



# SHAPES

Smart and Healthy Ageing through People Engaging in supporting Systems

## D3.7 – User requirements for the SHAPES Platform

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v_0.3	18/05/2020	Renato Silva, Pedro Rocha, Soraia Teles, Elísio Costa and Constança Paúl (UPORTO)	General remarks with respect to reference sites, and aspects to consider
v_0.5	20/05/2020	Marco Antonio Azhineira Morais Lourenco Manso and Barbara Guerra (EDGE)	General remarks to the structure of the Deliverable; suggesting a link with the VOLERE Methodology
v_0.5	21/05/2020	Exchange with Michael Cooke and Melanie Labor (NUIM) on the general scope; adaptation of the structure	
v_0.6	03/06/2020	Fotis Gonidis(Gnomon)	Integration of interoperability aspects
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v_0.14	12/06/2020	Artur Kurkowski and Eleni Zarogianni (ICOM), Zdeněk Meier (PU)	Integration of results of other WPs and tasks.

## Table of Contributors

Table 2 Deliverable Contributors

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## Table of Acronyms and Abbreviations

Table 3 Acronyms and Abbreviations

Acronym	Full Term
<b>CONOPS</b>	Concept of Operations
<b>EIP on AHA</b>	<i>European Innovation Partnership on Active and Healthy Ageing</i>
<b>OECD</b>	Organisation for Economic Cooperation and Development

<b>URs</b>	User requirements
<b>PRs</b>	Platform requirements

## Keywords

SHAPES Platform, User Needs, Dimensions, Requirements

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## Executive Summary

This Deliverable is the first iteration of the SHAPES Platform User Requirements (URs). It is thereby important to note that – following discussions within the consortium – this Deliverable deals with overall requirements to the platform and its operation in a multi-country setting. Hence, the term *user requirements* (related to the functionalities of the platform) is partly misleading since the related task should also consider more general requirements, relating for example to the country-specific legal and governance context or to ethical requirements. In order to specify these *dimensions of requirements*<sup>1</sup>, the main objective of the Deliverable was to suggest a first set of requirement dimensions and specifications. The methodology on how these were derived and the results are detailed in below.

Overall, the requirements development methodology follows an iterative process comprising four steps which will also span across the 2<sup>nd</sup> and 3<sup>rd</sup> iteration of this Deliverable (finally due in M18):

- 1) Information gathering on the context of users, particularly care givers and receivers
- 2) Identification of user needs as well as contextual requirement dimensions based on literature review
- 3) Envisioning and evaluation of requirements in collaboration with different stakeholder groups
- 4) Requirements specification based on the results of step 3)

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<sup>1</sup> We will from now on speak of integrated care platform requirements instead of user requirements to be less misleading.



# 1 Introduction

This Deliverable encompasses an introduction (Section 1) explaining the rationale and structure of this document. It is followed by the two core chapters on the theoretical background of developing the platform requirements (Section 2) as well as the description of the four steps of the requirements development methodology and the related findings.

Overall, this Word Document is the analytical part of the Deliverable which complements the Excel Sheet (Annex I) encompassing the requirements dimensions and specifications. This Excel Sheet will be a living document to be further refined in the next two iterations of the Deliverable in close collaboration with project partners and platform users. Currently, the content of the Excel file differs markedly between the different types of requirements. For example, ethical requirements are quite abundant and already have a high degree of specificity. Similarly, the sub-category of interoperability is also quite specific and contains a lot of requirements. Other categories are less detailed and need more work in the future. This discrepancy is due to the different progress that has been achieved in relevant associated tasks.

## 1.1 Rationale and purpose of the deliverable

The rationale and purpose of this Deliverable was the provision of a first set of requirements for the SHAPES Integrated Care Platform. It is thereby important to note that – following discussions within the consortium – Task 3.5 deals with overall requirements to the platform and its operation in a multi-country setting. Hence, the term *user requirements* (related to the functionalities of the platform) is too narrow and partly misleading since the related task should also consider more general requirements, relating for example to the country-specific legal and governance context or to ethical requirements. Consequently, we speak of *integrated care platform requirements* in the following.

The **SHAPES Integrated Care Platform** (or in short, SHAPES Platform) is an open, EU-standardised platform based on four factors (home, behaviour, market and governance). The non-technological aspects of SHAPES Integrated Care Platform are especially addressed in WP2 and WP3.<sup>2</sup> The SHAPES platform supports the interoperability of data, procedures and processes associated with the delivery of integrated care in Europe; SHAPES Digital Solutions present a toolbox of innovative, user-centred and personalised integrated care solutions that leverage on a smart living platform, integrating eHealth applications, IoT-based smart sensors, wearables and assistive robotic systems. The Platform will be deployed across Europe.

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<sup>2</sup> The SHAPES platform is not to be confused with the SHAPES Technological Platform (TP) which brings a combination of devices, software, and accessible modes of interacting within the living environment that can adapt to the needs and priorities of older individuals, including those facing permanent or temporary reduced functionality and capabilities. The SHAPES TP is tackled in WP4. The SHAPES Digital Solutions (DS) that are addressed in WP5.

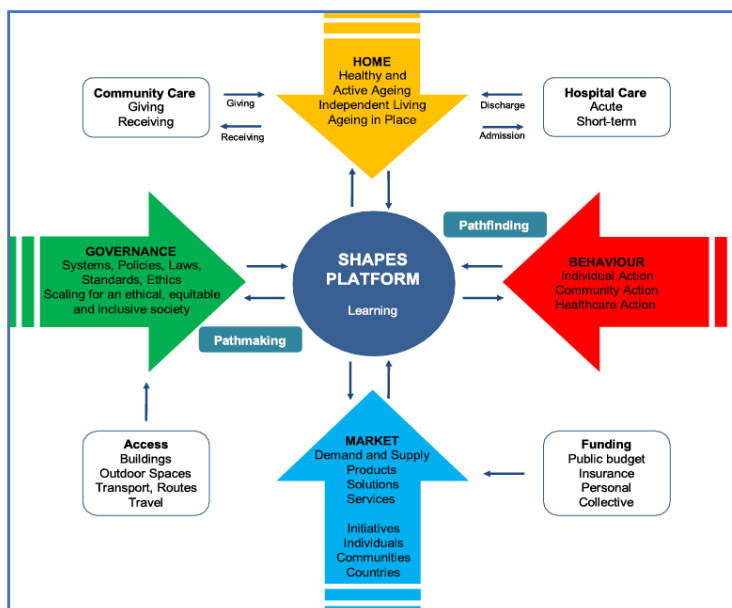


Figure 1: The SHAPES Integrated Care Platform

Source: SHAPES Description of Work, p. 11.

“SHAPES recognises that a technology platform for smart and healthy ageing (SHA) has to work in different ways for different people. Older individuals will be attracted to and use the SHAPES Platform because it makes life easier for them, prevents difficulties, or helps to manage them; be they psychological, social, medical, or otherwise. The Platform use should be seen as a positive proactive initiative by individuals and/or communities, regardless of health status” (SHAPES DoW, p. 11). Overall, the set-up of the platform is determined by the living context (*Home*) of individuals, their *behaviour* as well as contextual aspects of *governance* and *markets* (see figure 1). More precisely, different actors and contexts define different dimensions of platform requirements. This Deliverable details the specification and sub-division of these requirements *dimensions* and their specification in to more specified requirements. The Deliverable is based on literature review, the analysis of projects developing (ehealth) platforms as well as discussions with the SHAPES project partners<sup>3</sup>.

**Key inputs** for this Deliverable were received from WP 2 (Task 2.5 “SHAPES Personas and Use Cases”) and WP 3 (Task 3.1 “Ecological Organisational Models of Health and Care Systems for Ageing”). More particularly, the personas and use cases of Task 2.5 were used as a basis for the development of the functional platform requirements. Task 3.1 provided important input for contextualising the reference sites and the needs of care givers. Additional input was received from Task 8.4 “SHAPES Ethical Framework”, developing ethical requirements for the SHAPES platform as well as from WP4 on interoperability requirements. For the next iterations of this Deliverable, close collaboration will furthermore be sought with WP5 and WP6 for the requirements in the digital solutions as formulated by the use cases as well as with Task 2.1 “Understanding Older People: Lives, Communities and Contexts” and 3.2 “Scaling-up Improved Integrated Care Service Delivery”.

**Key outputs:** D3.7 provides input to WP 4 and WP5. Task 4.1 “SHAPES Technological Platform” as well as Task 5.1 “Platform User Experience Design Guidelines and Evaluation” will be main consumers of the outputs detailed below.

