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[1] R = Report, P = Prototype, D = Demonstrator, O = Other

[2] PU = Public, PP = Restricted to other programme participants (including the Commission Services), RE= Restricted to a group specified by the consortium (including the Commission Services), CO = Confidential, only for members of the consortium (including the Commission Services)

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1. Introduction

FATE (Fall Detector for the Elder) is a project with a very well identified objective: the correct detection of the falls occurring with elderly people. Apart of the identification of the falls, FATE complementary main objectives are the contribution to the reduction of the fear of falling and the prevention of the long lie syndrome.

This document presents the outcomes of the first task for the first work package (WP) of the FATE project's work plan. This strand of work focuses on the definition and description in a fully functional way of the e-health and social services to be validated in the pilots. The interrelationships among the FATE users' (doctors, elders, caretakers, familiars, etc.) will also be described.

The definition of the FATE services is determined by the architecture conceived for the FATE solution, which is depicted in Figure 1.

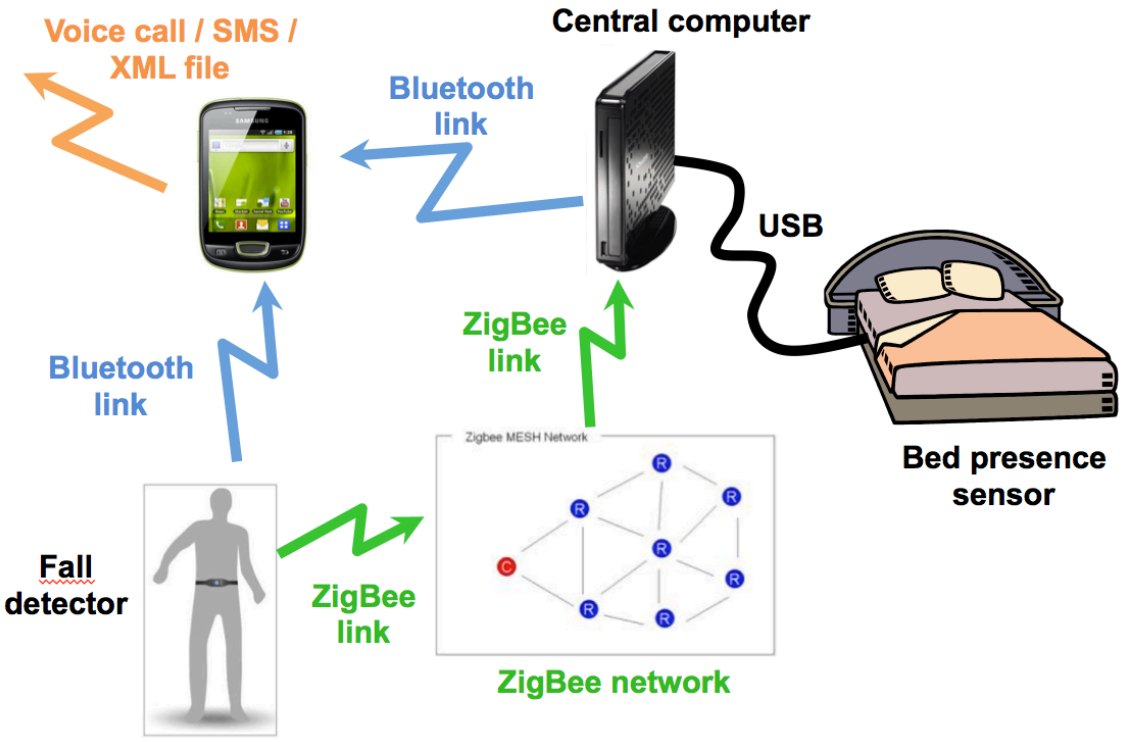


Figure 1. Overall architecture of the FATE system at user's home

The core of the system is constituted by a highly sensitive fall detector that is built using accelerometers, a processing unit and a communications module. The processing unit of the fall detector runs continuously a dedicated on-line detection algorithm that is able to detect a user fall. When this event rises and the user is at home a specific alarm message is sent using a ZigBee communication link that arrives to a central computer through a dedicated ZigBee network.

The goal of the ZigBee network is to permit the detection of falls in any place at user's home. This network is coordinated by the central computer and is supported by a set of ZigBee wall routers that are distributed at specific locations in the home, so as to guarantee enough coverage.

Another component of the FATE system is the bed presence sensor. The goal of this sensor is to detect eventual falls during the user sleep period, when the fall detector is not worn. The sensor is sending continuously messages to the central computer using a USB link. These messages indicate if the user is present on bed or not. Once the user goes to bed, if he/she leaves it and does not come back for a specific time window then this situation may be interpreted as a possible fall.

The central computer receives the messages sent by the fall detector and the bed presence sensor and stores them locally for validation and analysis purposes. Additionally, it relays them to the user's mobile phone using a Bluetooth link. A specific application running in the mobile phone analyses these messages in real time and decides if a fall alarm has to be sent. There are three alarm formats in the FATE system, as requested by the call centres in each pilot site:

- An automatic voice call. This is the format to be used in the Italian pilot.
- An automatic voice call plus an XML file containing information about the user status. This is the format that will be used in the Spanish pilot.
- An SMS containing information about the user status. This is the format that will be used in the Irish and the Italian pilots.

The mobile phone can also send other types of messages indicating specific situations that may arise while using the FATE system (automatic or manual fall recovery or low battery status, among others).

When the user leaves home (a situation that is detected by the fall detector by the absence of a ZigBee network) the fall detector establishes a permanent link with the mobile phone using the Bluetooth protocol. This link contains the same information that is sent at home using the ZigBee network. In the case the user leaves home the mobile phone will include in the messages sent to the call centre (SMS or XML file) information related to the position where a specific event has been detected.

For the FATE system installed at nursing homes the ZigBee and Bluetooth communication modules of the fall detector are replaced by an RFID tag. This tag communicates with the location solution provided by Gema Active Business Solutions, so that in the case a fall is detected the responsible personnel at the nursing home identify the place where it happened. In the same way, the bed presence sensor does send messages through a USB link, but through an RFID tag.

Additionally, the FATE system will contain another component for the pilots at nursing homes. It is the i-Walker, a robotic rollator developed by UPC that is based on a standard walker's frame and enhanced with sensors (6 force sensors, dual axis accelerometer and odometer), active motors and a processing unit. The i-Walker will be used as a technical aid to improve gait and balance, and therefore reduce the number of future falls.

More details of the FATE user scenarios at home and in nursing homes are including in deliverable D2.1 FATE Complete System Prototype.

In Chapter 2 of this document a use case scenario for each pilot site is detailed containing scenarios for the use of the FATE service indoors, outdoors and in residential homes. These use cases contain a "day in the life" commentary from each pilot site, describing how the FATE system responds to a series of requests from FATE actors.

In Chapter 3 of this document the service process models developed against this background and technology for each of the three pilot sites (Ireland, Italy and Spain) is described. This starts with a brief summary of the focus of the ICT-based service innovation to be pursued at each pilot site. Subsequently, envisaged changes to currently existing service processes are summarised. This will be detailed and represents the current service offerings in place in the respective countries and the fundamental differences that the FATE intervention will offer. This is then augmented with a graphical representation of the new service processes to be piloted.

A generic cooperative service process model is presented in Chapter 4. An overview of where individual pilot sites will put their focus on when it comes to implementing individual components of the generic overall model for piloting purposes is therefore presented as well.

2. Use Case Descriptions

2.1 Italian pilot

2.1.1 Use Case Description

2.1.1.1 General background to the FATE service

The Italian trial will involve 50 elderly at high risk of falling, living at home alone or with a cohabitant, resident in the Social Districts of Matelica, San Severino Marche, San Ginesio and Camerino. Users will be selected on the basis of the criteria established by the consortium, besides being beneficiaries of territorial social services. The trial will also involve specific "contact persons" (relatives, friends, neighbours, general practitioner, etc.), to be contacted when necessary. COOSS will select participants in close collaboration with the Social Districts coordinator and the social workers of the area of reference.

The FATE system will be installed at the users' home and configured by qualified personnel. The configuration will also allow adapting the system to the specific emergency services available in the area. The user will interact only with the fall detector and with the mobile phone.

The Call Centre has been specifically designed for testing the FATE system and is located at the nursing home in Tolentino city. When the Call Centre receives an SMS or a call of alarm/warning, the operator will follow a specific protocol (D2.2) that will ensure a timely and effective intervention according to the different cases.
All the information, activities and interventions will be duly recorded and stored in compliance with the privacy and data protection regulations.

2.1.1.2 Role naming

- **FATE User**: Anna
- **COOSS Researchers**: Dr Romina Boraso/Francesca Cesaroni
- **Social Districts Coordinator**: Dr. Valerio Valeriani
- **Social Worker**: Chiara
- **Call Centre Operator**: Lucia/Stefania
- **Contact Person**: Mario
- **Formal Carer/care operator**: Sara
- **General Practitioner**: Dr. Carlo Rossi

2.1.1.3 Role Description

a) Socio-technical assistive system - patient

Anna is 80 years old and lives alone in an isolated two-story house in the municipality of Camerino. Anna fell for the first time about two years ago while getting down the stairs, she could stand up with difficulty after a few hours and only then she could call her son to ask for help. Before this episode Anna led an autonomous and active life: she went to the town with her friends living in the proximity, she went to the church and to the market, she participated in the afternoon at leisure activities (playing cards, etc.) and during the weekend she went to visit her grandchildren.

In recent years Anna widowed and is at high risk of falling due to a musculoskeletal disease (osteoarthritis) that affects her walking. Anna is now less autonomous and for this reason has become more apprehensive and introverted. After the fall she comes out rarely and this leads to a progressive isolation. She doesn't trust to go out for a walk anymore or go to visit their grandchildren, even if accompanied and relies on SAD operators for whatever need. This leads to poor social relationships and few opportunities for leisure and conviviality.

Anna benefits from home care services (*SAD- Servizio di Assistenza Domiciliare* in Italian). The SAD operator, Sara, goes to her home twice a week for 3hours to help her in the heavier household, to bring the shopping and to assist her with bather personal hygiene. Anna benefits from the Social Transport Service, which she uses to the hospital for medical examinations. Anna's only son, Mario, lives 5 km away and works in another city of the Province. Mario calls his mother every day, but because of his work and family commitments, he visits her on the weekends. Anna's closest neighbours live three hundred meters from her, but there is no good relationship with them.

b) The socio-technical assistive system

- **COOSS Researchers**: Dr. Romina Boraso / Dr. Francesca Cesaroni

They are professional-experts employed in COOSS. They are project coordinators who act as manager, organizer and interface between COOSS, professionals of the area of reference and the FATE partners. They are responsible for a successful implementation of the trials and of an efficient collaboration between all stakeholders involved. The researchers are in charge of the pilot organization and monitoring, and of the professional relationships with the different actors.

- **Social Districts Coordinator**: Dr. Valerio Valeriani

He is an external professional-expert committed by the Regional Government. He is mainly a political and administrative figure, who acts as facilitator, organizer and interface between the Regional Government and the Municipalities (mayors) belonging

to the Social Districts under his competence. The Coordinator is in charge of the services co-designing and programming, of consulting initiatives and of the activation of sectorial and professional working groups on specific issues.

- **Social Worker:** Chiara

She is a COOSS Marche employee. She is a professional who, acting in accordance with the specific principles of her profession, operates to solve complex situations and to prevent social disadvantages. Through interviews and meetings with the elders and their relatives, she identifies the needs and implements the most suitable actions/services. Chiara is a specifically trained social worker involved in the FATE trials, to act as a link between all the actors (users, project staff, etc.) and to guarantee the successful performance of the pilot.

- **Call Centre Operators:** Lucia/Stefania

Lucia/Stefania is a professional who operates in the health care staff presently working at the nursing home. She was selected as FATE call centre's operator and was duly trained in using the system and in managing the emergencies according to the specific protocol.

Lucia/Stefania has a specific training concerning the health and social care relationship, particularly with the elders. She is specialized in social care emergency management and is able to evaluate case by case the type of intervention to be implemented, in accordance with what is defined by the specific operative protocol.

- **Contact Person-family member**: Mario

Mario is Anna's son and lives about 5 km away from her. He phones his mother daily and visits her once a week. With the SAD, Mario is often involved in the decision making process. With the activation of the FATE service, he will also be involved as contact person in case of alarms, The possibility that Mario, as family member, cannot be actively involved in the project because of different reasons (no time to devote to the project, works in remote area, etc.) has to be considered. In this case, some other referents for Anna will be identified as contact persons in case of emergency.

- **Formal Carer/Care operator:** Sara

She has the specific qualifications required by the law to operate as the Home Carer. She has a direct relationship with Anna and her son. She visits Anna for twice a week. Her tasks range from ordinary and extraordinary housekeeping to personal care and assistance.

- **General Practitioners (GP): Dr. Carlo Rossi**

Dr. Rossi is Anna's GP. He has been monitoring her since her last fall and has noticed that she is increasingly fearful and less autonomous. He considers her a good candidate for a fall detection system. His participation in the FATE trials is strongly recommended and will be sought for. If feasible the GP will collaborate and provide useful medical advices and supervision.

c) Technical assistive system

Anna lives alone in an isolated two-story house in the municipality of Camerino. Anna uses the FATE system composed of several elements.

When she gets up in the morning she removes the fall detector from the battery charger and activates it by pressing the "panic button". The elderly checks that the fall detector is turned on, noting that the LED flashes with a red colour. Anna places the fall detector within the neoprene belt and wears it at the waist, awaits confirmation that the fall detector is working properly until the LED flashes with a green colour. She removes the mobile phone from the charging station. There are ZigBee routers upstairs, covering the bedroom and the main bathroom and downstairs, covering the kitchen and living area. In the evening, when she goes to bed, she places both the mobile and the fall detector in their charging stations, placed besides her bed: from that moment her monitoring is guaranteed by the bed presence sensor fitted on her bed. This is connected via an USB to a central computer, placed in her bedroom.

2.1.1.4 'A day in the life' description of the FATE service

Below a "typical day" for the user assisted by FATE, to clarify the system operation and user tasks required for its use.

