ Describe the process and responsibilities for older people selection/entitlement and assessment to become beneficiaries of the service.
INSTALLATION	How equipment reaches patients home	☐ Describe the responsibilities and activities to install the service at home. ☐ Describe the facilitators and barriers for the installation.
SERVICE DELIVERY AND MONITORING	How the service is delivered and data are managed	☐ Describe how and who deliver and monitor the appropriate implementation of the service ☐ Describe the facilitators and barriers found in the delivery and monitoring
STORAGE AND MAINTENANCE	How the equipment is cared for	☐ Describe how and who is in charge of the storage, cleaning, maintenance and repairs, and technical user support of the service.
END OF SERVICE AND REMOVAL OF THE EQUIPMENT	How the service ends and the equipment is removed from patient homes	☐ Describe the process on how older people are discharged from the service and how the equipment is removed from the home.

Include the following information already collected from sections above: education and training, governance, measurement of impact, and research (to improve the service).

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