<sup>3</sup> Particularly with the Project and WP3 leaders. Furthermore, the Deliverable was shaped by the SHAPES Online Dialogue Workshop, held on 12<sup>th</sup> May 2020 as well as telephone conference with WP 3, 4 and 5 (19<sup>th</sup> May 2020) and an overall WP3 exchange (26<sup>th</sup> May 2020).



## 1.2 Structure of the document

This Deliverable encompasses the methodology for the identification of requirements dimensions (Section 2) and the specification of requirements dimensions (Section 3). In terms of the methodology, we specify the overall process that is to be completed after the 3<sup>rd</sup> iteration in M18. It encompasses four steps:

- 1) Information gathering on the context of care givers and receivers
- 2) Identification of user needs and contextual requirements based on literature review
- 3) Envisioning and evaluation of requirements in collaboration with different stakeholder groups, based on step 2)
- 4) Requirements specification based on the results of step 3)

This structure reflects the sub-sections in Section 3 “Developing SHAPES Platform Requirements”.

## 2 Theoretical background

### 2.1 Requirements Development (Methodology)

“Understanding user requirements is an integral part of information systems design and is critical to the success of interactive systems. It is [...] widely understood that successful systems and products begin with an understanding of the needs and requirements of the users” (Maguire & Bevon, 2002, p. 133). The development of human-centred design processes for interactive systems is specified in ISO standard 13407:1999 that places the user needs in the centre of the design process. Identifying and describing such needs is thereby not a simple process. However, the process steps are usually the following:



Figure 2: General process for user requirements analysis

Source: (Maguire & Bevon, 2002, p. 134)

The needs of the different user groups of the platform play an integral part in defining the (functional) platform requirements. Hence, this part of the analysis was closely linked with Task 2.5 (Personas and Use Cases) which encompass at the time being care receivers and (partly) informal care givers. Additional stakeholders of the platform such as doctors, formal care givers, etc. remain to be elaborated together with WP2 and Task 3.1.

However, the platform also needs to fulfil requirements relating to the contexts it aims to operate in. For example, it needs to fulfil legal and ethical requirements that may not necessarily be formulated as *needs* by the users. Relating this approach to the overall SHAPES platform conceptualisation (see also section 1.1 of this document), two main dimensions of requirements can be differentiated, *functional* and *non-functional* requirements (figure below). Functional requirements result from user needs which are again determined by their living contexts and their individual behaviour and the overall set-up and behaviour of the communities they live in. This requirement dimension is detailed in Section 3.2.1. The non-functional requirements are determined by aspects of governance and markets and can be further differentiated into legal, ethical, or health system requirements as will be specified in Section 3.2.2.

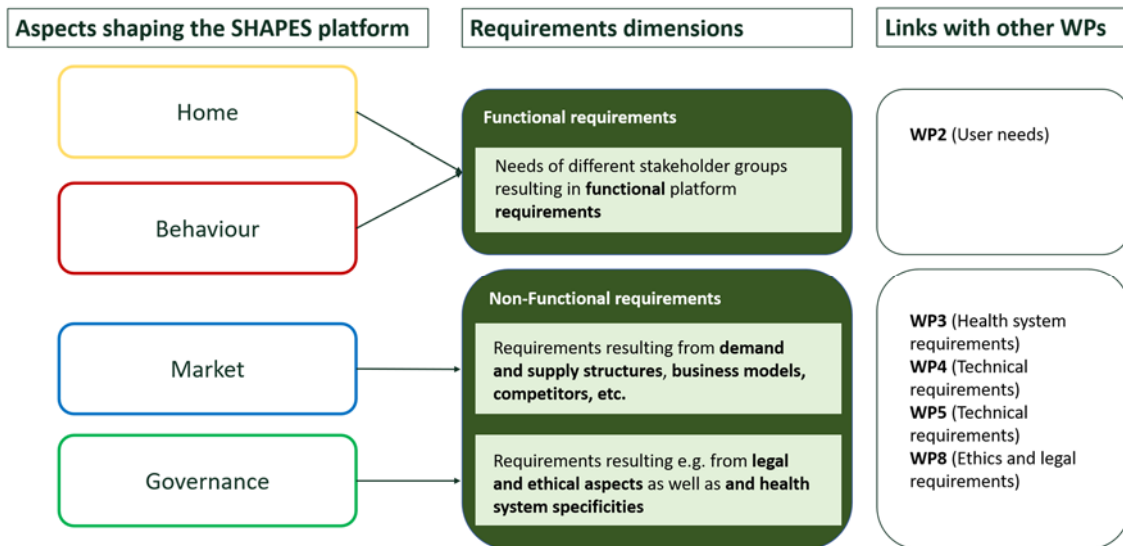


Figure 3: SHAPES platform Requirements Dimensions and their link with the SHAPES platform concept and other WPs  
Source: own figure.

In order to contextualise the platform use, information of potential requirements dimensions was initially gathered through literature review, integration of the personas and use cases of D2.5 “SHAPES Personas and Use Cases V1”. and Task 3.1 “Ecological organisational Models for Health and Care Systems for Ageing” into consideration (*Information gathering phase*).

The *identification of functional and non-functional requirements phase* was initially based on the review of projects similar to SHAPES and more in-depth literature review relating to the potential dimensions identified in step one. The phase was complemented by discussions with project partners including WP2, WP3, WP4 and WP5 representatives and an Excel Sheet (Annex I of this Deliverable) was made available in the project platform for review to partners.

First feedback stemming e.g. from WP8 (ethical requirements) and WP4 (interoperability requirements) are already included in this Deliverable. The aim of this document is to reach agreement on the requirements dimensions and a first set of specifications. In the phases to come (*Envisioning and evaluation and requirements specifications*), a set of requirements will be discussed with different stakeholder groups (Link with WP2) and be reviewed by the reference sites (WP6). Overall, the working steps for Task 3.5 and the interaction within the project and with users for further specifying the platform requirements can be visualised as detailed in the figure to the right.

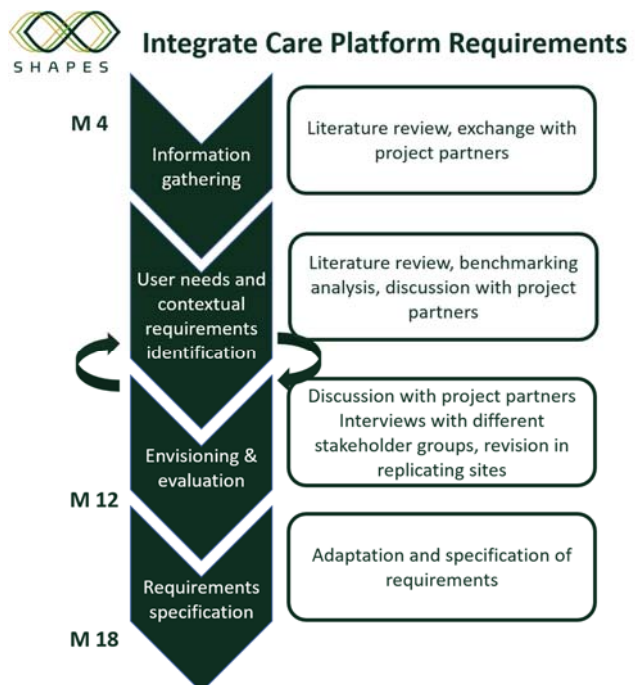


Figure 4: Overview of Task 3.5 Workflow.

Source: own figure.

## 2.2 Requirements coding

In order to be able to use and track the final platform requirements, they will each have a specific identification code. This code is made up of four sequences: <category>-<sub-category>-<number>-<user identification>.

Each category of requirements has a specific code, as follows:

- Functional requirements: FR

Non-functional requirements:

- Security: S
- Legal and Ethical: LE
- Health System: HS
- Business: B
- Technical requirements: TR

Similarly, each sub-category in every main category also has a unique code. For example, for the Legal and Ethical requirements there are the following sub-categories:

- General Ethics: GE
- Ethics for Platform: ET
- Ethics for Processes and Support: PE
- Ethics for Governance, Business and Ecosystem Models: ME

The third sequence element is a number, which starts at one for each sub-category.

Finally, the actor to which the requirement applies is given by the final element. The coding is as follows:

- Care Receiver: CR
- Care Giver (formal): CGF
- Care Giver (informal): CGI
- Doctors D
- Health administration / insurance: HAI
- Technology / Solution Provider: TP

A final requirement could for example look like this: FR-HS-1-CR (Functional Requirement; Health Services; First requirement; related to Care Receiver).