Anna wakes up early in the morning and wears the fall detector (see 2.1.1.3.c). Anna begins to perform her normal daily activities while wearing the fall detector. After having breakfast, she waits for Sara, in order to take a shower. When Sara arrives, while Anna is removing the belt with the fall detector, it slips and generates an audible alarm. Anna stops it by pressing the panic button. The system sends a warning message to the call centre and the call centre operator, Lucia, calls the user on the provided smartphone (according to the specific protocol described in D2.2). Anna reassures Lucia that everything is fine, quickly explaining what happened. She continues her activities. After the shower, Anna wears again the belt with the fall detector and dresses herself. After saying goodbye to Sara, she goes to the kitchen to prepare for lunch.

In the afternoon Anna waits for the operator of the Social Transport, to go to the medical examination. When she leaves home, she forgets to bring the mobile phone. The fall detector signals this situation through an audible "warning sound" (different

from the "alarm sound"). A message is automatically sent to the call centre that contacts the user on her personal mobile phone as described in D2.2. Anna goes back home and takes the phone that she forgot on the kitchen table.

After the medical examination, Anna returns home, wears pyjamas and goes in the kitchen to prepare the dinner. While cooking, Anna accidentally falls and the FATE system sends an alarm message to the call centre. The fall detector signals this situation through an audible "alarm sound". The call centre operator, Stefania, calls Anna (according to the specific protocol described in D2.2). Anna cannot get up and doesn't answer to the operator because the mobile phone is in the other room. When Stefania calls up Anna a few seconds later on her home phone, she doesn't respond, either. Stefania calls her son, Mario, who goes to visit her immediately. About 10 minutes later Mario is at Anna's home to make sure of her health condition. The son helps his mother to get up and sit on a chair and verifies that the fall had no serious consequences. Mario calls the call centre operator to confirm that Anna is fine, she feels a slight pain in the flank, but she didn't hit her head or lose consciousness, and doesn't need to go to the emergency service.

Anyway, the following day Mario will bring her to the general practitioner for a check-up. After dinner Anna sits down on the armchair to watch television, always wearing the belt with the fall detector. At bedtime, Anna connects the smartphone and the fall detector to their respective battery chargers. During the night Anna gets out of bed to go to the bathroom. She returns to bed within the specified time, thereby not generating any alarm.

2.1.2 Use Case Analysis

2.1.2.1 Solution existing prior to the implementation of the new FATE service

Had Anna fallen today, without wearing the FATE system, nobody would have been able to know and to offer prompt intervention. She would have remained on the floor until she managed to get herself back to the phone to call for help. If Anna would not be able to get herself up, she would remain on the floor for a long time, until her career came in the following mornings, or until her son alarmed that the mother's phone is ringing but there's no answer, would visit her to check the situation.

2.1.2.2 Innovative aspects of FATE service

a) Innovative aspect to the use case when compared with the current situation

FATE proposes a fall detector service, presently missing in the concerned pilot area. If Anna falls and is alone, the new service guarantees alarm, localisation and immediate

help. The FATE project will deploy a new call centre, providing 24h monitoring to its registered users. Such a service represents an innovative answer to the fear of falling, which hinders Anna's autonomy and confidence.

For these reasons the FATE system reinforces and extends the present assistance services offered in the Districts: it is a technology-based service which might start a new trend in the social health policies and services organisation. A key element of the FATE service is the response it offers to the strong need for autonomy and monitoring, often expressed by elderly living alone.

b) Positive impacts / advantaged that can be envisaged when compared with the current situation

The FATE innovative technology-based service offers 24 hours monitoring, never experimented in home assistance in the concerned area. The service will be addressed to self-sufficient users at risk of falling, who will gain confidence knowing to be constantly monitored. It is expected to increase autonomy and reduce the long-lie syndrome. Family members will gain in peacefulness knowing that FATE is continuously monitoring their relative and an immediate alarm will inform them in case of problems. If well structured, the system can improve the home assistance service, decreasing the carer's presence and hopefully contributing to cut the assistance costs. It can be easily integrated to the already existing services, improving the offer in the area of reference as described. FATE represents the possibility to safeguard the elders' wellbeing and the possibility to remain in their natural social context as long as possible.

c) Negative impacts / disadvantages that can be envisaged when compared with the current situation

The implementation of the FATE system might experience some issues relating to:

- Connection problems, due to the specific mountainous area of reference;
- Users' difficulties in dealing with the devices;
- Users' effort in understanding and lack of confidence with technological solutions.

2.1.2.3 Anticipated requirements on use case implementation

List here any additional requirements to implement the FATE service in your pilot as described in the use case above. Exclude the components of the FATE system.

a) Organisational / process requirements

- Call Centre Operators: attending specific training; integrating their usual activities with those specific to the call centre.
- Social Service Operators: integrating the new solution offered by the FATE system with the existing services; tackling with the digital divide.
- Contact Persons: familiarizing with the system.
- Local Service Coordinator: monitoring the impact of the FATE system on the current care services.

b) Legal / contractual requirements

- Documentation for the treatment of personal data and privacy issues, related to the trial.
- Specific agreements with service managers and municipal administrators for carrying out the trial in active collaboration.

2.1.2.4 Summary table of anticipated technology/functionality related requirements on the TAS

Role concerned	Required functionality of the FATE service	Other technology related requirements
Anna	Reliable fall detection both inside and outside the home. Timely and accurate alerting and rapid response	Correct understanding of the functioning of the system (technical issues: e.g. LED flashes, audible alarm, panic button, etc.)
Mario	Contact by the Call Centre Operator in case of alerts	
Lucia/Stefania	Contact in case of alerts: operative protocol available for the correct procedure to follow	Specific training on the call centre management
Chiara and Sara	Monitor the impact and proper use of the FATE system	Correct understanding of the functioning of the system
Dr Rossi	Possibility to analyse falls and activity data from the FATE system	
118-Emergency Service	Contact by the Call Centre Operator in case of medical emergency	

2.2 Irish Pilot

2.2.1 Use Case Description

2.2.1.1 General background to the FATE service

The FATE project is an ICT-based solution focused on improving the elder's quality of life by an accurate detection of falls in ageing people, both at home and outdoors. It consists of an accurate, portable and usable fall detector and a robust and reliable telecommunications layer based in ZigBee and Bluetooth technologies, capable of sending alarms when the user is both inside and outside the home.

The system will be complemented in the home environment by as a bed presence sensor, with the entire system ensuring successful prevention and detection of falls in all circumstances.

The system will be able to measure behaviour parameters such as the level of activity or the time a person lies in bed, allowing the anticipation of potential health problems.

2.2.1.2 Role naming

Patient: Tom
Formal Carer: John
Family Carer: Ann (Tom's sister)
Family Carer: Pat (Tom's nephew)
GP: Dr Byrne
Call centre operators: Caroline and Dan

2.2.1.3 Role Description

a) Socio-technical assistive system - patient

Tom is a 69 year old gentleman who lives alone in an isolated rural location in the West of Ireland. Tom has rheumatoid arthritis, has problems with balance and uses a stick when walking. He has some aids and appliances fitted in his home to aid him with day to day tasks, such as grab rails in the bathroom and a stair-lift.

Tom has a formal carer supplied by the HSE. He has been allocated 10 hours care per week. His carer, John, visits 5 days per week for 2 hours per day. John helps with exercise, personal care and some cleaning. Occasionally John helps Tom with the preparation of meals.

On Saturday Tom is visited by his sister Ann and his nephew Pat. They bring him shopping and help with household chores. Each Sunday Pat brings Tom to Ann's house for Sunday lunch.

b) The socio-technical assistive system

Ann is Tom's sister and next-of-kin. She lives in a small town 4km from Tom. Ann is retired and lives next door to her son Pat. Ann looks after Pat's 2 small children during the week. She does not drive and relies on Pat when she needs to travel to visit Tom. Ann is concerned about Tom's decreasing mobility and his difficulty in carrying out day to day activities.

Pat is Tom's nephew. He lives next door his mother Ann, 4km from Tom. Pat works 5 days a week and has 2 small children. John is a home care assistant employed by the HSE. He has completed a certificate in Healthcare Support and has been working as a homecare assistant for 5 years. Tom is one of 3 clients that John supports. John's role does not include major personal care tasks and he has not received training in fall prevention. John lives about 10km from Tom's house but holds a key for the house and has told Tom to ring him at any time in an emergency.

Dr Byrne is Tom's GP. He sees Tom on a regular basis and monitors his medication and exercise plan.

Caroline and Dan are employed by Tunstall Emergency Response, a for-profit social alarm service provider offering a 24/7 service nationwide with over 35,000 clients. They work as an operators at the centre and handle incoming alerts and calls. Caroline works nights, starting her shift at midnight and finishing at 8am. Dan works various day shifts, depending on his roster.

c) Technical assistive system

As a FATE user, Tom has been given a fall detector, a mobile phone and bed occupancy sensor. A ZigBee network has been installed in his home with devices upstairs and downstairs.

Tom lives in a 2-storey house which consists of kitchen and sitting room and 2 bedrooms and bathroom upstairs. In Tom's bedroom, upstairs, there is a bed occupancy sensor fitted to his bed. This is connected via usb to a central computer. The charging stations for the fall detector and mobile phone are also in his bedroom. Tom has a fixed-line phone in the house, with one handset in his bedroom and one in the sitting room.

2.2.1.4 'A day in the life' description of the FATE service

One Friday morning at 5am Tom awakens and is unable to get back to sleep. He gets up to make himself a cup of tea. Tom does not put on his fall detector, leaving it on the charger. While downstairs Tom turns on the radio and dozes off to sleep in his armchair.

When Tom hasn't returned to bed after 15 minutes his bed occupancy sensor alerts and fall software on the computer raises an alarm via the mobile phone.

In the monitoring centre, Caroline receives the "Out-of-Bed" alarm and immediately sets about contacting Tom to confirm he hasn't fallen somewhere in the house. She firstly tries to reach Tom via the mobile phone supplied as part of the FATE solution. Tom has left this charging upstairs so does not hear it. Caroline then checks Tom's file for other contact information. His fixed line phone is listed so she rings that. The phone handset ringing in the sitting room wakens Tom. He answers the phone and is slightly confused at first. Caroline stays on the phone chatting with him until he feels better. Tom confirms that he is ok and does not need any help. He goes back to bed and sleeps until 8:30am. When he gets dressed Tom removes the fall detector and mobile phone from the chargers, puts on his fall detector and carries his mobile phone with him.

Tom's formal carer John arrives at 9am. He helps Tom with breakfast and does some household tasks. Then they prepare meals for the rest of the day. John leaves again at about 11am.

Later that day, Tom decides to walk to visit a neighbour. He is still carrying his mobile phone in his pocket. His route to his neighbour's house consists of minor roads and rural roads and is less than 1km.

Along the way Tom stumbles on rough terrain and falls. He injures his hip and is unable to get up. The fall detector alerts immediately and sends a "Fall Detection" alarm to the monitoring centre, via the mobile phone. In the monitoring centre the alarm is handled by Dan. Dan can see clearly that John has fallen outdoors and tries to contact him by mobile phone. Unfortunately, because of the way he fell, John is unable to reach his mobile phone in his pocket to answer it. John is reassured though, by the ringing of the phone, that his fall has been detected and help will be on the way very soon.

Next Dan rings Ann. She is immediately concerned for Tom's welfare. Dan offers to ring Pat with the GPS co-ordinates of the alarm. Pat agrees to pick up his mother and go look for Tom. They find Tom easily on the minor road near his home but as he is injured they call an ambulance. Tom is taken to hospital to be checked out but discharged later that day as he has only minor bruising.

2.2.2 Use Case Analysis

2.2.2.1 Solution existing prior to the implementation of the new FATE service

Previous to the implementation of the FATE service, Tom would have remained laying on the road until he was found by a passer-by. He could possibly have greater injuries due to being on the ground for a longer time, which would likely lead to a longer stay in

hospital. Even if his physical injuries were not serious his fall could result in a loss of confidence, with resultant loss of mobility and independence.

2.2.2.2 Innovative aspects of FATE service

a) Innovative aspect to the use case when compared with the current situation

The major innovation of the FATE service, over current fall detection products, is the ability to detect falls occurring outside the home and locate the patient using GPS co-ordinates.

b) Positive impacts / advantages that can be envisaged when compared with the current situation

The reassurance that comes with wearing a fall detector will allow Tom the freedom to stay active and leave the house. Fear of falling would leave him in a situation where his independence and mobility would be reduced, putting an extra strain on his carers as well as reducing Tom's own quality of life.

c) Negative impacts / disadvantages that can be envisaged when compared with the current situation

Using the data on sleep patterns and level of activity will mean less privacy for Tom. It is important that patients see the gathering of this data as an aid to their long-term health rather than an encroachment on their day-to-day life.

2.2.2.3 Anticipated requirements on use case implementation

a) Organisational / process requirements

Currently the operators at the call centre are fully proficient in taking and dealing with all types of alarm calls and in communicating with the patient, carers and emergency services. The computer at the patient's home collects data about the patient's sleep patterns and levels of activity. If this data is to be processed via the monitoring centre then a new protocol will need to be developed, with training for operators on how to understand and report this information.

b) Other

When a patient falls out of doors the SMS message will contain GPS co-ordinates to where the fall occurred. If these co-ordinates are to be passed to a carer (rather than the emergency services), then there is a requirement to ensure that the carer knows how to locate the patient based only on GPS co-ordinates.

2.2.2.4 Summary table of anticipated technology/functionality related requirements on the TAS

Role concerned	Required functionality of the FATE service	Other technology related requirements
Tom	Reliable fall detection both inside and outside the home. Quick response time in the case of an alert.	
John	Timely contact in the case of an alert from Tom.	
Ann	Timely contact in the case of an alert from Tom.	
Pat	Timely contact in the case of an alert from Tom.	
Caroline / Dan	Accurate information regarding falls and location.	
Dr Byrne	Analysis of the sleep pattern and activity data from FATE.	