## 3 Developing SHAPES Platform Requirements

### 3.1 Information gathering

In this process, it needs to be considered that the potential of eHealth technology can only be fully exploited when a human-centred approach that considers the specifics of the context (both organizational and that of the individual user) in which the technology is to be used. In alignment with the above presented process it is hence suggested to gather “information on the context of use, the designated end users and the professionals that need to implement the eHealth intervention” (van Velsen et al., 2013, 2).

Information gathering on the SHAPES platform context related to two main aspects:

- Extraction of information from Personas and uses cases on care receivers and (partly) informal care givers (see below)
- Development of profiles of the reference sites extracting information from Task 3.1

Information gathering usually encompasses the *differentiation of user groups*. While the differentiation of user groups and their platform requirements will be (further) differentiated in the 2<sup>nd</sup> and 3<sup>rd</sup> cycle, for the development of the initial set of requirements dimensions, the focus was on the care receivers (in line with Task 2.5). The personas included context information on the user groups such as age, gender, physical and cognitive capabilities and motivation as well as the environment they live in, their health status, and partly the related requirements of informal care givers.

## 3.2 Functional requirements and non-functional requirements

In order to extract a first set of requirements, we built on two main aspects: user needs (functional requirements) as identified by the SHAPES project, as well as additional non-functional requirements. The functional requirements of the SHAPES platform are closely linked with the personas and use cases (Task 2.5) as well as the analysis of the health care ecosystems by Task 3.1. They are described in Section 3.2.1 and 3.2.2 respectively. Any requirements that were extracted from these personas and use cases have been put into the accompanying D3.7 excel file. In addition, non-functional requirements have been identified by the review of comparable projects and literature review (Section 3.3 below). These have also been added to the D3.7 excel file.

### 3.2.1 SHAPES User Needs

User needs can be identified by a number of different methods. They can encompass user surveys including a set of written questions that the users need to complete, as well as interviews, focus groups, but also scenarios, use cases, and personas (Maguire & Bevon, 2002, 137 f). Respective methods have been implemented by other tasks within SHAPES. For example, Task 2.5 developed personas (for the more detailed methodology see the respective Deliverable). Within Task 3.1 interviews have been and are being conducted with representatives of the SHAPES replicating sites. Hence, no own primary data was collected by this Deliverable but user needs were extracted based on the work conducted by Task 2.5 and Task 3.1. In this iteration of the Deliverable, we focus on two main user groups: care givers and care receivers.

#### 3.2.1.1 Care receivers – Link with personas and summary of needs

Task 2.5 “SHAPES Personas and Use Cases” developed a set of nine evidence-based personas and 13 use cases that mirror the basic types of users adapted to the requirements of SHAPES’s target groups. The details of the personas are described in Deliverable 2.5. In order to link with the user requirements, a short summary including the extraction of particular needs is given below:

##### 3.2.1.1.1 Active, healthy older adults

This group of actors encompasses adults of 65 – 75 years of age, characterized by generally good health and an active approach to life. These older adults are usually retired but some members of this group are still working or are semi-retired, they often like to travel, have rich hobbies and a satisfying social life. Important is also an active participation in the life of the community through various volunteer work. They enjoy physical activity and may support this for example by the use of smart watches.

*Resulting needs:*

- Identify deteriorating conditions;
- Monitoring overall levels of activity;
- Easy communication with family & friends;
- Keep healthy with sports activities & good dietary balance.

#### 3.2.1.1.2 Older adults with mild, but multiple chronic conditions

This persona category describes a significant portion of older adults that have multimorbid chronic conditions, typically diabetes, hypertension, chronic respiratory disease, oncological condition in remission, etc. As aging is related to chronic deterioration of multiple organ systems, multimorbidity is now recognized as the single most common chronic condition in a group of older adults. One of the main problematic areas in this group of older adults is the need to undergo behavioural change, which is often stressed out by medical personnel. This may include a change of diet, reduction of alcohol intake or to stop smoking.

Self-management of behavioural change may help to enhance the overall health, better control of symptoms, avoid unnecessary re-hospitalization, enhance quality of life, and decrease overall mortality. A problem that this group faces, is the complexity of the health care systems and the scattered information that several specialists are unable to match to a patient history.

#### *Resulting needs:*

- Increase awareness of own health conditions and its evolution; increase awareness of health conditions of his/her companion;
- Peer mentoring, peer learning, to increase internal motivation to adhere to the doctor's life style recommendations and to increase health literacy in some engaging way;
- Better working health care system – to ensure that all doctors have access to the same information;
- Support health literacy, support control of dietary limitations;
- Be able to find reliable source of online information, that is accessible (based on real people's stories) but somehow supervised by doctors.

#### 3.2.1.1.3 Older adults with chronic musculoskeletal disorders

Mobility difficulties, typically arthrosis and vertebrogenic syndrome (back pain), are some of the most common problems of older adults. These conditions may negatively affect the ability to move around the home as well as outside, maintain independence, keep their hobbies and often may lead to increased social isolation. Frequently, this group suffers from (the fear of) falls. This may result in limited movement, decreased muscle strength, higher risk of disability and threat of social isolation. This group of adults may need support for daily routines such as dressing, taking a shower, cooking or shopping. They may also be challenged by certain characteristics of their living environment such as stairs or narrow doorways. To overcome these challenges, they make use of grab bars or special railings, using shower chairs, or similar.

#### *Resulting needs:*

- Strengthen self-efficacy and support resilience by assisting technology that enable better movement, better coping of domestic tasks (cooking etc), and personal hygiene;

- Peer online groups;
- Online physiotherapy application;
- Easier pain management (does not have to visit personally to get new prescription);
- Monitoring in case of falls;
- Sharing the experience of living with this condition helps coping;
- Support of active involvement in decision making regarding pain management – to have all the possible help listed somewhere online and to be able to read, share and try/ choose, also alternative methods, not just painkillers.

#### 3.2.1.1.4 Older adults with neurodegenerative diseases

The next persona is dedicated to another of the most common health conditions in older population – Alzheimer’s disease, specifically its early to middle stage, while still staying in home care, which is also associated with the issue of informal caregiving.

Due to the associated cognitive decline older adults in this population may often experience embarrassing situations which may result in feelings of shame and a sense of withdrawal. As a result of the fear of stigmatization these older adults may limit their social activity and thus experience loneliness and isolation. Even as the memory gradually deteriorates, for people with Alzheimer’s it is important to keep a sense of who they are. This can be achieved through the sharing of narratives.

This group is closely related with informal caregiving at home.

##### *Resulting needs:*

- Cognitive training;
- Monitoring of all sorts of possibly dangerous situations in the house (fire, gas, electricity);
- Monitoring the progression of illness – important for relatives if ethically OK, support of staying in home care;
- Support of personal hygiene;
- Some kind of device that carries all the important information – what day it is, names of children, grandchildren – like personal notes, that is easily found (reacts to voice);
- Increase personal safety and some technical support to be able to get of the house more (GPS tracker);
- In-home activities customized to the individual’s interests and capabilities;
- Needs in the area of legal issues and advance care planning - healthcare power of attorney and documenting wishes for end-of-life care.

##### *Additional needs of caregivers*

- Be able to have up to date information on the development of the illness;
- Access the monitoring from outside the house (cameras) - this must be ethically acceptable to the patient;
- Social support groups, information, education, nutrition help;
- Emotional support;
- Respite care;
- Some technology that would help to keep the individuals busy and focused.

#### 3.2.1.1.5 Lonely and/or socially isolated older adults

This persona highlights the health and well-being implications of loneliness relating to dissatisfaction with the amount and/or quality of social relations. More specifically the social loneliness that is presented in this persona is a state of dissatisfaction with the extent of a social group of contacts, or

engaging interactions, absence of a group of friends or colleagues. It is often related to dislocation when moving to a new context, but also the quality of neighbourhood relations or perceived safety and vulnerability to crime. At the same time, environment characteristics such as attractiveness of buildings or accessibility of parks are positively related with a reduced perceived loneliness.

*Resulting needs:*

- Support of active spending of time, to join some network of people with the same interests;
- Reduce fear of strange / new environment, enable the individual to go out on her own;
- Assistive technologies for sensory impairments that maintain dignity;
- Technology that enables improvement of social contact and communication (but if it encompasses relatives, it has to be some seamless effort);
- Support life review process and healthy reminiscence.

#### 3.2.1.1.6 Older adults with alcohol or drug dependency and severe chronic conditions non-complying to medical recommendations

The issue of alcohol and drug dependency is even more pronounced when there are associated multiple chronic illnesses (such as diabetes, heart conditions, COPD). Nevertheless, the respective group does frequently not respond to doctor's recommendations or even visit him/her on a regular basis. Many acute health crises are solved by calling emergency or visiting an emergency room. Emergency services thus may be often their only point of contact with the health care system.