2.3 Spainish Pilot – At Home

2.3.1 Use Case Description

2.3.1.1 General background to the FATE service

The Catalan trial will involve 25 elderly at high risk of falling, living at home alone or with a cohabitant, resident in Barcelona. Users will be selected on the basis of the criteria established by the consortium. The trial will also involve specific contact persons (relatives, friends, neighbours, general practitioner, etc.), to be contacted when necessary. SEM will select participants in close collaboration with medical teams (nurses included) responsible of the area of reference.

The FATE system will be installed at the users' home and configured by qualified personnel (from UPC Universitat Politècnica de Catalunya). The configuration will also allow adapting the system to the specific emergency services available in the area. The user will interact only with the fall detector and with the mobile phone.

The Call Centre has been specifically designed for testing the FATE system and is located at SEM building in Barcelona (Address: Pablo Iglesias 101-115 08908, L'Hospitalet (Barcelona)). When the Call Centre receives a call of alarm/warning, the operator will follow a specific protocol that will ensure a timely and effective intervention according to the different cases. This protocol is related with general protocol for trauma events in SEM.

All the information, activities and interventions will be duly recorded and stored in compliance with catalan and spanish government privacy and data protection regulations.

2.3.1.2 Role naming

- **FATE User**: Pedro Vidal
- **Researchers**: Sra Mireia Boixaderas, Dr Xavier Jiménez
- **Health Worker (nurses)**: Elisabeth Carrera, Juan José Zamora
- **Call Centre Operator**: Angels Mora
- **Contact Person-family member**: Pedro Jr. and Marta
- **General Practitioner**: Dr. Rafael Ruiz

2.3.1.3 Role Description

a) Socio-technical assistive system - patient

Pedro is 81 years old and lives alone in a third floor apartment, in a working class neighbourhood, in Barcelona. Pedro fell for the first time about nine months ago while leaving home, he couldn't stand up and after a half an hour he could call her neighbour to ask for help. Before this episode Pedro led an autonomous and active life with his friends and family.

Actually he is at high risk of falling due to a chronic disease (COPD (pulmonary disease) and artrosis) that affects his walking. Pedro is now less autonomous and for this reason has become more apprehensive and introverted. After the fall he comes out with care. He usually tries to go out for a walk or go to visit his grandchildren.

Pedro benefits from health home care services Elisabeth, goes to his home once a week, but he doesn't have social benefits to bring the shopping and to assist his with personal hygiene. Pedro benefits from the Barcelona Social Transport Service (Transport Programat), which he uses to go to the hospital for medical examinations. Pedro Jr. and Marta, his son and daughter, live 1 km away and they work in Barcelona. Pedro Jr. calls his father every day, but because of his work and family commitments, he and Martha visit Pedro (senior) on the weekends.

b) The socio-technical assistive system

- **Researchers**: Sra Mireia Boixaderas, Dr Xavier Jiménez

They are professional-experts employed in Public Health (family practice and emergency practice). They are project coordinators who act as manager, organizer and interface between SEM, professionals of the area of reference and the FATE partners. They are responsible for a successful implementation of the trials and of an efficient collaboration between all stakeholders involved. The researchers are in charge of the pilot organization and monitoring, and of the professional relationships with the different actors.

- **Health Worker (nurses)**: Elisabeth Carrera, Juan José Zamora

They are public health employees. They are professionals who, acting in accordance with the specific principles of their profession, operate to solve complex situations and to prevent health and social disadvantages. Through interviews and meetings with the elders and their relatives, they identify the needs and implement the most suitable actions/services. They are involved in the FATE trials to guarantee the successful performance of the pilot.

- **Call Centre Operator**: Angels Mora

Angels is a professional who operates in the health care staff presently working at the call centre. She was selected as FATE call centre's operator and was duly trained in using the system and in managing the emergencies according to the specific protocol. She has a specific training concerning the health care relationship, particularly with the elders. She is specialized in emergency management and is able to evaluate case by case the type of intervention to be implemented, in accordance with what is defined by the specific operative protocol.

- **Contact Person-family member**: Pedro Jr. and Marta

Pedro's son and daughter Pedro Jr and Marta live about 1 km away from Pedro. Pedro phones her father daily and visits him once a week. With Elisabeth (nurse), Pedro Jr. is often involved in the decision making process. With the activation of the FATE service, he and his sister will also be involved as contact persons in case of alarms.

- **General Practitioners (GP): Dr. Rafael Ruiz**

Dr. Ruiz is Pedro's GP. He has been monitoring Pedro since his last fall and has noticed that he is increasingly fearful and less autonomous. He considers him a good candidate for a fall detection system. His participation in the FATE trials is strongly

recommended and will be sought for. If feasible the GP will collaborate and provide useful medical advices and supervision.

c) Technical assistive system

Pedro will use the FATE system composed of several elements. When he gets up in the morning he removes the fall detector from the battery charger and activates it by pressing the “panic button”. He checks that the fall detector is turned on, noting that the LED flashes with a red colour. He places the fall detector within the neoprene belt and wears it at the waist, awaits confirmation that the fall detector is working properly until the LED flashes with a green colour. He removes the mobile phone from the charging station. There are three ZigBee routers at home, covering the bedroom and the main bathroom, kitchen and dining room. In the evening, when he goes to bed, he places both the mobile and the fall detector in their charging stations, placed besides her bed: from that moment her monitoring is guaranteed by the bed presence sensor fitted on her bed.

2.3.1.4 ‘A day in the life’ description of the FATE service

Below a "typical day" for the user assisted by FATE, to clarify the system operation and user tasks required for its use.

Pedro wakes up at 7:00 am and wears the fall detector; he begins to perform his normal daily activities while wearing the fall detector. Before having breakfast, he takes a shower, taking off the fall detector first and leaving it on a chair close by while he is using the shower. After the shower, Pedro wears again the belt with the fall detector and dresses himself. He goes to the kitchen to prepare for breakfast. Usually he tries to walk with his friends and buy some food and cleaning devices.

In the afternoon Pedro rest at home watching TV or using internet. When he leaves home, he doesn’t forget to bring the mobile phone, because last Sunday when he forgot the mobile phone, when he went out from home, the fall detector signalled this situation through an audible “warning sound” (different from the “alarm sound”). Pedro went back inside his home and took the phone that he forgot from the battery charger. A message was automatically sent to the call centre that contacts Pedro on his personal mobile phone to check he now has it with him.

At 19:00 Pedro goes in the kitchen to prepare the dinner. Pedro goes to the bathroom, accidentally falls and the FATE system sends an alarm message to the call centre. The fall detector signals this situation through an audible “alarm sound”. The emergency call centre operator calls Pedro (according to the specific protocol). Pedro cannot get up and doesn’t answer to the operator because the mobile phone is in the bedroom. The operator calls his son, Pedro Jr., who goes to visit his father immediately. About 5 minutes later Pedro Jr. is at Pedro’s home to make sure of his health condition. The son helps his father to get up and sit on a chair and verifies that the fall had no serious

consequences. Pedro calls the call centre operator to confirm that Pedro is fine, he doesn't feel pain, he didn't hit his head or lose consciousness, and doesn't need to go to the emergency service.

The operator notifies to the system this incidence and tomorrow Pedro's nurse and family doctor will receive this information. They will schedule a visit the same day.
After dinner Pedro sits down on the sofa to watch television, always wearing the belt with the fall detector. At bedtime, Pedro connects the smartphone and the fall detector to their respective battery chargers.

During the night Pedro gets out of bed to go to the bathroom. He returns to bed within the specified time, thereby not generating any alarm.

2.3.2 Use Case Analysis

2.3.2.1 Solution existing prior to the implementation of the new FATE service

If Pedro falls today, without wearing the FATE system, nobody would have been able to know and to offer prompt intervention. He would have remained on the floor until he managed to get himself back to the phone to call for help. If Pedro would not be able to get himself up, he would remain on the floor for a long time, until his son alarmed that the father's phone is ringing but there's no answer, would visit him to check the situation.

2.3.2.2 Innovative aspects of FATE service

a) Innovative aspect to the use case when compared with the current situation

FATE proposes a fall detector service, presently missing in the concerned pilot area. If Pedro falls and is alone, the new service guarantees alarm, localisation and immediate help by the public emergency system (SEM). The FATE project will not deploy a new call centre in Barcelona, but provides 24h monitoring to its registered users. Such a service represents an innovative answer to the fear of falling.

For these reasons the FATE system reinforces and extends the present public assistance services offered in Barcelona: it is a technology-based service which might start a new trend in the social health policies and services organisation. A key element of the FATE service is the response it offers to the strong need for autonomy and monitoring, often expressed by elderly living alone.

Another innovation of the FATE service, over current fall detection products, is the ability to detect falls occurring outside the home and locate the patient using GPS co-ordinates with a localization error of a few meters.

b) Positive impacts / advantaged that can be envisaged when compared with the current situation

The service will be addressed to self-sufficient users at risk of falling, who will gain confidence knowing they are constantly monitored. It is expected to increase autonomy and reduce the long-lie syndrome. Family members will gain in peacefulness knowing that FATE is continuously monitoring their relative and an immediate alarm will inform them in case of problems. If well structured, the system can improve the home assistance service, decreasing the carer's presence and hopefully contributing to cut the assistance costs. It can be easily integrated to the already existing services, improving the offer in the area of reference as described. FATE represents the possibility to safeguard the elders' wellbeing and the possibility to remain in their natural social context as long as possible.

c) Negative impacts / disadvantages that can be envisaged when compared with the current situation

The implementation of the FATE system might experience some issues relating to:

- Technological problems Unable to detect GPS Co-ordinates, metal structures in buildings…
- Connection problems, due to the specific area of reference;
- Users' difficulties in dealing with the devices;
- Users' effort in understanding and lack of confidence with technological solutions.

2.3.2.3 Anticipated requirements on use case implementation

a) Organisational / process requirements

- Call Centre Operators: attending specific training; integrating their usual activities with those specific to FATE in the call centre.
- Contact Persons: they will be familiarized with the system.
- Local Service Coordinator: monitoring the impact of the FATE system on the current care services.

b) Legal / contractual requirements

Documentation for the treatment of personal data and privacy issues, related to the trial. Specific agreements with health service managers for carrying out the trial in active collaboration.

2.3.2.4 Summary table of anticipated technology/functionality related requirements on the TAS

Role concerned	Required functionality of the FATE service	Other technology related requirements
Pedro	Reliable fall detection both inside and outside the home. Timely and accurate alerting and rapid response	Correct understanding of the functioning of the system (technical issues: e.g. LED flashes, audible alarm, panic button, etc.)
Pedro (Jr)	Contact by the Call Centre Operator in case of alerts	
Call operators from SEM	Contact in case of alerts: operative protocol available for the correct procedure to follow	Specific training on the call centre management
Mireia/Xavi	Monitor the impact and proper use of the FATE system	Correct understanding of the functioning of the system
Dr Ruiz	Possibility to analyse falls and activity data from the FATE system	

2.4 Spanish Pilot – Residential Homes

2.4.1 Use Case Description

2.4.1.1 General background to the FATE service

The FATE system in senior living facilities consists in two parts: is a real time alarm system capable of detecting falls for the purposes of communicating these fall events in order to improve the care to the fallen person (day and night fall detector) and the second part is an intelligent walker designed to minimize the risk of falls of elders (i-Walker)

In this scenario (nursing homes), we must consider two important issues. On one hand the FATE system will be integrated with a real time locating, identifying and monitoring RFID (Radio Frequency Identification) technology-based solution, that allows the protection and supervision of residents. In this case, the Tag (wireless input OEM module) and the fall detector will be integrated in one device, as the bed sensor too (bed sensor + Tag) and, on the other hand, the FATE system will work in an assisted environment. This means that when a fall detection alert occurs, staff members will know in real time who has fallen and also where they have fallen. In this instance the staff members (physician assistant, nurse or physician) who attends the elder fallen must decide the next step to do according the internal actuation protocol of the facility. Fall severity will dictate whether the elder will be treated in the same facility or will be taken to the hospital. All the information regarding fall event will be gathered for the staff members for further study and analysis.

Regarding the i-Walker we must consider elderly suffering the biggest gait difficulties that routinely use an assistive device for ambulation, such as a walker. The system will be complemented by the i-Walker, an intelligent walker designed to minimize the risk of falls of those elders.

Elderly subjects that will be enrolled in this kind of scenario are not able to walk without a device and use a rollator to move independently. They are affected by gait and balance difficulties often due to a neurological disorder, such as ictus, Parkinson disease, etc. For some users of the study their traditional walker will be substituted by the i-Walker. The i-Walker will support the user reaching stand up position and relieving him from doing a determined percentage of the necessary forces. Moreover it can force the user to apply a forward pushing force in the handlers in a downhill situation.

The i-Walker is able to record all the data coming from the different sensors and actuators that integrate. All the information regarding exercise and activity will be gathered for the staff members for further study and analysis

2.4.1.2 Role naming

In a typical use case for the system at senior living facilities, the actors involved are as follows:

Fate users: Jordi and Pepita
Care assistant: Laura
Nursing Home Director: María
Physiotherapist: Antoni
Medical manager: Dr. Pérez.

2.4.1.3 Role Description

a) Socio-technical assistive system - patient

Fall detector:

Jordi is a 70 year old gentleman that lives in a senior living facility with other 95 people. Jordi fell six months ago and, as a result of this fall, he broke his left leg. After a hard recovering period, Jordi increased his fear to fall again and doesn't want to do several activities that he did before to fall.

i-Walker:

Pepita is a 75 years old lady that lives in a senior living facility with other 95 people. Pepita has gait and balance difficulties due to a prior ictus and uses a rollator without assistance to move independently in the nursing home. In the past 6 months she has experienced two falls. This fact has increased her fear to fall, feels somewhat and doesn't want to do several activities that she did before to fall.

b) The socio-technical assistive system

Laura, María, Antoni and Dr. Pérez are staff members of the nursing home. Laura's role includes assisting Jordi and Pepita in the daily activities and helping them in any case if they need something. María is the manager of the facility. She organizes the different work protocols in the facility and is in direct contact with the Jordi´s son and Pepita´s daughter. Antoni is the physiotherapist; he takes care of Pepita's evolution after the ictus and programs her exercises Finally, Dr. Pérez is responsible for the medical aspects related with Jordi and Pepita. He monitored their rehab after their falls and he is concerned about the fear of both of them to fall again.

c) Technical assistive system

In the nursing home where Jordi and Pepita live, is installed a real time locating, identifying and monitoring RFID (Radio Frequency Identification) technology-based solution. He wears a device that integrates the fall detector and the Tag (radio frequency transmitter) and he has a bed presence sensor integrated with a Tag fitted in hid bed. Pepita wears the Tag (radio frequency transmitter). All the facility is monitored by the locating and identifying solution and, in case that a fall occurs; an alert will be generated by the locating solution indicating that Jordi is fallen and where he is. On the other hand, the solution allows Pepita to ask for help just only pressing the button of her wristband Tag. All these alerts will be sent to the staff members by means DECT

phones, SMS, pagers or e-mail. Pepita also has assigned an i-Walker that uses daily to move around.