Solutions to help them enhancing their health situation and reduce the number of emergency room visits would result in considerable improvement of their quality of life as well as significant cost savings. Aspects to consider are limited motivation to any change of lifestyle, resentment to be told how to live and the insistence on keeping their autonomy.

*Resulting need:*

- Wants the system to let him live his life but at the same time to monitor his health to decrease emergency visits.

#### 3.2.1.1.7 Oldest old and frail

The persona is dedicated to the oldest old, which is usually defined as the age category over 85 years of age. They frequently suffer from frail as an age-related decline, related for example with exhaustion, unexplained weight loss, acute confusion. Frailty may be alternated by periods of normal functioning. Frailty increases dependency on others and it is associated with the need of relocation to institutionalized settings.

The vast majority of older people strongly prefer to age in their own home for as long as possible. Sometimes the decision to move is postponed until some major incident or health crisis that may be related to frailty. The decision process connected to moving can be very complex and demanding. One of the most difficult elements of moving is the attachment of older adults to their possessions such as favourite furniture, photographs, and other cherished artefacts. Very often there is a need for some down-sizing of the belongings.

*Resulting needs:*

- Monitoring of all vital functions, cognitive functions;
- Monitoring of risk situations around the house (electricity, fire, falls);
- Support of healthy nutrition;
- Support and monitoring of drinking regime (often risk of dehydration and malnutrition);

- Support of social contact, support of caregivers (monitoring / cameras);
- Even among frail people over 90 mild exercise can have beneficial effects both physically and mentally: support of rehabilitation and mild exercise;
- Encourage continued participation in social, neighbourhood and civic activities.

#### 3.2.1.1.8 Deafblind older adults (older adults with dual sensory impairment)

The following persona represents people with a concomitant sight and hearing impairment. The degree of it varies but it always results in a severe and unique disability. This has a significant effect on communication, socialisation, mobility and thus their independence. There are people with congenital deafblindness – who were born or became deafblind before spoken, signed or other visual forms of communication have developed. Another type is acquired deafblindness where vision and hearing deteriorate at a later stage of life due to an accident, injury, disease or the aging process.

##### *Resulting needs:*

- Need assistive devices to support communication;
- Education tools and material that is suited to their specific needs.

#### 3.2.1.1.9 Additional functional potential requirements stemming from literature research

In order to be as encompassing as possible, the research for this Deliverable also encompassed a review of functional requirements as identified by comparable research which is detailed below. For example, Willard et al. (2018) identified the following services for an ehealth platform:

##### **General services:**

- Easy to use communication services
- News and entertainment, e.g.
  - o Newspaper/Book (Read Aloud);
  - o Calendar with Audio and Reminders;
  - o Games to Play Individually.
- Community
  - o Service to arrange;
  - o Information about Local Events and Activities;
  - o Community Resources listed on an Interactive Map.
- Help with everyday tasks
  - o Food shopping support.

##### **Health services:**

- Calendar
  - o Medication Reminder;
  - o Appointment Reminder;
  - o Possibility to ask Questions Online for a Consultation;
  - o Results of the Consultation.
- Advice
  - o Lifestyle Advice/Counselling;
  - o Online Contact with Paramedics;
  - o Chatbot & virtual nurse;
  - o Medication Counselling Online;
  - o Telemedicine; remote monitoring of psychical parameters;
  - o Risk assessment /predictive models (e.g. stroke, decompensation);
  - o 24/7 eHealth call centre.



- Emergency system / alerts
  - o Emergencies in the house (e.g. fire, open window);
  - o Medical emergencies (e.g. falling, stroke).

The final functional requirements will have to be determined by project partners and the care receivers within the next iteration of the Deliverable.

### 3.2.1.2 Care givers/ Health system context

The contexts of the professional and informal care givers, more precisely the “Ecological Organisational Models of the Health and Care Systems for Ageing” have been and are currently analysed in detail by Task 3.1, taking the below detailed dimensions into account.

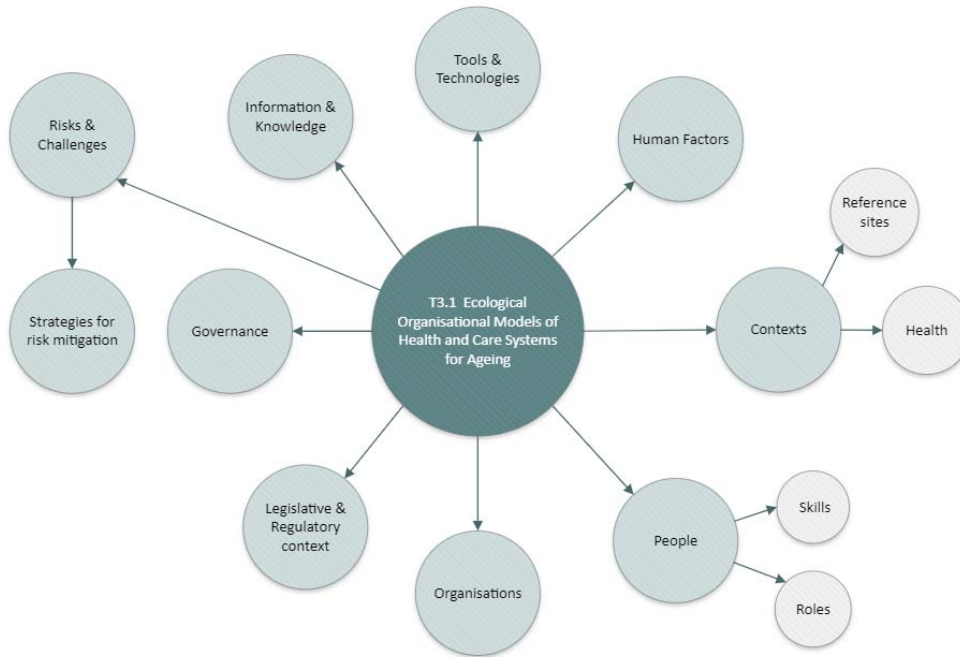


Figure 5: Main categories for the analysis of care delivery contexts as developed by Task 3.1

To link the analysis of Task 3.1 with the SHAPES platforms requirements, questions for caregivers were developed by Task 3.5 and integrated into a survey of Task 3.1. The questions pertained to the experience of care givers dealing with technology in their daily work. Some are focused on the advantages, disadvantages and general aspects of technologies that are already in use. Others addressed specific needs when introducing new technologies, e.g. required training for staff or better internet connectivity, and tried to elucidate what concerns and obstacles exist, including technical as well as possible organizational issues.

Questions also focused on the individual and organizational needs of caregivers when trying to introduce a new technology. The questionnaire can be found below:

1. What digital technologies are you currently using as a care provider?
  - a. Briefly describe the most important ones (maximum of 3).
  - b. When did you introduce them?
  - c. What are the advantages of using these technologies?
  - d. What are the disadvantages of using these technologies?
  - e. While using these technologies, what are/were the major concerns and obstacles (i.e. personal skills, organizational problems, technical issues/limitations)?

2. If more digital solutions were to be introduced in your unit, what additional elements would you require (e.g. training for workers, more computers, high-speed internet access)?
3. Is there a way of linking any of these technologies?
4. With regard to the user experience of the platform, what information do you need to have in order to be able to use it?
5. Will the platform be used by every individual care giver?
6. How many users do you think will need to have access to the platform?
7. Will you have a single user of the platform (e.g. someone in management)?

The questions contributing to the questionnaire were developed in several steps. First, literature research was conducted in order to identify important aspects of potential requirements and a first set of questions was developed. After a more detailed literature research, the above questions were finalised for integration into the 3.1 survey.



*Figure 6: Process for developing questions for integration into Task 3.1 survey.*

Source: own figure.

Overall, the review and analysis of Task 3.1 with the Deliverable on the SHAPES Ecological Organisation Models will give an encompassing overview on the characteristic of the respective systems and the resulting requirements for the SHAPES platform. However, since the Deliverable will only be completed in M12 (October 2020), a preliminary overview also reflecting the diversity of the pilot and replicating sites and their needs, is detailed below.

This section is a description of three selected pilot sites which are participating in the SHAPES project. In Task 3.1 (Ecological Organisational Models of Health and Care Systems for Ageing), we are exploring models of healthcare provision in participating EU Member States and the UK (Northern Ireland). The diverse political landscape in Europe presents a challenge as healthcare provision differs not just between countries but also within. European political systems can be placed on a continuum of self-governance, and countries can be categorised as unitary, federal, and devolved states (Dardanelli, 2019; ISMERI Europa & Applica, 2010).

Each political system also affects the way healthcare is managed. For example, Portugal is a predominantly unitary state which involves a centralised approach to healthcare provision. By contrast, the Federal Republic of Germany is characterised by strong regional governments and takes a much more decentralised approach to healthcare provision. A third example is Spain which can be categorised as a devolved state which retains a centralised government but delegates the management of healthcare to its so-called autonomous communities (Dardanelli, 2019; ISMERI Europa & Applica, 2010; OECD & European Observatory on Health Systems and Policies, 2019a, 2019c, 2019b).

The diversity within European political systems made it challenging to develop a Concept of Operations (CONOPS) which accurately describes the various organisational structures, systems and

processes of healthcare services in Europe<sup>4</sup>. Therefore, we decided to provide a snapshot of selected European healthcare models. Data was gathered through a range of online interviews with representatives of the SHAPES pilot sites as well as desk-based research.

In the following sections we present three pilot sites located in Germany Portugal and Spain to provide a brief summary description of each pilot site and the respective country's healthcare system, challenges to healthcare provision and necessary or desired changes identified by interview partners. Two of these pilot sites (*Saxony* and *Porto4Ageing*) are also part of the *European Innovation Partnership on Active and Healthy Ageing* (EIP on AHA), a partnership that promotes active and healthy ageing. EIP on AHA is comprised of 102 partners which include "regions, cities, integrated hospitals or care organisations and their quadruple helix partners from industry, civil society, academia and government authorities" (European Commission, 2020).

Overall, Deliverable 3.1 and the second iteration of the Platform Requirements will be completed jointly in M12. Task 3.1 will hence play an important role in specifying the platform requirements (completion of the Excel Sheet in Annex I), based on the insights derived through interviews and surveys.

#### 3.2.1.2.1 Saxon State Ministry of Social Affairs and Consumer Protection (Germany)

The *Saxon State Ministry of Social Affairs and Consumer Protection (Saxony)*, is one of the sixteen *Bundesländer* (federal states) of the Federal Republic of Germany. Saxony is also one of the regional EIP on AHA reference sites which covers an area of approximately 18,400 square kilometres (Statistical Office of the European Union, 2020a) and shares borders with Poland and Czechia. In 2019, Saxony's population was 4.1 million and with 221.5 persons/km<sup>2</sup>, Saxony is more densely populated than the EU average (118 persons/km<sup>2</sup>). Yet, just over one third (34%) of the population lives in one of its three major cities: Chemnitz (n=247,237), Dresden (n=554,649) and Leipzig (n=587,857). By contrast, the remaining two thirds are spread across Saxony's ten *Landkreise* (regional districts) (Statistical Office of the European Union, 2020a).

The Saxon population is comparatively old. Although the German population overall has been getting older – 21.5 percent fall within the 65 years or older age band – this trend is even more pronounced in Saxony: 26.1 percent are 65 years old or older, with an average age of 48.8 years (Statistical Office of the European Union, 2020c). In 2018, the average life expectancy for men and women in Germany at age 65 was 19.6 years, out of which 11.9 were healthy life years (Statistical Office of the European Union, 2018b, 2018a).

### **Brief summary of the German healthcare system**

#### *Organisation and governance*

Self-governance and solidarity are guiding principles of healthcare provision in Germany. In practice, this means that powers of governance are divided between the Federal Ministry of Health, the *Länder* (States), and the sickness funds/private insurance providers. Policies and administrative guidelines are drafted at the federal level and falls under the remit of the Federal Ministry of Health. Hospital planning and funding of hospital investments take place at state level (OECD & European Observatory on Health Systems and Policies, 2019a). The *Gemeinsame Bundesausschuss* (G-BA, Federal Joint Committee) unites the following four leading self-governing organisations: the National Associations

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<sup>4</sup> The CONOPS referred to in the present deliverable (D3.7) will be described in the forthcoming deliverable **D3.1: SHAPES Ecological Organisation Models** due for submission in November 2020.

of Statutory Health Insurance Physicians and Dentists, the German Hospital Federation, and the Central Federal Association of Health Insurance Funds as well as patient representatives. The Committee's responsibilities include the issuing of legally-binding "directives for providers, payers, patients and manufacturers" (OECD & European Observatory on Health Systems and Policies, 2019a, p. 9), decisions about the benefits that are paid for by the statutory sickness funds, quality management and assurance, and lastly, the "funding projects on new forms of healthcare delivery and healthcare research" (Gemeinsamer Bundesausschuss, n.d.).

### *Accessibility and financing*

The German healthcare system rests on three pillars: inpatient medical care, outpatient medical care and the public health service. While both inpatient and outpatient healthcare focusses on therapy, the public health service focusses on prevention. Both inpatient and outpatient coverage and use is high. Germany has the highest density of beds in the EU (OECD & European Observatory on Health Systems and Policies, 2019a), and Saxony has 77 hospitals and approximately 25,000 beds (Sächsisches Staatsministerium für Soziales und Gesellschaftlichen Zusammenhalt, n.d.). Germany does not have a gatekeeping system which means that patients can see a general practitioner (GP) or consultant specialist without referral, which also means that patients can book several appointments at once.

Healthcare provision in Germany and hence, Saxony, is based on a mixed public/private model which provides almost universal healthcare coverage. Health insurance is mandatory and may be obtained from either statutory *Krankenkassen* (sickness funds) or private health insurance providers. Most people in Germany are insured through public sickness funds and contribution levels are calculated based on an employee's gross income. Generally, employee contributions will be 14.6 percent of their gross income, plus an individual contribution which is set by each individual sickness fund. The total contribution is shared in equal parts by employee and employer. People who are unemployed are publicly insured but their contribution is covered through general taxation. Approximately 11 percent of the population (people whose income exceeds a certain threshold, who are self-employed or civil servants) may opt for private health insurance. In addition, there special schemes for certain groups, such as police or soldiers (OECD & European Observatory on Health Systems and Policies, 2019a).

### *Unmet needs*

Overall, self-reported unmet medical needs due to distance, waiting times or for financial reasons were "close to zero" (OECD & European Observatory on Health Systems and Policies, 2019a, p. 15) in 2017. The accessibility of the German healthcare system is also reflected in levels of out-of-pocket spending which, at 12.5 percent, is lower than the European average of 15.8 percent (OECD & European Observatory on Health Systems and Policies, 2019a).

### **Challenges and necessary or desired changes to healthcare provision**

Despite the relatively healthy performance and accessibility of the German healthcare system, there are challenges stemming from both an ageing population and workforce (OECD & European Observatory on Health Systems and Policies, 2019a). According to participants, doctors and pharmacists have been experiencing difficulties in finding a successor once they retire. This has led to a decrease in hospital density, and to the closure of GP surgeries and pharmacies. Consequently, people who live in rural Saxony may find it more difficult to access healthcare. Moreover, participants identified a lack of available spaces in rehabilitation facilities and nursing homes, and particularly care recipients with complex needs and multiple morbidities are struggling to access places.

Another challenge is the decentralised nature of healthcare provision as well as the principle of self-governance. Participants criticised that decision-making processes at state and committee level without state intervention impeded Germany's ability to compete with other countries. Participants argued that although Germany was very good at inventions, the country was very resistant to innovation. In practice, this translates into the G-BA's refusal to fund innovative technology, such as ehealth products, and in a 'brain drain' from the country. According to participants, legislative change was needed at national level.

Moreover, a myriad of healthcare providers and buyers has resulted in a highly fragmented and siloed system (OECD & European Observatory on Health Systems and Policies, 2019a) where, according to participants, different services tend not to talk to each other. Participants stressed the need for digital upgrades of established healthcare services. The lack of infrastructure, such as a centralised platform for communication, makes it more difficult for healthcare providers to access patient information as there is no facility for the electronic transfer of patient files which instead takes place manually.

#### 3.2.1.2.2 Porto4Ageing (Portugal)

The [Porto4Ageing](#) consortium is one of the EIP on AHA reference sites which is comprised of over 100 organisations which are predominantly located in the Porto Metropolitan Area. The Porto4Ageing consortium, which seeks to achieve structural change, is diverse as it is comprised of stakeholders from different areas of expertise, i.e. regional governments and health and care providers, academia and research, industry and civil society. Porto4Ageing is active in the following key thematic areas: i) care and cure, ii) active ageing and independent living, iii) prevention, screening and early diagnosis, amongst others.