2.4.1.4 'A day in the life' description of the FATE service

Fall detector

Jordi wakes up in the morning. The fall detector is in the bedroom and was connected to its charger last night before going to bed.

Laura removes the fall detector from the charger and activates it by pressing the panic button and will see that the fall detector is switched on because the LED is blinking with a magenta colour, indicating that the courtesy period has started. Then Laura helps to Jordi to places the fall detector inside the neoprene belt and then to place it on the waist of Jordi.

Jordi starts his normal life activity and goes to have his breakfast. Going to the dining room, Jordi stumbles and falls. In real time, Laura receives an alert in his DECT phone that indicates that Jordi is fallen in the area 2 of the corridor 1 in the second floor. Laura comes quickly to help Jordi to get off the floor. Fortunately, the fall was not serious and was not necessary to call do anything else but notify the fall details to the facility manger.

That night, Jordi left his bed to go to the bathroom. After a given amount of time after leaves his bed, the bed presence sensor integrated with the Tag, detected that Jordi had not back to his bed. An alarm was sent to the DECT phones of the staff members that went quickly to the Jordi's room to help him. Laura was the first to arrive and found Jordi fallen in the floor of the bathroom. She called to María and Dr. Pérez that, after examining the state of Jordi, decided to call an ambulance and to take Jordi to the hospital for an x-ray.

i-Walker

Pepita wakes up in the morning. The i-Walker is in the bedroom and was connected to its charger last night before going to bed.

Pepita stands up from the bed with the aid of i-Walker. The i-Walker is braked, so it avoids dangerous situations like unwanted forward-sliding. When Pepita is already standing, releases the i-Walker brakes and is ready to start moving. Antoni configured in his last visit the helping parameters of the i-Walker accordingly to Pepita's status. Antoni introduced using the remote configuration tool the parameters for each of the i-Walker motors, compensating the muscular force unbalance.

Pepita starts his normal life activity and goes to have his breakfast. i-Walker supports Pepita providing active differential assistance to compensate unbalanced muscle force.

Moreover, it provides to the user active brake assistance to compensate lack muscle force when the floor is in descent.

Going to the dining room, Pepita stumbles and is close to fall, but thanks to the support of i-Walker she is able to avoid falling and recovers successfully. Taking advantage of the i-Walker assistance Pepita moves around the residence comfortably and reaches the dinning room.

After the breakfast, she decides to visit the garden for a walk. When she reaches the ramp that goes down to the garden she remembers her old rollator, that pulled her downhill and was hard to control making her feel unsecure. The new i-Walker not only is not pulling her, but also is behaving as if the ramp was not there. She enjoys a stroll in the garden during the morning and when she goes back to the main building at the lunchtime, the i-Walker helps her again to climb the slope as if she was walking on a flat surface.

Thanks to the i-Walker she is able to move around more time without getting tired as it happened with her previous conventional rollator. She also feels discharged in the part of her body that was more affected by the ictus. Feeling the support that i-Walker is providing her, she feels in better shape and safer.

The i-Walker supporting capabilities will be inoperative when battery discharges, becoming a conventional rollator. Consequently, before going to bed Laura helps Pepita connecting her i-Walker to its respective charger in the bedroom. Pepita's i-Walker has been recording all the activity that she has been performing along the day. This data is logged in the internal memory of the i-Walker and it is transmitted to an external database. This information is available at any time to be screened and reported to Antoni or Dr. Pérez in order to monitor Pepita's evolution.

2.4.2 Use Case Analysis

2.4.2.1 Solution existing prior to the implementation of the new FATE service

Fall detector

Without the FATE system in the senior living facility, when Jordi fall in the morning, nobody can help him until someone listen the cries for help or see Jordi fallen on the floor. Due we are talking about an assisted environment, most probably this occurs in a more or less short gap of time.

More serious is the situation in the night. Without the FATE system, Jordi would remain on the bathroom floor until the next morning or until the next scheduled visit to his room of one care assistant, with the possible fatal consequences of this delay in the assistance.

i-Walker

Without the FATE system in the senior living facility, when Pepita used a common rollator she had more balance problems and got tired easily. Consequently she tried to move around the less the possible and her fear of falling did not improve.

2.4.2.2 Innovative aspects of FATE service

a) Innovative aspect to the use case when compared with the current situation

Fall detector

Basically to dispose of an automatized and effective fall detection system and the integration of this system with a real time locating, identifying and monitoring RFID (Radio Frequency Identification) technology-based solution is an important innovation that add value to the current situation in the nursing homes.

i-Walker

Basically the availability of a mobility support that goes beyond the conventional mobility aids providing tailored help that adapts to the specific support needs of each user as prescribed under medical considerations.

The i-Walker is able to maintain an almost constant pushing force, independently of the path improving the user navigation experience uphill/downhill and safety in such situations.

The strategy of helping the user consists on relieving him from doing a determined percentage of the necessary forces. The i-Walker operates passively; it never pulls the user with its motors and only provides support when the user is actively moving the i-Walker.

b) Positive impacts / advantaged that can be envisaged when compared with the current situation

Fall detector
Clear improvement in the response time after a fall.
Decrease of the fall fear due that the seniors knows that with the FATE system will be better monitored.
Peace of mind for the elder's family and for the care givers.
Improvement of the service level of the nursing homes with the FATE systems that allows them to differentiate to the competitors.

i-Walker

The improvement of users' mobility experience, thanks to the support offered by i-Walker. As a consequence, improve the user exercise rate and hence its physical condition reducing risk of falls. Reduction of the fear of falling feeling more in control and autonomous that with a conventional mobility aid.

Enhance independence and improve the peace of mind for the elder's family and for the caregivers. Improvement of the service level of the nursing homes with the FATE systems, allowing them to differentiate of the competitors.

c) Negative impacts / disadvantages that can be envisaged when compared with the current situation

Usability is critical. The elders must to feel comfortable themselves with the belt and driving the i-Walker

Investment needed for the FATE system implementation can be a brake. We must to identify clearly the customers, not the users.

2.4.2.3 Anticipated requirements on use case implementation

a) Organisational / process requirements

Very low impact. The most of the procedures to follow are already implemented in the nursing homes.

b) Legal / contractual requirements

Basically, submit the pilot to the judgment of the ethics committee, fulfill the Spanish law regarding data protection and involve the management staff and the medical responsible of the facilities in the pilot.

2.4.2.4 Summary table of anticipated technology/functionality related requirements on the TAS

Role concerned	Required functionality of the FATE service	Other technology related requirements
Jordi	Reliable fall detection in the whole facility during 24h/day. Timely and accurate alerting and rapid response.	
Pepita	Reliable mobility support in the whole facility during 24h/day. Tailored support to the user specific needs under medical prescription.	
Laura	First assistant in case of fall. Links to other sources of help (other care assistant, medical responsible, etc…) Assistant to support the user charging the i-Walker.	
Antoni	Configuration of i-Walker support parameters. Analysis of i-Walker logged data about user activity.	
María	Contact with the family of elders in case of fall or other circumstance. Analysis of falls and activity data from the FATE system.	
Dr. Pérez	Make the medical evaluation after a fall. Analysis of falls and activity data from the FATE system. Make the medical evaluation of the user functional and motor capabilities. Analysis of i-Walker logged data about user activity.	

3. Service process model set

3.1. Italy

3.1.1. Service model analysis

In Italy the provision of social and care services has always been a commitment of the municipalities, who are obliged to guarantee their citizens' wellbeing, investing part of their budget in social care.

With the introduction of the National Law 328/2000, new strategies and management policies were introduced to ensure better services to the citizens. Among them, the "Social District" concept was introduced, that is an area including a number of neighbouring municipalities with similar characteristics and needs. Municipalities belonging to a Social District plan their services together, identify the specific needs of their citizens and provide the required services. Their networking allows sharing of costs, resources and equipment, but also ensures provision of services that the single municipalities would have not been able to afford. Each Social District is managed by a Coordinator, who acts as facilitator and interface between the Regional Government, the municipalities and the citizens. The coordinator is responsible for designing the services, planning jointly with the majors of the single municipalities. The coordinator is supported by sectorial working groups and professional experts on specific issues.

This model aims to overcome the weaknesses resulting from fragmentation of social interventions, and to benefit from the joint planning of the services to offer more effective solutions.

The objective is to ensure all the citizens equal rights of access to qualitative services.

The FATE project will involve three Social Districts of Marche region in the trials:

Social District N. 16 – S. Ginesio (15 Municipalities)
Social District N. 17 – S. Severino (8 Municipalities)
Social District N. 18 – Camerino (13 Municipalities)

The 36 municipalities belonging to the three Social Districts of reference are situated in a mountainous area of Marche region: apart from some well served ones (Camerino, S. Severino, Matelica…), there are very small municipalities, quite distant from each other, with small roads connecting them, which can be cut-off in case of snow. Some older people live in isolated houses, where telecommunication problems often arise. In this situation, elderly users are at risk of isolation and loneliness: the strategy to network the territorial resources is an important step to limit isolation and guarantee more effective care and emergency services.

The operative management of the services is committed by the Local Administrations to private organizations through public auctions. Managing a service means: organizing activities, times, tools, equipment and financial aspects; selecting and employing the necessary professional figures; coordinating and monitoring all the aspects related to the service process.

COOSS Marche manages a great number of health and care services all over the Regional area, mainly to elderly and disabled persons, provided both at home and in sheltered and protected

houses. In the pilots' area, COOSS manages the greatest part of the services described in Chapter 3.1.4.1 – Services information.

3.1.2. Process related analysis of the new service innovation

Table summarises the innovation provided by the project with respect to the current service available at the COOSS pilot site.

Table 1. Analysis of new service innovation at COOSS pilot site.

Current service	New service	Specific differences
The citizens can consult **the Online Information Service** to get the information needed, provided that they have Internet access. In case they don't, they can go to (or call) the **Information Desk** to explain their need. The **Information Desk** operator analyses the request, problem or need. If it is a simple need, the operator is entitled to make the decision by himself. If it is a complex need, the practice is forwarded to the Social Services Department or to the Integrated Evaluation Unit, where teams of professionals analyse the request and plan the proper solution. Once the service needed to solve the elder problem is identified, the user is taken in charge and accompanied in the handling of the bureaucratic practices to access it. A monitoring activity is activated to assess the user satisfaction and the service effectiveness.	FATE proposes a fall detector service, presently missing in the concerned pilot area. If the client falls and is alone, the new service guarantees alarm, localisation and immediate help; FATE will deploy a call centre, providing 24h monitoring to its registered users. Such a service represents an innovative answer to the fear of falling, which often hinders the users' autonomy and confidence; FATE is a technology-based service presently missing in the area of reference, which might start a new trend in the social-health policies and services organisation.	Innovative technology-based service. 24 hours monitoring, never experimented in home-assistance in the concerned area. . The service will be mainly addressed to self-sufficient users at risk of falling, who will gain confidence knowing to be constantly monitored. It is expected to increase autonomy and reduce the long-lie syndrome Family members will gain in peacefulness knowing that FATE is continuously monitoring their relative and an immediate alarm will inform them in case of problems. If well structured, the system can improve the home assistance service, decreasing the carer's presence and hopefully contributing to cut the assistance costs.

3.1.3. Graphical representation of service process

Figure 2 presents the COOSS service process as it currently is, before FATE introduction.

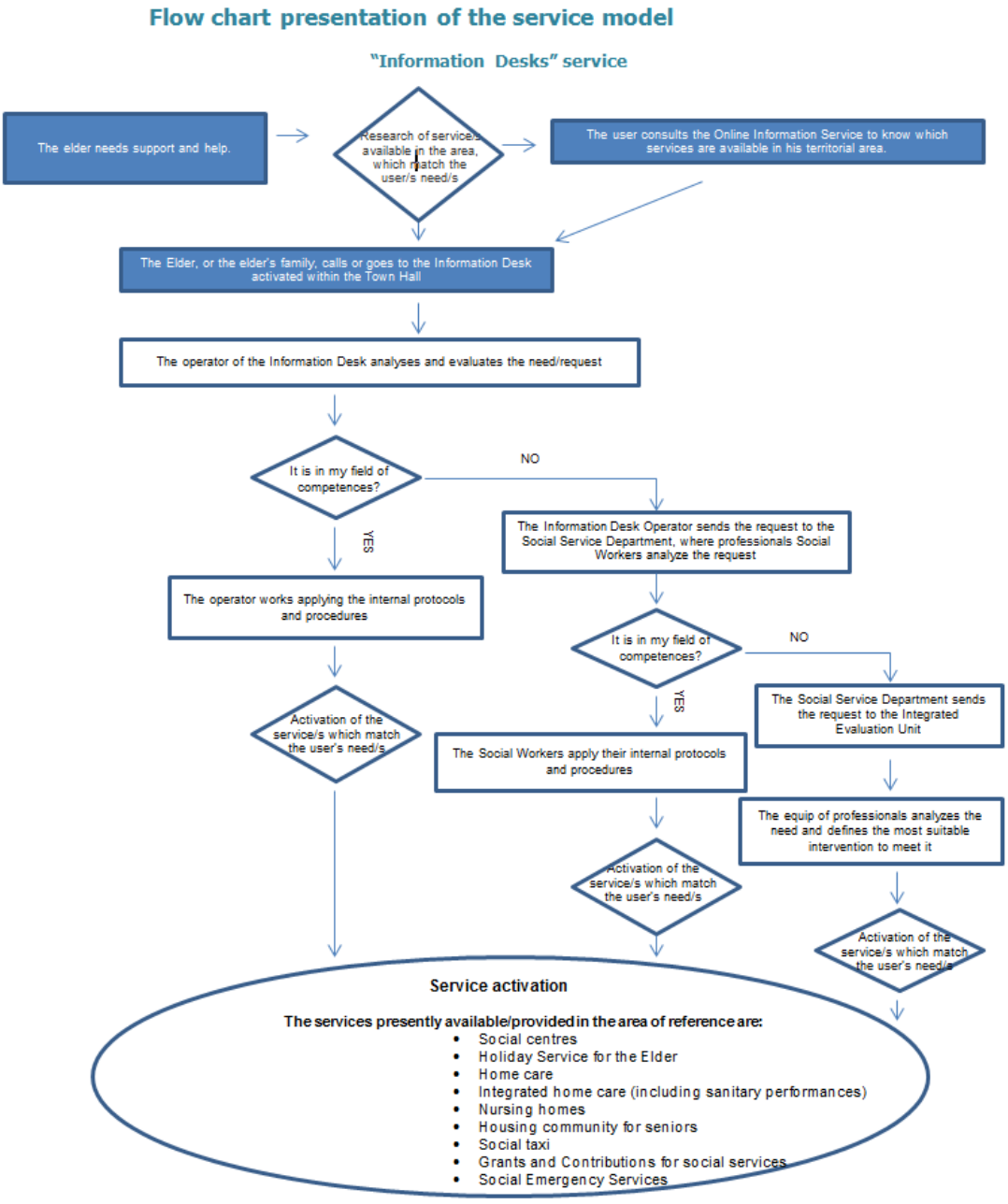


Figure 2. Current service process at COOSS.

Figure 3 presents the COOSS service process as it might be after the introduction of FATE.

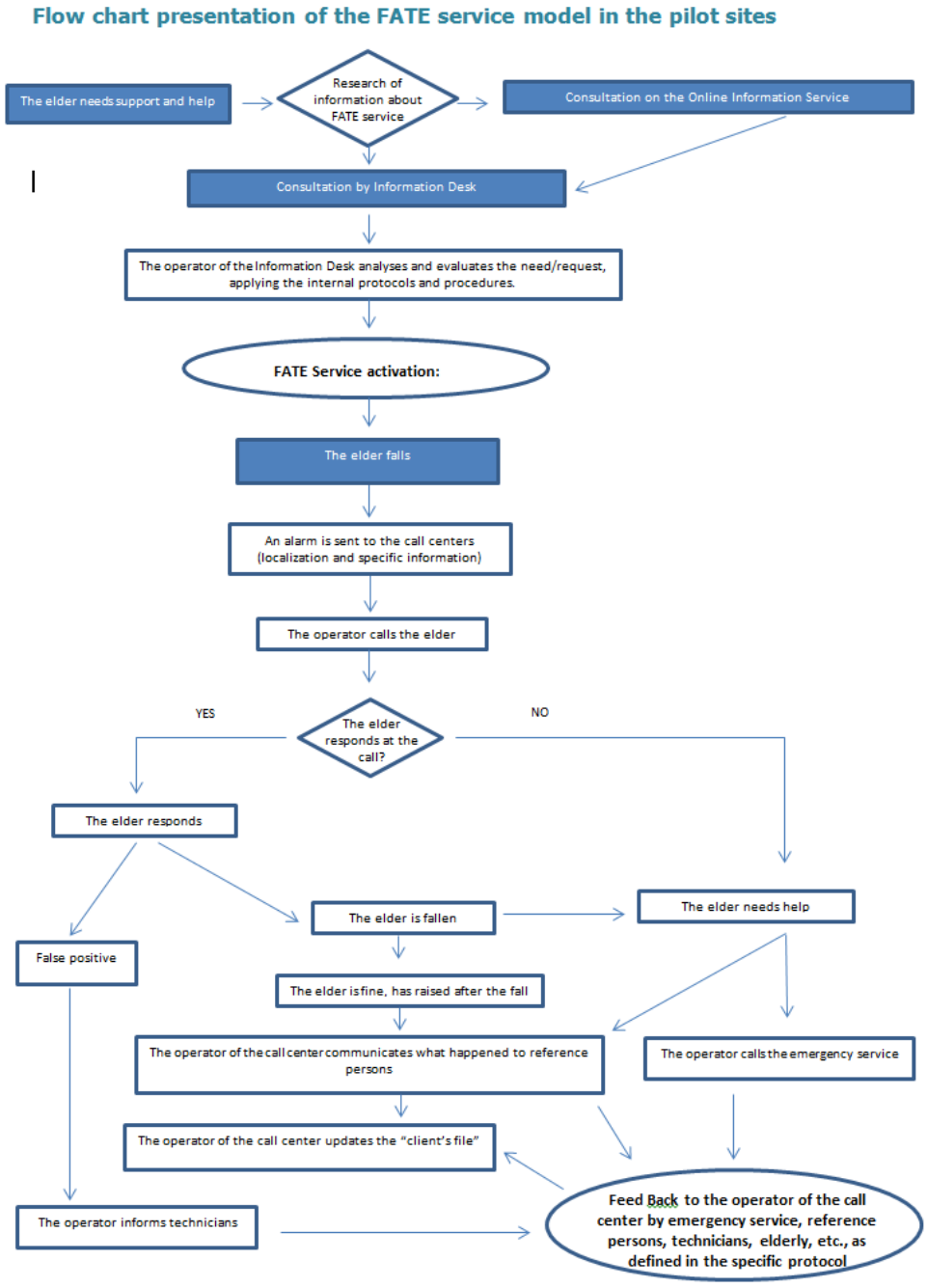


Figure 3. Possible service process after FATE introduction.2.1.4. Additional information

3.1.4. Additional Information

3.1.4.1. Services information COOSS

In the three Social Districts involved in the FATE project, telecare services and solutions are not presently deployed. The services illustrated below are mainly human-based traditional interventions, not linked to telecare solutions. Nonetheless, their description is expected to

provide possible scenarios for the deployment of innovative ICT-based solutions, as the FATE system might be.

One interesting existing service is the **Online Information Service,** a web portal where citizens can find information about the social, educational and health services existing in the territory. The system is also used for internal procedures, mainly through the dedicated Intranet, which allows professionals and administrative staff involved in the services provision to manage the users' records, services data and to monitor results.

The FATE service will be added to the list of available services and information on its functioning, accessibility and benefits provided. It will represent an innovative resource available for users with mobility problems and poor autonomy due to the fear of falling, which will facilitate their daily life and increase their wellbeing.

A key element of the FATE service is the activation of the most appropriate service for an identified need, i.e. the need for autonomy and monitoring, often expressed by older people living alone.

Current services available in the area covered by the FATE project are:

- **Home assistance** is a service that supports older people with basic housekeeping, personal care and social activities (i.e. activities of daily living). Home assistance is provided to frail older people to allow them to continue to live in their own homes for longer.
- **Integrated home assistance**: This service integrates social (housekeeping, personal care) and health (medical treatments, nursing, rehabilitation) tasks, to be provided at the users' home by different professionals. It is provided to older people recently released by the hospital, or in need of regular treatments, to avoid inappropriate hospital admissions and to keep the patient in his or her own living environment.
- **Housing community for seniors:** this is a residential scheme, consisting of a group of self-sufficient older people that decide to live together mainly for mutual solidarity.
- **Nursing Home**: The nursing home is a residential structure intended for temporary or permanent accommodation of autonomous elderly who prefer the community services to better face senility and loneliness.
- **Social Taxi:** this service was activated to meet one of the most frequent needs expressed by older people: the need for mobility. This need is particularly meaningful in the area covered by FATE, where isolation and lack of services is more prevalent than elsewhere. A dedicated phone number is available to request the taxi. The operators analyse the request, check its compliance with the criteria set in the protocol and plan the itinerary. Both older people and their family members can benefit from the Social Taxi.

Finally, two successful leisure services to promote opportunities for socialization and entertainment to autonomous elderly persons are available:

- **Holiday Service for the Elder:** this service organises holidays for older people, especially in summer. Older people are supported by the operators who accompany them, who guarantee assistance in case of need and the organization of leisure activities during their stay.
- **Social centres:** provide a space for independent older people where they can come together and reduce isolation, abandonment and marginalisation. The Social Centre is managed by the members and supported by the municipality it belongs to. It promotes cultural and educational initiatives, recreation activities and leisure opportunities. It is a free and direct access service.

The activation and deployment of FATE service will follow the procedures of the traditional services, whose main steps are:

- Analysis of the need.
- Identification of the most appropriate service to meet the need.
- Definition of the access modalities to the services.
- Identification of "integrated interventions", involving the National Health System, when needed.

3.1.4.2. Roles and actors

From the point of view of the services provided by COOSS Marche, the main actors and their associated roles are:

- **Social Districts Coordinator**: It is an external professional/expert committed by the Regional Government. It is mainly a political and administrative figure, who acts as facilitator, organizer and interface between the Regional Government and the Municipalities (mayors) belonging to the Social District/s under his/her competence. The Coordinator is in charge of the services co-designing and programming, of consulting initiatives and of the activation of sectorial and professional working groups on specific issues.
- **Information Desk Operator:** COOSS Marche personnel carry out this function. It is a key actor, as the effectiveness of the Information Desk Service highly relies on his/her competence. He/she is usually a social worker or a specifically trained operator competent in the protocols/procedures for the users' admission to the services, in the Social Districts regulations, in the specific patrimonial tools needed to identify the users' economic status (ISE-ISEE), etc. This operator has a central role in the interaction with local, social and health services staff. In the area of competence, the Operator is a COOSS Marche employee.
- **Social Workers:** COOSS Marche personnel carry out this function. They are professionals who, acting in accordance with the specific principles of their profession, operate to solve complex situations and to prevent social disadvantages. Through interviews and meetings with the elders and their relatives, they assess the needs and implement the most suitable actions/services. Some of them are COOSS employees, others are employed by the local bodies. Particularly during the FATE trials, a specifically trained social worker will be involved, to act as a link between all other figures (users, project staff, etc.) and to guarantee the successful performance of the pilots.
- **Operators/carers on the territory:** COOSS Marche personnel carry out this function. They must have the specific qualifications required by the law to operate in the different services. Because of their direct relationship with users and families, they must be able to communicate and to cooperate with users and professionals with different roles and expertise. Their tasks range from ordinary and extraordinary housekeeping to personal care and assistance and social/leisure activities. They are mainly COOSS employees. When medical treatments and nursing interventions are needed, health professionals and medical supervision are required.
- **Elderly people (users):** They are owners of rights, resources able to operate within the society, and not only users of the health and social services tout-court. Their expectations from the social policies are the respect for their problems, the reduction of

bureaucratic obstacles, the safeguard of their wellbeing and the possibility to remain in their natural social context as long as possible.

- **Family members:** In the traditional services, they usually support the elderly user and are often involved in the decision making process. With the activation of the FATE service, they will also be involved as referent persons in case of alarms, provided that the users give their consensus to this. The possibility that family members cannot be involved because of different reasons (they are not present, do not have time to devote to the project, do not have a good relationship with elderly users, live in remote areas, etc.) has to be considered. In these cases, some other referents for the elderly will be identified.
- **General Practitioners (GP):** Their participation in the FATE trials is strongly recommended and will be sought for. If feasible the GP will access the "client file" and provide useful medical advices and supervision.

3.2. Ireland

3.2.1. Service model analysis

The main focus of the service innovation to be pursued in the context of the FATE project concerns continued wellness of older people living in the community, in particular those who are prone to falls. These are to be enabled to better maintain their conditions, inter alia by ICT-enabled monitoring and advice. It is expected that they will have fewer falls, which currently occur quite often because the frequency of their falls and conditions are not monitored closely enough or the deteriorating of the patient's condition is noticed too late. To achieve this goal, the digital infrastructure to be piloted will enable the different parties involved in the overall care process to better coordinate their activities than has hitherto been the case, including general practitioners, occupational therapists, physiotherapists, home care workers and social carers. The constant monitoring of the patients will allow more informed decisions to be made in relation to their care plans and the assistance required and interventions on behalf of family and the health service.

3.2.2. Process related analysis of the new service innovation

Table summarises the innovation provided by the project with respect to the current service available at the TER pilot site.

Table 6. Analysis of new service innovation at the Irish pilot site.

Current service	New service	Specific differences
Current solution is provided by a Lifeline unit and fall detector device. Once a fall is detected a call is put through to the 24-hour monitoring centre where the client's name and details are available immediately. 2-way speech is established allowing the situation to be assessed and the appropriate action taken. Current service will only function if client falls within close proximity to the Lifeline unit	New solution is provided by a wearable fall detector and a mobile phone, a bed sensor, a, ZigBee network, a computer in the home also running fall decision software. If a fall event is detected by the wearable fall detector, the software running on the computer ascertains if it is a real fall or a false alarm. Actual alarms are put through to the 24-hour monitoring centre where it can be dealt with. If the client falls outside of home the fall event is detected by the wearable fall detector and notified to the monitoring centre over the mobile network via the mobile phone.	The chances of receiving a false alert are reduced with the new service. FATE will also detect falls when the client falls outside of the home.
Individual procedures: 1) Fall detector detects a fall event. 2) Event is notified to Monitoring Centre. 3) Action taken by operator.	Individual procedures: 1) Fall detector detects a fall event. 2) Software running on computer in home ascertains if this a real fall or a false alarm 3) Only real falls are put through to the monitoring centre. 4) Action taken by operator	Number of false alarms handled by monitoring centre is reduced. Client can get help if they fall outside their home.
Individual actors: 1) Client 2) MC Operator 3) Family/carers 4) Health Services 5) Emergency service	Individual actors: 1) Client 2) MC Operator 3) Family/carers 4) Health Services 5) Emergency service	None

3.2.3. Graphical representation of service process

Figure 4 presents the TER service process as it currently is, before FATE introduction.