As stated, members of the Porto4Ageing consortium are largely based in the Porto Metropolitan Area which covers an area of 2,028 km<sup>2</sup>. With 849.1 persons per km<sup>2</sup>, the region is much more densely populated than the EU average (118 persons/km<sup>2</sup>). Like many other European countries, Portugal's population is getting older, too. While overall, 21.8 percent are aged 65 years old or older, the proportion of population within this age group at 20.4 percent is slightly lower in the Porto Metropolitan Area. Although life expectancy was 20.3 years at age 65 in 2018, healthy life years at age 65 was only 7.3 years, which is 2.6 years below the EU average.

### **Brief summary of the Portuguese healthcare system**

#### *Organisation and governance*

Portugal is a unitary state which means that healthcare provision is governed centrally by the Ministry of Health, which is responsible for planning, implementing, regulating and auditing. Portugal employs a mixed (public/private) model which consists of the universal national health service (NHS), health subsystems and private voluntary health insurance (VHI). Healthcare provision is governed centrally through the Ministry of Health which has the following two core responsibilities: the development of health policies, and the monitoring and evaluation of the implementation of health policies. The Ministry of Health regulates, plans and manages the NHS, and the Ministry also regulates, audits and inspects private health care providers (Simões et al., 2017).

#### *Accessibility and financing*

The NHS, which is funded via general taxation, provides universal coverage to all residents, irrespective of legal and employment status, or socio-economic background. The health subsystems are health insurance schemes which are open to specific employees in either the public or private sector (OECD & European Observatory on Health Systems and Policies, 2019b). At 27.5 percent, out-of-pocket spending is considerably higher than the EU average (15.8%). Co-payments for outpatient

medical care (13.1%) and pharmaceuticals (6.4%) make up the largest proportion of OOP expenses but may also include contributions to inpatient care or long-term care.

### *Unmet needs*

Although unmet needs have been decreasing since 2014, cost, distance and waiting times are still posing barriers to accessing healthcare for approximately 2.3 percent of the Portuguese population, including irregular migrants. Out-of-pocket expenses is one of the most significant hurdles to accessing healthcare, particularly for low-income earners.

Participants suggested that lack of affordability may also play a role in the care for older people. Although primary care is covered by the healthcare system, some services, such as physiotherapy, as well as medication or assistive technology, are often carried by the care recipient. Although governmental subsidies may be available, this requires much initiative from the care recipient.

### **Challenges and necessary or desired changes to healthcare provision**

Affordability of services and products seems to be one of the key obstacles to accessing healthcare. Participants identified the improvement of the relationship between regional and national governments, research organisations, companies, and service providers, as well as the enrolment of citizens/end-users in the development of innovative solutions as key areas for social change. Participants suggested that the digital transformation of healthcare based on regional needs should be included in national healthcare strategies. Moreover, participants argued for a faster introduction of innovative products and services which requires new financial schemes for the funding of research, knowledge, and the transfer of technologies.

#### **3.2.1.2.3 Asociación Benéfico Social (Spain)**

Unlike *Saxony* and *Porto4Ageing*, the *Asociación Benéfico Social (El Salvador)*, a non-profit retirement home, is a single-unit pilot site. El Salvador is located in the town of Pedroche in the region of Córdoba which is one of the eight provinces<sup>5</sup> of Andalucía in the South of the Iberian Peninsula (Spain). With 57.8 inhabitants per square kilometre, Córdoba is one of the least populated<sup>6</sup> provinces in Andalucía (Statistical Office of the European Union, 2020b, 2020d). Moreover, with only 12.5 inhabitants per square kilometre, the municipality of Pedroche is even more sparsely populated (AdminStat Spagna, 2017). Furthermore, the population of Pedroche is significantly older than in both Andalucía and Spain overall. In 2017, 30.7 percent of the population of Pedroche were aged 65 and older<sup>7</sup> compared to Andalucía (16.8%) or Spain (19.1%). The contrast was even more pronounced in the age group 75 and older alone: in Pedroche, 20.5 percent belonged to this age group in 2017 compared with Andalucía (7.9%) and Spain (9.4%). In 2018, the average life expectancy for men and women in Spain was 21.3 years at age 65 but with only 11.4 remaining health life years was 19.6 years, out of which 11.9 were healthy life years (Statistical Office of the European Union, 2018b, 2018a).

In addition, Pedroche seems to have been experiencing a decline in population. In 2018, 1,520 people lived in Pedroche compared to 1,658 in 2012 (AdminStat Spagna, 2018). Participants associated this decline with younger people leaving to pursue their career. However, we also learned that people

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<sup>5</sup> Andalucía is comprised of the following provinces: Almería, Cádiz, Córdoba, Granada, Huelva, Jaén, Málaga, Sevilla (Eurostat, 2020).

<sup>6</sup> Almería (79.9 inhabitants per km<sup>2</sup>), Cádiz (170.8 inhabitants per km<sup>2</sup>), Córdoba (57.8 inhabitants per km<sup>2</sup>), Granada (72.8 inhabitants per km<sup>2</sup>), Huelva (52.4 inhabitants per km<sup>2</sup>), Jaén (47.8 inhabitants per km<sup>2</sup>), Málaga (227 inhabitants per km<sup>2</sup>), Sevilla (140.1 inhabitants per km<sup>2</sup>).

<sup>7</sup> This includes the age bands 65-74 years and 75 years or older.

originally from the Córdoba region tend to return when they reach retirement age which also includes people who went to work and live abroad (e.g. Germany, Switzerland, France) will return to Córdoba to retire. Eventually, some older residents of Pedroche, as well as surrounding areas, may go on living in Pedroche either as part-time or full-time residents.

El Salvador has 147 places and out of those, 100 are publicly funded and 47 are privately funded. However, about  $\frac{3}{4}$  of the private places are subsidised while the rest is entirely self-funded. As suggested in the previous paragraph, the population of Pedroche is getting older. This trend is also reflected in the age profile of the residents: while only 8 are younger than 65 years old, 22 are aged between 65 and 80 years old and 111 are 80 years old or older. Forty-seven of the full-time residents are able to leave the centre during the day and are free to move around in the village. Informants suggested that this allows the residents to keep connected.

In addition to institutional care, El Salvador also provides home-care services for 90 people. Furthermore, older people who are on the waiting list for a public place at El Salvador may visit the nursing home during the day. There they can avail of the same services as regular residents which are provided by the staff on a voluntary basis.

### **Brief summary of the Spanish healthcare system**

#### *Organisation and governance*

Spain is a unitary state with a decentralized approach to healthcare provision (Dardanelli, 2019; ISMERI Europa & Applica, 2010). Healthcare is provided through three statutory entities: the *Sistema Nacional de Salud* (SNS) - Spain's national health system, and two subsystems: i) three mutual funds which provide coverage for members of the civil service, armed forces and the legal profession; ii) the mutual funds for accidents and occupational diseases (OECD & European Observatory on Health Systems and Policies, 2019c). A process of decentralisation resulted in greater levels of self-governance for both the Institute for Health Care Management (INGESA) and the 17 Autonomous Communities (AC) who are responsible for planning, coordination and provision of healthcare (Bernal-Delgado et al., 2018).

#### *Accessibility and financing*

The Spanish healthcare system is based on a mixed public/private model and on “the principles of universality, free access, equity and fairness of financing” (Bernal-Delgado et al., 2018, p. 15). The SNS is predominantly funded through general taxation and public spending accounts for 71% which is below the EU average (79%) and can be attributed to cost-cutting measures and an increase in out-of-pocket (OOP) spending in response to the 2009 economic crisis. OOP spending accounts for 23.6% and includes pharmaceuticals (7.7%), dental care (6.7%), outpatient medical care (3.4%), such as medical devices. Moreover, dental care is not covered under the current system (OECD & European Observatory on Health Systems and Policies, 2019c).

#### *Unmet needs for medical and dental care*

As most of the cost for health services are covered by the SNS, only about 0.1 percent of the Spanish population reported unmet medical needs relating to cost, distance or waiting times, and differences between high- and low-income earners are very small. Yet, as dental care is not covered by the SNS, 4 percent of the population reported unmet dental care needs, and there were significant differences between high- and low-income earners.

Participants suggested that at El Salvador, there was a good ratio between residents and care staff and moreover, an open-door policy allows family members to help take care of residents, such as help with feeding during mealtimes. In addition, social events, such as concerts, at the home facilitate a sense of integration into social life at Pedroche.

### **Challenges and necessary or desired changes to healthcare provision at El Salvador**

Although participants have pointed out the satisfactory ratio between care staff and residents, they also suggested that Pedroche, like Saxony, has been experiencing difficulties in both retention and recruitment of young people and healthcare professionals. Staff at El Salvador have been getting older alongside the village population. According to participants, young healthcare professionals tend to perceive their position at El Salvador as temporary which makes it more difficult for people to access healthcare.