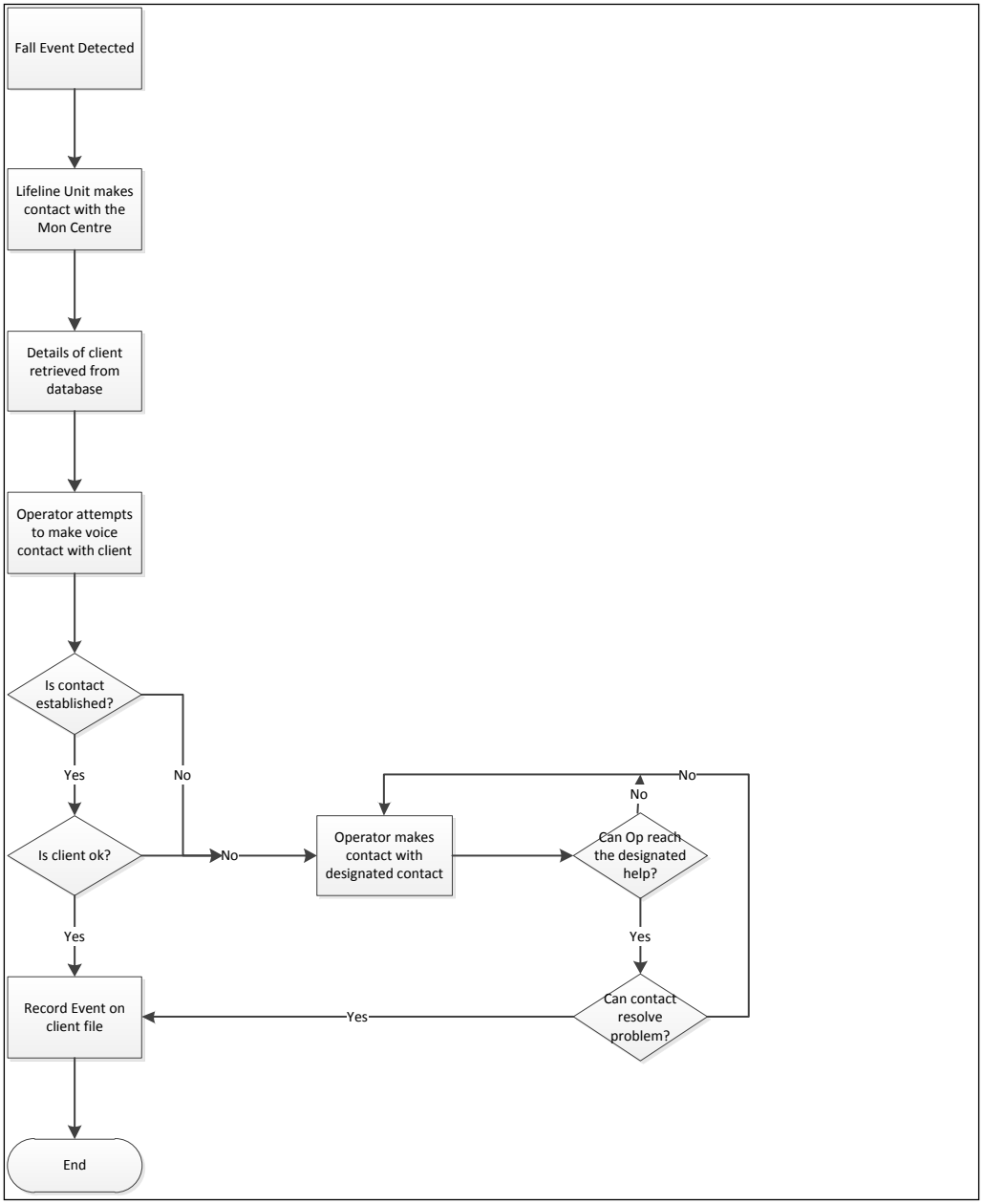


Figure 4. TER service process.

3.2.4. Additional information

3.2.4.1. Services information

Currently, telecare has not been implemented within the Health Service Executive (HSE), and there are no clear pathways for integrating telecare services with HSE service provision for people with dementia. However, it is intended to consult with key HSE stakeholders during the evaluation process, using an approach developed within the Renewing Health Project, known as the Telemedicine Readiness Evaluation and Assessment Tool (TREAT). This consists of:

1. Group assessment of current maturity against the core enabler and core patient experience targets.
2. Shared insights from open, cross-organisational discussion and best practice sharing.
3. Identification of key objectives, gaps and constraints.
4. Agreement of priority actions from discussions.

This tool will be adapted for the Irish context, and will include a brief online survey to be sent to key stakeholders (including HSE staff) in Ireland, followed-up by two in-depth workshops. In this way, it is hoped to link up with the HSE to assess current readiness and future potential.

The current mechanism for funding is provided for basic telecare services through the Department of Environment but is not directly linked into the healthcare or social services. Access to the funding is provided through local community based groups or Non Governmental Organisations and is subsequently distributed to individuals via these groups. Healthcare professionals and social services staff have difficulty in accessing this funding stream as all of these groups are predominantly voluntary and it leads to ad hoc arrangements.

The HSE has completed a large scale telecare project that is the first of its type in the last twelve months and have identified technology as a central strand of assisting people to remain independent and remain at home. The obvious benefits to this strategy are to reduce hospital admissions and reduce cost associated with hospital stays.

The FATE service will improve the information that can be made available to healthcare professionals and assist them with informed decision making in relation to care plans. The FATE system will obviously assist healthcare professional to identify people who are prone to falls and a telecare centre to react in real time when an actual fall takes place. This in turn will help to reduce the recovery time associated with falls when they are dealt with in as fast a time as possible.

The users of the FATE service receive reassurance that should they fall either at home when alone or outside the home the fall will be detected by the device and help will be dispatched to them immediately. Family members and carers are also reassured that the elderly person can be left alone to get on with their day-to-day activities and in the event of a fall they will be notified.

3.2.4.2. Roles and actors

The main actors and their associated roles are:

- **Monitoring Centre (MC Operator):** Monitoring Centre operators will be responsible for responding to any falls notified to the monitoring centre. They will interact with the wearer, their family and carer and healthcare professionals in order to get the appropriate help for the wearer of the FATE device.
- **HSE (Family doctor / occupational therapist / nurse /carer):** Family doctor / Nurse / Occupational Therapist will deliver care to the wearer. They will use the data regarding users' day to day activity and any falls from the FATE service to assist them in making decisions on what care the wearer needs. Carers may be responsible for ensuring the user wears the device, the device gets charged, the mobile phone gets charged. They may also be a designated contact if the user falls and needs assistance.
- **Family members:** Family members who live with the service user may be responsible for ensuring the user wears the device, the device gets charged, the mobile phone gets

charged and the user has the phone with them when they leave the house. Family members may be the first contact in the case of a fall.

3.3 Spain

3.3.1. Service model analysis

In Catalunya (the Spanish region where the FATE pilots will be carried out) social services are provided by Social Care Department, Health Department, Counties and Municipalities. Citizens can access social services from different administrations or providers depending of the service or problem they are asking for. It is a quite distributed model, which actually it is under coordination efforts to ensure an integrated provision of services independent of the administration responsible for it.

Basic home monitoring services are provided by the city council of Barcelona for their citizens, but are provided by the counties (*Diputacions*) for all other municipalities out of Barcelona. The basic home monitoring services provide an alarm system that has to be activated manually, and is prescribed by the social workers at the primary care centres or at the municipalities.

No specific monitoring services for falls detection in actually in place, therefore the service is a new situation where the service process has to be defined.

The actual health plan engages the healthcare system to improve the provision of integrated care services to citizens, ensuring a better health status and an increase of service quality without increasing costs.

The actual areas involved in the pilot for the FATE home service in Catalonia will be Barcelona (two different Health Districts):

- Àrea Bàsica de Salut (Basic Health Area) La Mina
- Àrea Bàsica de Salut (Basic Health Area) Besòs

The emergency service provided in Catalunya comprises a team of professionals (doctors, nurses, technicians and managers of coordination). After a telephone warning, they offer the most appropriate response in each case, either giving health information and health advice, or assisting the patient. The aim is to respond to care hospital health emergencies quickly, efficiently and with high quality. The service will run on a 24-7 basis, 365 days a year. The treatment process consists of two distinct areas:

1. The Call centre (Centre Coordinator) receives and manages requests for assistance and gives the appropriate response in each case, either by resolving the issue or mobilizing the most appropriate resources in each situation. All mobile resources (ambulances, helicopters and vehicles on call) distributed throughout the Catalan territory attend the patient at home or in public places and move them to the nearest health centre.
2. Receipt of call and classification of health information. From the time of receipt of the call, the call operators use a computer system. This tool allows them to locate, classify, determine an answer and record all data on the service. The system has a database of towns, villages and streets to assist in the proper location of the incident. Classification and response are determined by the protocol (supported by software) developed, agreed, reviewed and updated periodically by staff. Depending on the input regarding the reason

for the call and symptoms, a response is proposed by the system based on crystallized protocol: information. This contains a referral for medical consultation and / or activation of resource assistance. Patient identification, location, time and reason for calling and data required for classification, and response protocol crystallized attention are all recorded.

Concerning the FATE pilot organized at residential homes, at least 3 different facilities will be joined. Probably one on them in the Barcelona area, a second one in Zaragoza and the third in Madrid. FATE pilot in residential homes will have two different parts: a first experience with the fall detection using the system combined with the RFID identification system already installed at the nursing home and a second with the i-Walker specific users.

3.3.2. Process related analysis of the new service innovation

Table summarises the innovation provided by the project with respect to the current service available at the Spanish pilot site.

Table 3. Analysis of new service innovation at Spanish pilot site.

Current service	New service	Specific differences
Elderly citizens access social services either from their municipality or their primary health care provider. The social workers in collaboration with the healthcare professionals define the care services they should receive. No specific service for falls detection is actually in place. Only a generic basic alarm service is provided by the counties.	Clinicians at hospital and at primary care detect possible users of the service. The social workers assess the specific necessities. The specific service for fall detection will be provided to the users fulfilling the specified criteria.	The service provided is specially designed for elderly people who may suffer a fall. Trying to prevent the derived effects from the fall.
Individual procedures: **Social workers**: assess user needs and prescribe accordingly **Home care alarm system**: a basic alarm system is provided by the county, and manages the alarms through a call centre that makes the triage of the requests, and in case a health intervention is needed the call centre operators contact the specific health care provider that takes care of the specific intervention	Clinical and social assessment for potential users benefiting from the new service will be screened. The new service will be provided as a standalone system, independent from the presence of the home care alarm system.	The new service will directly contact the health emergency services when required, according to the alarm system designed in the new system.
Individual actors: **Citizen**: Potential users of social services access the services provided on a basis of proximity and needs	The new service will be provided when potential users access health related services. When those patients are	Only health related providers will have access to prescription of the new service. But actual services provided will not be changed.

Municipal social services: from a social needs approach they detect the specific needs a user has, and prescribe the social aids or services to be provided to a user.

Primary health care social service: from a health care approach citizens can access to specific services prescribed by social workers or clinical professionals

General Practitioner: is in charge of the follow up of elderly people and can detect potential needs the user requires

Day Hospital: is in charge of following up the patients who require some specific health care

Hospital: patients are admitted at hospital emergencies room when an acute health related event occurs

Health emergency service: deals with the emergency alarms received at their call centre, and according to the request and the situation identified, resources are allocated to solve the problem

detected as possible users of the new service, assessment on the health and social conditions will be performed by the professionals of the provider in charge of the patient.

3.3.3. Graphical representation of service process

Figure 5 represents the service process at the Spanish pilot after FATE introduction.

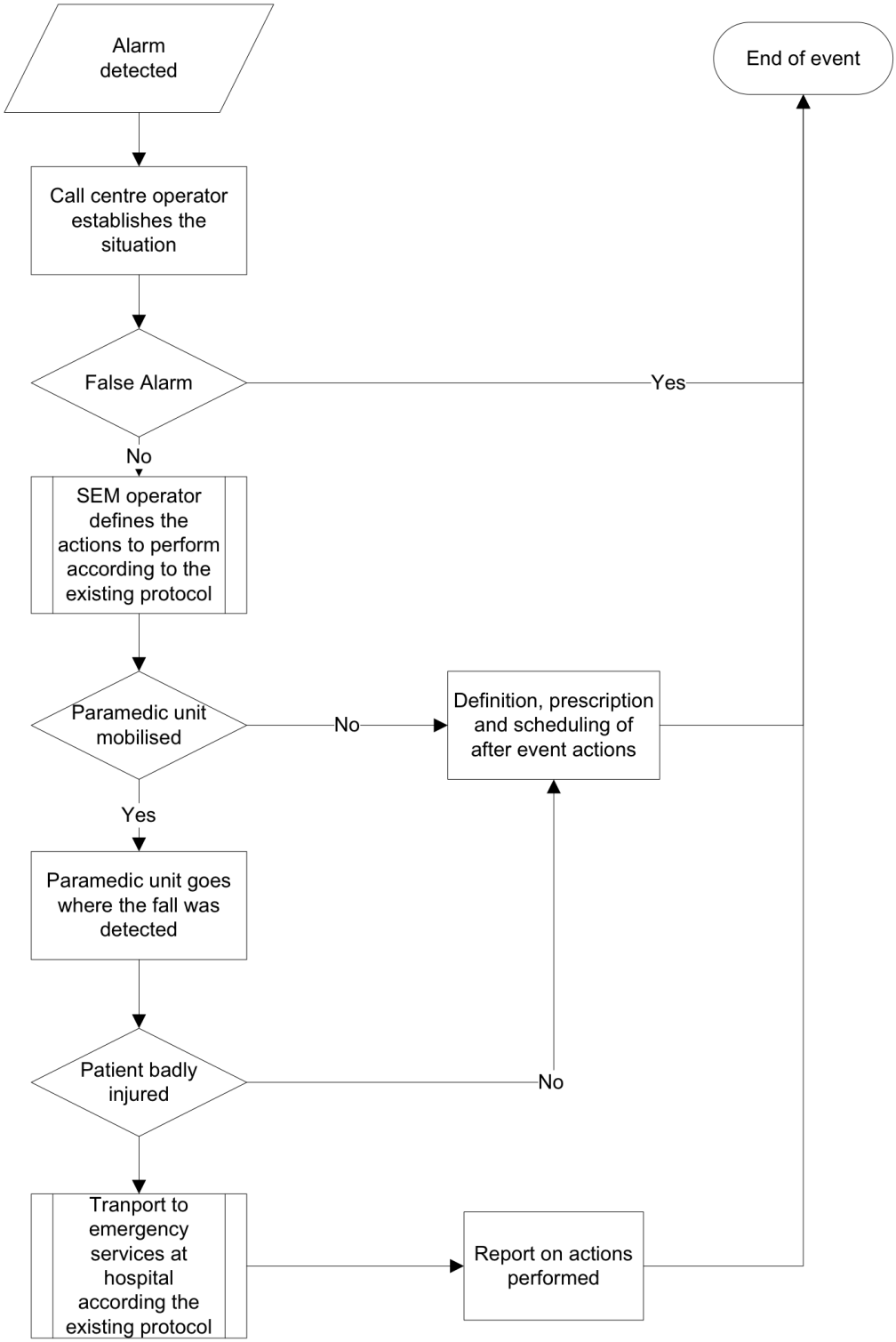


Figure 5. Service process at the Spanish pilot after FATE introduction.

The specific process used by the emergency service is depicted in

Figure 6.

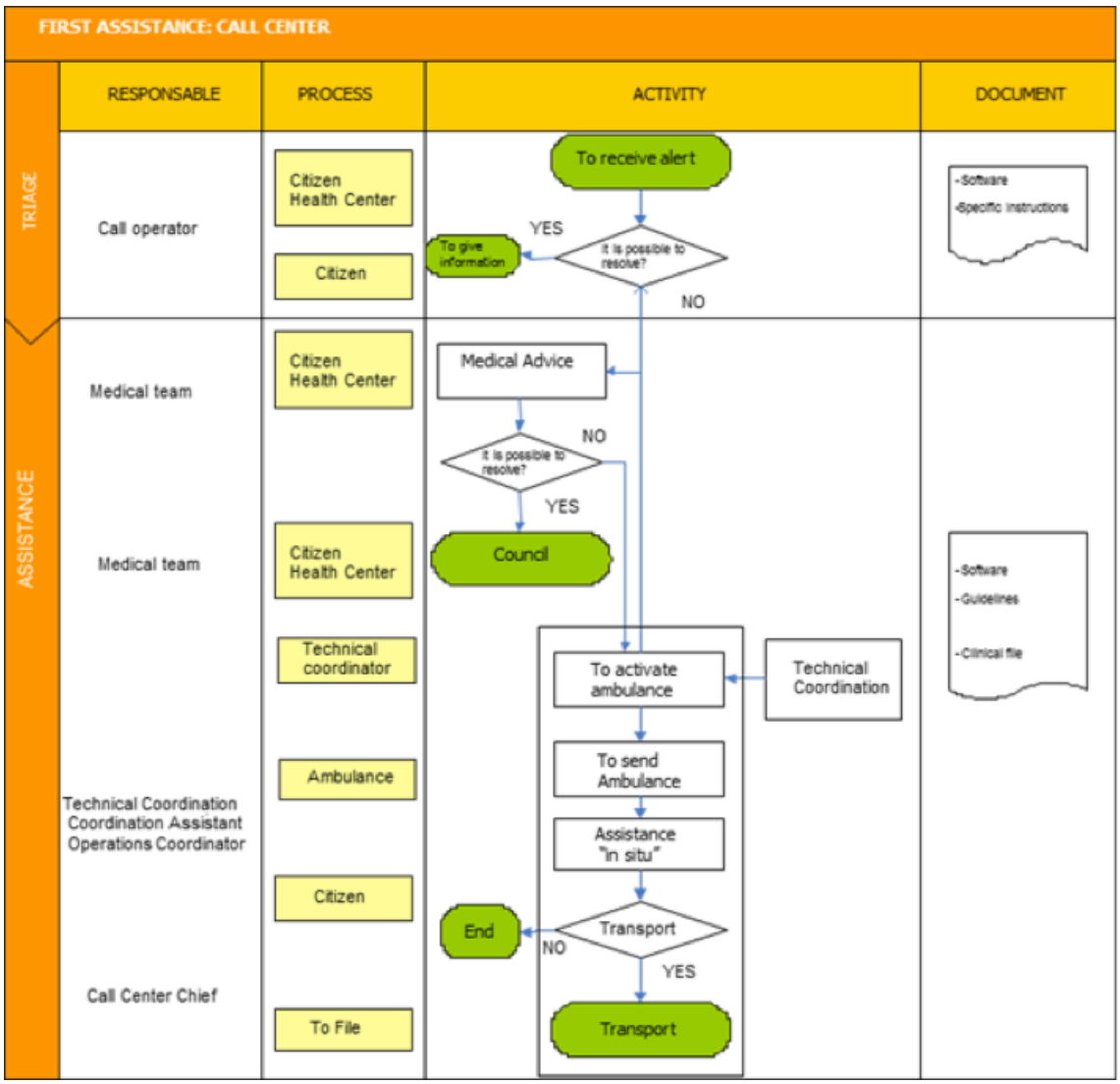


Figure 6. Specific service process for the emergency service.

3.3.4. Additional information

3.3.4.1. Services information

The new system will detect more quickly patients who have the FATE system, reducing the time currently devoted to patient identification and classification of cause for alert.

3.3.4.2. Roles and actors

HealthCare Providers

They provide the care services according to user's needs and perform the screening and follow up for the new service. The main actors and their associated roles are:

- **Primary health care social service**: from a health care approach citizens can access to specific services prescribed by social workers or clinical professionals
- **General Practitioner**: is in charge of the follow up of elderly people and can detect potential needs the user requires
- **Day Hospital**: is in charge of following up the patients who require some specific health care
- **Hospital**: patients are admitted at hospital emergencies room when an acute health related event occurs.

Health emergency service

Deals with the emergency alarms received at their call centre, and according to the request and the situation identified, resources are allocated to solve the problem. The main actors and their associated roles are:

- **Operational director**: Acts as head of the call centre each day, and is the coordinator with other institutions.
- **Technical coordinator**: Is responsible for supporting units acting in situ and ensuring compliance with operational procedures to activate resources and performs other activations to emergency services (police, fire, etc.).
- **Call operators**: receive the alarms produced by the system in their actual emergency system. According to existing protocols they define the resources to be mobilised according to the situation.
- **Paramedic team**: is responsible for the first aid of emergency situations presented due to an alarm detection.
- **Medical team**: is responsible for the resolution of emergency situations presented due to an alarm detection.

4. FATE Services description

4.1. Services available through the FATE platform

The components that constitute the FATE platform have been chosen in order to provide a common set of features or services. These will be adapted at each pilot site in order to integrate them into the services already provided by the corresponding participants (SEM, COOSS and TER). This section will first introduce the features associated with the FATE platform, and then the individual services provided at each pilot site will be specified. In the case of the Spanish pilots, as foreseen in the FATE objectives, two different kind of services will be available: those provided at user's home and those available at retirement homes (residences) where the user is living.

4.1.1. Fall Detector

The fall detector unit developed at UPC is constituted by the following main components:

- **Triaxial accelerometer:** It is a sensor able to measure continuously the three components of the acceleration appearing in the object to which it is attached.
- **Processing unit:** It is constituted by a microcontroller that samples periodically the three acceleration components provided by the accelerometer. These samples are processed by a software module running in the microcontroller that is in charge of detecting if a fall has occurred.
- **Communication unit:** It is composed by two wireless communication modules (ZigBee and Bluetooth). It is in charge of sending the appropriate alert message upon the detection of a fall.
- **Power management unit:** It is in charge of controlling the charging process of the battery included in the fall detector unit and also provides the appropriate voltage levels to the different components of the system (sensor, communication modules and processing unit).
- **Input/output interface:** The fall detector unit is provided with some LEDs that permit the user to inspect the status of the battery at any time. Additionally, it contains some switches and buttons that permit the user to start/stop its operation and to manually send an alarm message (panic button).

The basic service provided by the fall detector unit will thus consist in sending an alert message once a fall is detected. This alert message will be sent using the ZigBee module in the case a ZigBee network is detected (which means that the user is at home) or alternatively using the Bluetooth module when no ZigBee networks are present (which means that the user is outdoors).

4.1.2. i-Walker

The i-Walker is a robotic rollator developed by UPC, it is based on a standard walker's frame enhanced with the following sensors, actuators and components:

- **6 force sensors:** To detect in both handlebars the 2 force components: Longitudinal (Forward/Pushing), Vertical (Leaning/Resting) and the normal forces of the floor.
- **Dual axis accelerometer.** The accelerometer sensor is attached to the Walker frame and measure continuously the (x,y) components of the acceleration appearing while

using the walker.

- **Odometer.** It consists in and encoder embedded on the wheel that report the travelled distance for each rear wheel. The trajectory can be recovered from these data.
- **Two brushless DC motors** as the only actuators.
- **Processing unit:** Distributed microcontroller architecture samples periodically the forces, acceleration and the travelled distance. A software module running in the microcontroller logs these samples.
- **Communication unit:** It is composed by a Bluetooth and serial communication link modules used as the interface to periodically gather the logged information by an assistant.
- **Power unit:** The i-Walker use standards batteries as the only power supply.
- **Output interface:** The i-Walker is provided with some LEDs in the handlebars that permit the user to inspect the status of the battery at any time.

The i-Walker offers the following services:

- Maintain an almost constant pushing force of the i-Walker, independently of the path as prescribed by medical considerations.
- Record in real time (every 0.1s): forces exerted by the user while using it, the 2D trajectory and travelled distance, the acceleration suffered by the i-Walker while driving it.
- A wireless and wire communication module to transfers the logged data to other devices as a service.
- Moreover a database and software application will be tailored to analysis the information, (how the patient lays onto the walker and how much force exerts on the handlebars while following path, the experimented acceleration by the i-Walker during the walk, etc.).

4.1.3. Bed presence sensor unit

The main goal of the bed presence sensor is to detect if a person is lying on the bed. It is required in order to detect eventual falls at home when the user is not wearing the fault detector unit because it has to be recharged overnight.

The bed presence sensor unit is constituted by a highly sensitive piezoelectric sensor and a hub module. The sensor is in charge of detecting any kind of vibrations appearing on the bed (even those caused by involuntary movements like breathing or heartbeat). The hub module is in charge of converting the presence/absence of vibrations into messages that can be processed later. For instance, if the user is not wearing the fall detector and no vibrations are present on the bed for a given amount of time an alert message can be generated indicating that it is possible that the user has fallen at home.

In summary, the basic service provided by the bed presence sensor unit is to indicate the moment at which a person enters or leaves the bed. This information can then be processed in order to estimate:

- If a fall false positive has been produced due to the person lying in bed while at the same time wearing the fall detector unit.
- If there are potential health problems or behaviour anomalies. This can be determined

after analysing the resting periods.

- If the person has fallen when not wearing the fall detector unit.

4.1.4. FATE infrastructure at home

The FATE infrastructure at home is composed by the following elements:

- Fall detector unit
- Bed presence sensor unit
- Smartphone
- ZigBee wall routers
- A PC with a Bluetooth and a ZigBee USB modules.

The ZigBee wall routers are in charge of creating a ZigBee network that is managed by the PC. When the fall detector unit detects the presence of this network it knows that the alarm message to be generated once a fall is detected has to be sent through this network.

The PC also manages a Bluetooth communication link with the smartphone. This link is used in order to force the smartphone to send an alarm when a fall has been detected at home. In the case the Bluetooth link between the PC and the smartphone can not be established because of low coverage reasons the PC will use the ZigBee network to route the alarm message to the fall detector unit, which will then transfer it to the smartphone by means of a Bluetooth link.

In the case the fall detector units determines that it is out of reach of the ZigBee network (a situation that typically corresponds to the user being outdoors) it will send the eventual alarm messages directly to the smartphone using a Bluetooth link. In this case the alarm sent by the smartphone will contain its current coordinates determined by GSM triangulation, so that the control centre knows the place where an eventual intervention is required.

The bed presence sensor is connected to the PC by means of a USB cable. It will let know the software modules running on the PC when a person enters or leaves the bed. This information, together with that provided by the fall detector unit, may be used to determine if an alarm corresponds to a false positive (in the case the person is lying on the bed while wearing the fall detector unit) or if a person has fallen when not wearing the fall detector unit.

4.1.5. FATE infrastructure at residences

Gema Active Business Solutions provides a real time locating, identifying and monitoring RFID (Radio Frequency Identification) technology-based solution, destined to senior living facilities that allows the protection and supervision of residents. The trials of FATE with 50 users that living in residence in Spain will take place in facilities that use this solution. An integration between locating and identifying solution and fall detection will be needed. In this case, the Tag (wireless input OEM module) and the fall detector will be integrated in one device, as the bed sensor too (bed sensor + Tag).

Some features of the locating and identifying solution:

- Automated wanderers control: When a resident is approaching to an unauthorized access, the programed alerts / actions are generated.
- Panic button “everywhere”: Providing residents a user-friendly device that enables them

to ask for help from anywhere in the facility, just only pressing the Tag button. For FATE trials, when a fall is detected, a transmission from Tag is generated in the same way that if the panic button was pressed.

- Residents real time locating: Immediate locating of residents in the facility for any issue, allowing a complete security and control.

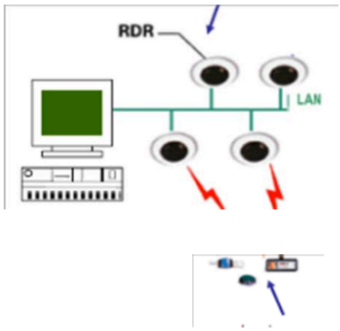
The main benefits of the solution are:

- Improved efficiency and effectiveness of elders' assistance.
- Greater residents protection.
- Optimization of service levels.