Many of the full-time residents at El Salvador are older people with Alzheimer's disease and other forms of dementia. Participants described that nursing staff typically check on residents several times during the night, which means that there are phases between checks where residents are left unattended. Although this is not an issue when the person is asleep, they may wake up which puts them at risk of falling and potentially lose their consciousness. Participants suggested that technology might assist staff in monitoring residents' activity levels and alert staff should the person have an accident.

Another issue identified by participants relates to staff rotas and communication between staff. Different staff may attend during mealtimes which makes it more complicated for them to monitor residents' food intake. Participants suggested that a tracker that monitors the number of times that a person's hand moves from plate to mouth might make it easier for staff to keep track of nutrition and quantity. However, participants emphasised that technological innovations could not replace the interpersonal relationships between residents and staff which have, in many cases, grown over the course of a lifetime. Moreover, participants identified certain ethical implications of movement trackers which would need to be evaluated carefully.

#### **3.2.1.2.4 Care giver requirements from personas**

Finally, one persona ("Older adults with mild, but multiple chronic conditions") also encompassed needs for care givers which are listed below:

- Learning/information about:
  - Peer support;
  - Emotional support;
  - Respite care;
  - Physical assistance.

### **3.2.2 Non-functional requirements**

The central goal of SHAPES is the development of a platform to improve healthy ageing. The platform has two primary end-users: First, end-users, which encompasses care providers, doctors and nurses, and care receivers as well as associated people and organisations such as the health and care systems (e.g. nursing homes, insurance companies, public health employees) want to access the tools provided in the platform in the easiest possible way to enhance healthy ageing. Second, technology providers want to link their individual solutions with this platform to increase the visibility and usability of their technology. All of these actors have specific functional requirements that need to be met by the platform and the individual solutions. However, also additional and non-functional requirements such legal and ethical requirements or regional and national markets create requirements that the platform



has to meet. In order to get a preliminary understanding of these additional requirements, a review of recent and current H2020 projects that have developed technology platforms has been carried out. The aim was to get a better understanding of the clustering of respective requirements.

Using the search term 'platform' in the Cordis database yielded over 5,000 search results. This list of projects was screened for projects that develop a technology platform similar to the one envisaged by SHAPES. An initial ten projects were reviewed in detail, which entailed an analysis of how the project had developed their requirements and what types of requirements in general and what specific requirements they had identified.<sup>8</sup> This relatively small sample size compared to the more than 5,000 hits from the search already yielded a plethora of requirements. One common element was the development of surveys or questionnaires to ask users for requirements that they have, which is an approach that will be followed in SHAPES as well. In addition, with regard to the general overall types of requirements, these were quite congruent. In order to test if any projects that specifically work in the health sector developed completely different types of requirements, another Cordis search using the search string 'platform AND health' was conducted. This search yielded over 1,460 hits for just H2020 projects. Another five projects were assessed in the same way as before.<sup>9</sup> As was expected, these health specific projects utilised similar approaches to develop requirements and had identified similar categories of requirements.

In a second step, these categories of requirements were pooled and their use as categories for SHAPES evaluated by the authors. Key criteria of this evaluation were the types of users that are part of SHAPES and the envisioned use of its platform. The resulting categories of requirements as follows:

1. Security requirements
2. Ethical & Legal requirements
3. Health system requirements
4. Business requirements
5. Technical requirements

Of course, certain requirements might fall under several of these dimensions. In order to follow a practical approach, it should be sufficient to collect them once and ensure that dimensions are considered in developing the platform.

These requirements have been subject to additional literature review and are discussed in more detail below. Overall, an extension and evaluation of the sub-categories for specification into user requirements is needed for the next iteration of the Deliverable. This will be done in close collaboration with the SHAPES partners and particularly WP2 and Task 3.1, Task 3.2, WP5 and WP6, interacting with the platform users. In addition, deliverables within SHAPES will be continuously screened to see if any requirements can be extracted from it.

### ***3.2.2.1 Security requirements***

The tools in the SHAPES platform and the platform itself will involve the use of personal data, including highly sensitive information about health. Thus, the platform will have to provide a very high level of security standards in order to allow the sharing and storing of this information. And guard against any intrusion and hacking attempts.

Examples:

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<sup>8</sup> The projects were: BONSEYS, PLUGGY, SoCaTel, SWAMP, PlatformUptake.eu, MetaPlat, openMOS, Mobile-Age, Vicinity, SIMPATICO

<sup>9</sup> The projects were: iManageCancer, Picaso, REACH2020, FrailSafe, i-PROGNOSIS.

- Regular security updates
- User identification protocols

### ***3.2.2.2 Legal & Ethical requirements***

Both ethical and legal requirements will be a substantial factor in developing the platform and using its associated tools and technologies as any information concerning health and health data are inherently highly sensitive. With regard to the ethical requirements, D8.4 Shapes Ethical Framework already developed 102 different types of ethical requirements, which have been taken up in the requirements excel file. In addition to ethics, SHAPES will have to consider the legal requirement on an EU-level as well as the requirements of the states participating in SHAPES.

Examples:

- Human oversight for AI tools
- Digital inclusion
- Trustworthy IT/AI
- Maximise the level of fundamental rights of older persons and of care givers
- Data protection and privacy
- Right to be forgotten
- Right of access
- Digital Rights Management (DRM) for collaborative developments of technologies for the platform
- Confidentiality should be provided by protecting sensitive data using state of the practice cryptographic mechanisms (Taumberger et al., 2018)
- Regulated access to data
- Privacy and trust (Mehri et al., 2018; Steghöfer & Esfandiari, 2017)

### ***3.2.2.3 Health system requirements***

While the requirements of the technology providers and end-user such as care givers and receivers are collected under the functional requirements category, there are associated end-users, such as the public health system or nursing homes and hospitals that need to enable their specific actors (e.g. nurses, doctors, public health workers) to be able to use the platform. This aspect could pertain to technical elements such as providing the necessary internet access and bandwidth to fostering the incorporation of the platform into their day-to-day operations and processes.

Examples:

- Foster positive attitude of health providers to eHealth (Lolich et al. 2019)
- Incorporation of platform into daily operations
- Accessibility of tools for professionals

### ***3.2.2.4 Business requirements***

While the overall functionality of the platform is paramount, it is equally important to ensure that it supports business in being able to showcase and further development their technologies on the platform. Equally, at the back end, it needs to ensure that the practitioners and their organisations are able to access the tools and be able to purchase the relevant services.

Examples:

- Extensible ontologies
- Cost-benefit, effective devices need to be selected

- Contracts need to be prepared for authorised third parties

### 3.2.2.5 *Technical requirements*

The non-functional requirements directly derive from how the tools that are tested in SHAPES will be able to connect and interact with the platform. It is important to differentiate these requirements from those for the individual tools and how well they perform. These non-functional requirements also need to incorporate the demands and needs to the eventual users of the platform, such as care receiver and care takers. The requirements identified in the EU project VICINITY was taken as a starting basis. (Wagner et al., 2016)

Examples:

- Scalability: Does the platform allow and support the scaling up of tools, i.e. does it allow tools to be used on a larger basis continuously (Wagner et al., 2016)
- Capacity
- Availability of the platform needs to be ensured so that the system is continuously available even in case of disconnections from the Internet and lack of access to any cloud data centre (Taumberger et al., 2018)
- Reliability
- Recoverability
- Maintainability: How easy is it to update and maintain a tool once it is connected to the platform (Wagner et al., 2016);
- Serviceability
- Manageability
- Environmental
- Data Integrity
- Usability
- Performance
- Interoperability: Does the platform enable and support the exchange of information between different tools

## 3.3 *Envisioning and evaluation*

In this first iteration of the requirements matrix, it consist of several key categories as well as sub-categories for each of these. These two elements were derived from the literature and project reviews in combination with discussions within the SHAPES consortium, supported by already finished deliverables such as the D8.4 Shapes Ethics framework. Thus, the content in the excel file varies between the different categories and sub-categories. In order to fill in any missing gaps as well as potentially merge some sub-categories, it will be necessary to get specific feedback on the requirements from the individual experts, such as technology providers, care-givers, care-receivers or health administrators.