The FATE infraestructure at residences, as depicted in Figure 7, is composed by the following elements:

- Eiris Server
- Local area network
- Readers RF, LF and IR
- Tags + Fall detector units integrated in one device
- Tags + Bed sensor units integrated in one device
- EDP (ElPas Display Pannel)
- Infraesterucutre accessories (Junction Box, power supply, etc..)

The bed presence sensor is connected to a Tag. From this point we will know when a person enters or leaves the bed. In case that, under the conditions configured, an alert must to be generated, will be done by means the Tag transmission and will be sent to the staff member's DECT phones, to EDP (Display panels) and to PC.



1 *Tags with triple technology (RF, IR and LF) communicating with antennas. In this case the Tag and the fall detector will be integrated in one device as the bed sensor too.*

3. *When a fall is detected, an alarm is generated and the server provides real time information about the location and identification of resident fallen, sending this alarm and information to the staff member's DECT phones, to EDP (Display panels) and to PC.*

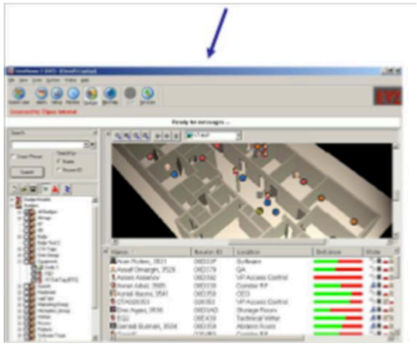


Figure 7. Overview of the FATE system at residences.

4.2. Description of services provided at the pilot sites

4.2.1. Spain

4.2.1.1. Home services

SEM Emergency Medical System is the largest provider of emergency care in Catalunya, including all kind of emergency situations anywhere. We currently receive 1.600.000 calls to the monitoring centre annually. These calls range in type from reassurance to emergency situations.

Some telecare public services and several private companies offer telecare services, usually based on manually operated alarms. But if an emergency occurs, they dial the emergency response at SEM, generating quite long triage and response time.

With the FATE service we can offer customers and their family peace of mind that, if the customer has a fall when home alone or outside the home, the monitoring centre will be notified automatically and will take appropriate action immediately. The real benefit of the new service is that for the first time in Catalunya citizens will have the ability to lead a normal life outside of their home and yet have the reassurance of knowing that in the event of a fall, assistance will be

provided to their location automatically. And as the alarm for fall events is directly linked to the emergency response, a reduction of response time in these events is expected.

FATE consists of a number of elements installed at the customers' home to monitor their movements and detect a fall. The combination of a fall detector worn by the client and a bed occupancy sensor records clients' movements and detects any falls.

When a fall event is detected and the customer is indoors in his or her own home the event is notified to the monitoring centre. Monitoring centre operators will then attempt to make contact with the customer to check if they need help. If contact cannot be established, or the customer confirms he/she has fallen and need help, the operators will activate an ambulance for patient assessment in situ.

4.2.1.2. Residence services

Gema Active Business Solutions is the leader providing Real Time Solutions Systems in senior living facilities in Spain with more than 40 facilities running with its solution Gema LOC+ Residences. This real time locating and identifying solution allows a better protection and supervision of residents by means the improving and optimization of the job procedures in the facility.

In the case of FATE project, we integrate the location and identification with the fall detection and bed presence and we will leverage this integration in order to provide a wider range of features.

The FATE services that can be offered in residences include the following ones:

Fall detection in real time

As depicted in Figure 8, when a fall is detected in any place of the residence, a transmission from Tag is generated in real time and transmitted to the facility staff members (DECT phones, Display panels and PC), indicating the person fallen and its location. The same process will happen when, under the conditions configured, an alert must to be generated when an elder leaves the bed, since the bed presence sensor is integrated too with the locating and identifying solution.

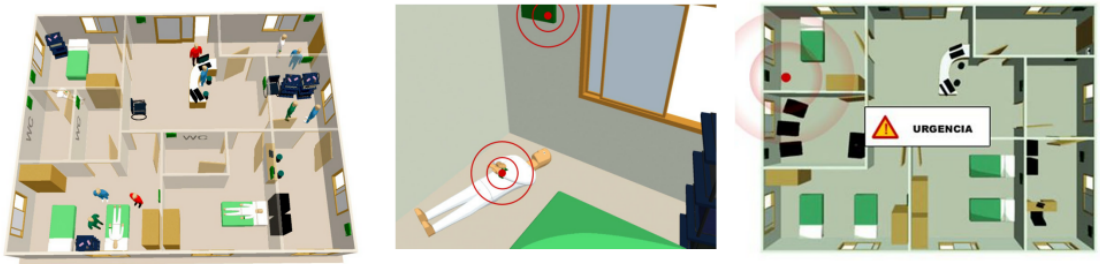


Figure 8. Fall detection service.

Automated wanderers control

As illustrated in Figure 9, when a resident is approaching to an unauthorized access, the programed alerts / actions are generated (audible, SMS, DECT phones, etc.) and, if required, the door will be locked.

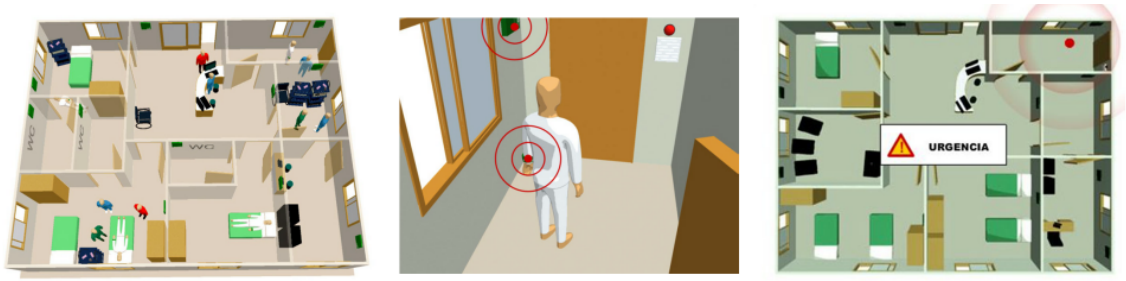


Figure 9. Automated wanderers control service.

Panic button "everywhere"

Providing residents a user-friendly device that enables them to ask for help from anywhere in the facility, just only by pressing the Tag button, improving responses time in critical situations.

Nurse Call System

Since the FATE solution is integrated with PBX (telephony system), the resident is able to ask for help from room by pressing the Tag button. Automatically, a call between the nurse control and the room will be generated and the channel voice of the phone will be opened to establish oral communication. The same process will happen when, under the conditions configured, an alert must to be generated when an elder leaves the bed, since the bed presence sensor is integrated too with the locating and identifying solution and, therefore, with PBX. This service is illustrated in Figure 10.

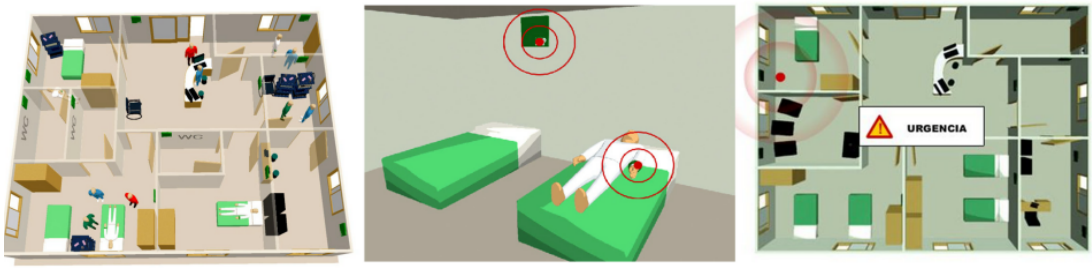


Figure 10. Nurse call service.

Residents and employees real time locating

As represented in Figure 11, immediate locating of residents and employees in the facility for specific job or treatment, allowing a complete security and control and the automation of job procedures.

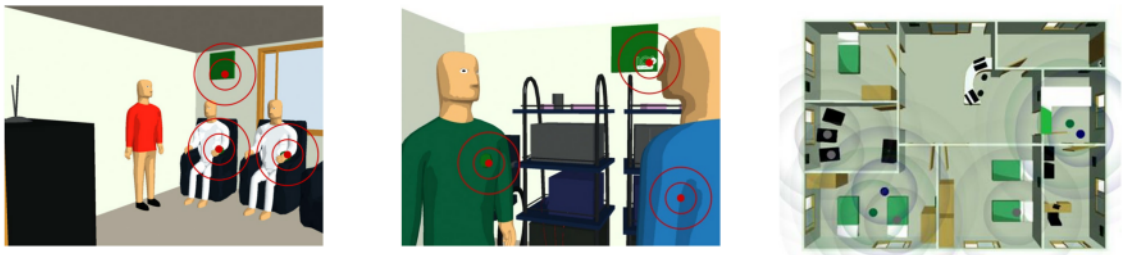


Figure 11. Real time locating service.

Report generation and integration with CCTV

It permits to configure custom reports, allowing to the facility managers to dispose of information in real time about service levels, incidents, time of response, etc.

As depicted in Figure 12 FATE solution will be integrated with CCTV, allowing see in real time the image of the camera associated to the place where the alarm (fall detection, ask for help, etc.…) occurs.

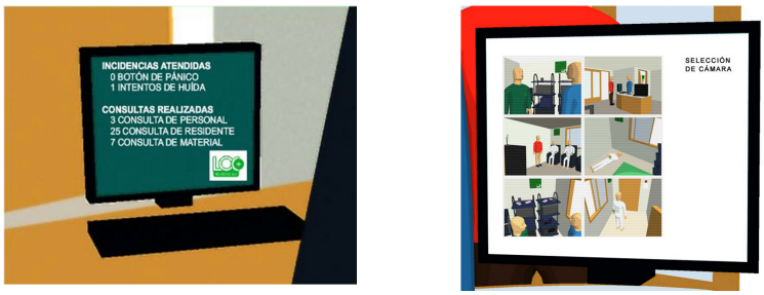


Figure 12. Report generation service.

4.2.2. Ireland

Tunstall Emergency Response is the largest provider of telecare services in Ireland. We currently have 35,000 customers nationally and receive in excess of 350,000 calls to the monitoring centre annually. These calls range in type from reassurance to emergency situations and are driven by carious elements of telecare packages installed in people's homes. Predominantly and historically this takes the form of a basic pendant alarm but increasingly more peripheral sensors are being deployed (i.e. fall detectors, epilepsy sensors, dementia specific sensors) This innovative range of non-intrusive telecare sensors offer a comprehensive way of managing the risks to a person's health and home environments, 24 hours per day, 7 days per week.

With the FATE service we can offer customers and their family peace of mind that, if the customer has a fall when home alone or outside the home, the monitoring centre will be notified automatically and will take appropriate action immediately. The real benefit of the new service is that for the first time in Ireland clients will have the ability to lead a normal life outside of their home and yet have the reassurance of knowing that in the event of a fall assistance will be summoned to their location automatically.

FATE consists of a number of elements installed at the customers' home to monitor their movements and detect a fall. The combination of a fall detector worn by the client and a bed

occupancy sensor records clients' movements and detects any falls. The data collected can be passed on to medical personnel to build a care plan for the customer. The HSE (Irish Health Service) manage falls and blackouts through a network of "falls clinics" and the data provided by a service as detailed in the FATE project will prove invaluable to them. It is estimated that there are approximately 30,000 – 35,000 referrals to these clinics on an annual basis and often with no supporting data.

When a fall event is detected and the customer is indoors in his or her own home the event is notified to the monitoring centre. Monitoring centre operators will then attempt to make contact with the customer to check if they need help. If contact cannot be established, or the customer confirms they have fallen and need help, the operators will put a call through to family and/or carers as appropriate. If no contacts can be reached or the operator considers more urgent help is needed emergency services will be called. Once the situation is satisfactorily resolved, the customer file is updated with the incident details and the operator in the monitoring centre closes the call.

4.2.3. Italy

Coherently with the procedures described in chapter 3.1.2, the FATE service will comply with the following model:

The elder at risk of falling, who needs support and help in case of fall, can consult the Online Information Service, or directly call or go to the Information Desk of the territory, so to clearly understand how FATE works and for what purpose.

The operator of the Information Desk analyses and evaluates the need/request and if he/she deems it appropriate will activate the FATE service. In this case the operator applies the specific procedures for the activation of FATE (to be detailed in Deliverables D1.3 and D2.2). These procedures will detail the activation criteria, the persons to be informed in case of falls - relatives, neighbours, friends, 118 in case of emergency – terms for the involvement of the physician; information and relation with the call centre; etc. These aspects will be gathered in a dedicated protocol.

The process is graphically represented in the Flow Chart "FATE service model in the pilot sites" – Chapter 3.1.3.

An important aspect will be the "client file" which will be elaborated by the call centre; its features (protocol, actions, procedures, feedback, data sharing, etc.) will be described in D2.2.

FATE represents a new and advanced specific service, which could properly respond to the elders' fear of falling and increase their confidence in going out and attending social activities. It can be easily integrated to the already existing services, improving the offer in the area of reference as described in Chapter 3.1.2.

On the carers' and family members' perspective, FATE can improve the peacefulness as they can confide on continuous monitoring and immediate alarm in case of problems.

5. Conclusions

In conclusion, and given the differing service models in operation on the three pilot sites, the FATE project offers a unique opportunity to provide specific context and real data to support the healthcare services. This data can assist in the modelling of care plans unique to the patient, based upon actual events, and, subsequently should improve the standard of care received. The significant advantage the FATE service offers is that, for the first time, an event can be captured outside of the home automatically. This is a huge progression from all current services provided in the three pilot sites and should make a significant improvement in the lives of patients and carers alike. The most striking advantage of the FATE service is the enhancement of independent living and the obvious benefits which accrue from it.

The challenge that the service faces is the unevenness and inconsistent implementation of care services across the pilot sites. The challenge in the longer term will be to convince the relevant authorities of the benefits of the service and the business case behind that. However initial feedback has been extremely positive and that augurs well for implementation throughout and beyond the life of the project.