This process will consist of several steps. The first step will consist in identifying more requirements, especially on the lowest level, i.e. the actor who is responsible for the requirements. A requirements identification template (Table 4) will be sent to stakeholders within the SHAPES consortium such as the technology providers, platform developers and to the pilot studies sites to distribute to relevant care-receivers, care-takers, doctors and health administrators. The identified requirements will be reviewed and put into the requirements excel file, ensuring that requirements are not duplicated and maintaining a common terminology. This process may yield a rather large number of requirements, which may possibly contain duplicates. In a second step, the list of requirements will again be

evaluated by relevant actors (care-receivers, care-takers, doctors and health administrators) in order to eliminate duplicates and merge similar requirements. This step is crucial as too many and ill-defined requirements will severely impede any further work in SHAPES, especially in the development phase of solutions and the platform itself. This assessment of the requirements list will be done by a Delphi approach. Different actors will be surveyed to discuss the validity, usability and importance of the identified requirements. The answers will be collected and the list of requirements adjusted based on the responses. This new list of requirements will then be shared again with the participants. The process is then repeated for a third and final time. The Delphi method will allow the reduction of the number of requirements and ensure that no important requirements have been left out. The Delphi approach will be coordinated with Task 5.1 “SHAPES User Experience Design and Guidelines” which also plans to implement a Delphi approach to weight the respective recommendation. The coordination will ensure a consistent approach across SHAPES and reduce effort for the involved actors. Jointly, characteristics will be determined for different categories of expertise for the participants in the Delphi study.

Table 4 The Template for the SHAPES User Requirements

<b>Requirement ID:</b>	Each requirement has a specific ID, which is based on the category, sub-category and a number. <Category>-<Sub-category>-<Number>
<b>Category</b>	<p><b>The SHAPES requirements are classified into different categories:</b></p> <ul style="list-style-type: none"> <li>• <b>Functional (coding: FR)</b></li> <li>• <b>Security (coding: S)</b></li> <li>• <b>Legal &amp; Ethical (coding: LE)</b></li> <li>• <b>Health system (coding: HS)</b></li> <li>• <b>Business (coding: B)</b></li> <li>• <b>Technical (coding: TR)</b></li> </ul> <p>These are briefly discussed in D3.7. In addition, each category consists of several sub-categories, which have a specific coding ID as well.</p>
<b>Target User (Beneficiary)</b>	Identify who is the key user who has to address the requirement. Options are: Care recipient, Informal Caregiver, Professional Caregiver and Healthcare/Care Service Provider. A requirement may have several beneficiaries.
<b>Use Case</b>	Number of the pilot theme’s use case(s) it refers to, if applicable (D6.1).
<b>Dependencies</b>	Mapping to persona, if applicable (D2.5). Mapping to use case, if applicable (D2.5). Mapping to organisational models of health and care organisations, if applicable (D3.1).
<b>Customer Value</b>	Requirements should be classified according to their importance: High, medium, low.
<b>Description</b>	A one sentence statement describing the requirement.
<b>Rationale</b>	A paragraph on the reason and context of the requirement.
<b>Supporting material</b>	External references, such as bibliographical references, if applicable.

### *3.5 Requirements specification*

Finally, general requirements will be distinguished from those requirements that have to be specified per user group. For example, while ethical requirements might be more universal, functional requirements specification such as “Medication reminder” are likely translate into different requirements for different user groups. After differentiating these two types of requirements, the missing specifications will be completed in collaboration with WP2 and Task 3.1, Task 3.2 and WP6.

Finally, all platform requirements (PRs) need to undergo a logical cross-check to ensure that they are not contradicting each other; E.g. a functional requirement could not fulfil an ethical requirement.

## 4 Conclusion

Deliverable 3.7 is the first iteration in developing the SHAPES Platform requirements. It describes the development of overall six requirements dimensions, based on literature review, benchmarking review and discussion with the project partners. These dimensions encompass functional requirements and non-functional requirements and their relationship with other WPs. The functional requirements relate to the needs as defined by different types of platform users such as care receivers, care givers (formal and informal), health system authorities, hospitals, etc. The identification of these functional requirements is closely linked with WP2, WP3 and WP6 in which Task3.5 is in close contacts. The non-functional requirements can be differentiated into Security, Legal and Ethical, Health System, Business and Technical requirements dimensions which are closely linked with WPs 3,4,5, and 8.

The dimensions have been broken down into a first set of requirement specifications as detailed in the Excel Sheet, annexed to this Deliverable. This document will be a living document which will be extended and specified in collaboration with the project consortium in the next months. Some WPs (such as 5 and 8) have already contributed, e.g. on requirements relating to technical interoperability or ethical and legal requirements. Hence, the current version of the Platform Requirements Excel Sheet differs markedly between the requirements dimensions in terms of the level of specification. The level of specification is to be harmonised by the next iteration of this Deliverable (D3.8) in M12.

Finally, the requirements have to be weighted and prioritised to allow for an application. This process will be implemented by the use of a Delphi approach. Different actors will be surveyed to discuss the validity, usability and importance of the identified requirements. The answers will be collected and the list of requirements adjusted based on the responses. This new list of requirements will then be shared again with the participants. The process is then repeated for a third and final time. The Delphi method will allow the reduction of the number of requirements and ensure that no important requirements have been left out. This process will be aligned with Task 5.1 “Platform User Experience Design Guidelines and Evaluation” which also plans to implement a Delphi approach to weight its recommendations. Overall, the specification and weighting of requirements will be completed by M18 with the 3rd iteration (D3.9) of this Deliverable.

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# Annex I

User Requirements		Actors									
Main requirement categories	Sub-categories	Specification	Coding	Evaluation (high; medium; low)	Care receiver (Codes to end with CR)	Care giver (formal) (Codes to end with CGF)	Care giver (informal) (Codes to end with CGI)	Doctors (Codes to end with D)	Health administration/insurances (Codes to end with HAI)	Technology/ Solution providers (Codes to end with TP)	
Functional requirements (Coding: FR)	Health support (Coding: HS)	24/7 eHealth call centre	FR-HS-1		Needs easy access to the service --> Total code = FR-HS-1-CR	Needs professional / technical expertise Total code: FR-HS-1-CGF	Needs to be able to provide information and receive decision support	Need to be connected to the call centre in case patients need specific support		call centre needs to be available 24/7;	
		Health data management	FR-HS-2								
		Help for dealing with legal issues (e.g. advanced care plans; end-of-life care)	FR-HS-3								
		Risk assessment systems	FR-HS-4								
		Medication reminder / support	FR-HS-5								
		Pain management system	FR-HS-6								
		Medical emergency alert system	FR-HS-7								
	Information services (coding: IS)	Easy to use communication systems	FR-IS-1			Easy communication with family & friends (FR-IS-1-CR)					
		Information about support services: peers	FR-IS-2								
		Information about support services: mental health	FR-IS-3								
		Information about support services: physical help	FR-IS-4								
		Information about support services: peer support	FR-IS-5								
		Data sharing system for health data	FR-IS-6								
		Easy notification of corresponding caregivers	FR-IS-7								
	Health maintenance (coding: HM)	Monitoring of general health levels	FR-HM-1								
		Physical exercises	FR-HM-2								
		Mental exercises	FR-HM-3								
		Support in maintaining good dietary balance; health literacy	FR-HM-4								

Figure 7: Example of the SHAPES Platform Requirements Table, p. 1

User Requirements		Actors								
Main requirement categories	Sub-categories	Specification	Coding	Evaluation (high; medium; low)	Care receiver (Codes to end with CR)	Care giver (formal) (Codes to end with CGF)	Care giver (informal) (Codes to end with CGI)	Doctors (Codes to end with D)	Health administration/insurances (Codes to end with HAI)	Technology/ Solution providers (Codes to end with TP)
Security (Coding: S)	Cybersecurity (Coding: CS)	Ensure that security protocols are in place and up to date to protect platform infrastructure	S-CS-1							
	Resilience (Coding: RE)	Ensure critical services are running 24/7 and are resistant to outside interference	S-RE-1							
		Security updates	S-RE-2							
Legal and Ethical (Coding: LE)	General Ethics (Coding: GE)	Maximise the level of fundamental rights of older persons and of care givers that SHAPES can promote (including balance between older persons' rights and care workers' rights).	LE-GE-1							
		Ensure that SHAPES does not violate any fundamental rights of older persons and/or other stakeholders (e.g., non-discrimination, dignity, integrity and privacy when having robots, web-cameras at home), (TBD)	LE-GE-2							
		Be aware of the four biomedical principles. Apply and promote those within SHAPES (justice, beneficence, non-maleficence and autonomy when using SHAPES services).	LE-GE-3							
		Be aware of the perspectives of care ethics. Apply and promote those within SHAPES (empathy,	LE-GE-4							

Figure 8: Example of the SHAPES Platform Requirements Table, p. 2