S H A P E S

Smart and **H**ealth **A**geing
through **P**eople **E**ngaging in supportive **S**ystems

D2.5 – SHAPES Personas and Use Cases

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Table of Acronyms and Abbreviations

Table 3: Acronyms and Abbreviations

Acronym	Full Term
Apps	Mobile applications
DIPEx methodology	Database of Individual Patient Experiences methodology
EU	European Union
GP	general practitioner
H&C	Health and Comfort
IoT	Internet of Things

NUIM	National University of Ireland Maynooth
OBJ	Objective
PACT criteria	Program of Assertive Community Services
RA	Receiving Agent
RO	Registration Operator
TP	Technological Platform
UP	Palacky University Olomouc
WP	Work Package

Keywords

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Executive Summary

This deliverable presents the initial, evidence-based personas and use cases that mirror the basic types of users of the solutions provided by SHAPES. The development of the personas and general use cases is in accordance with the SHAPES strategic objectives, namely to build and deliver the innovative European-led SHAPES Platform, providing a broad range of interoperable solutions to improve the health, well-being and independence of older individuals, while enhancing the long-term sustainability of H&C systems in Europe, and further also to create, enlarge and consolidate the SHAPES Ecosystem for active and healthy ageing allowing stakeholders to exchange knowledge and expertise, identify current and future solutions for active and healthy ageing, provide mutual advice, training and support and exploit collective knowledge for social and commercial purposes. The development of the initial personas and general use cases including scenarios was a first step towards the fulfilment of these goals. This deliverable report presents 8 new personas that are ready to be used in future stages of the SHAPES project. Furthermore, 13 general use cases including scenarios were developed. These general use cases represent a range of possible SHAPES digital solutions and innovations, and they are ready to be supplemented by other new use cases during the subsequent stages of the SHAPES project. This deliverable also describes suggestions for project partners including future challenges, risks, and opportunities, e.g. the problem of acceptance of digital solutions from the perspective of the final users, a possible risk of the lack of engagement of end-users, and resistance focused on the use of digital technologies in the daily lives of the end-users. All the goals of Task 2.5 formulated in the original SHAPES project were fulfilled. All the works conducted in Task 2.5 and all works during the preparation of this deliverable met all the relevant ethical codes of practice, and ethical and security acts, directives, and regulations of the EU. Updated versions will follow with numbers and submission months.

1 Introduction

This chapter outlines the main objectives of the Task 2.5, the development of the personas and use cases. Key inputs and outputs are explained as well as the interconnections of this task to the SHAPES strategic objectives, synergies and interdependencies.

1.1 Rationale and purpose of the deliverable

Task 2.5 "SHAPES Personas and Use Cases" aims to contribute to a better understanding of the user needs for SHAPES by developing personas and use cases including scenarios. Basic personas with their attributes, attitudes, behaviours and characteristics are considered to be evidence-based knowledge bases that provide models of users of future SHAPES digital solutions and innovations. Utilizing a human centred co-design process, basic use cases were planned to be developed illustrating the interactions between users and the SHAPES digital solutions and innovations in order for the future assessment of functional and non-functional SHAPES platform features. The use cases are proposed to include scenarios to illustrate how different stakeholders would use the SHAPES digital solutions and innovations. The Task 2.5 was planned to inform the core SHAPES Platform and its socio-technological deployment and iterative improvement within future diverse Pilot Sites, contributing also to the fulfilment of the proposed objectives of SHAPES.

1.1.1 Deliverable objectives

Following the original SHAPES project proposal, the **main two objectives** of Task 2.5 "SHAPES Personas and Use Cases" are:

- to develop basic personas with their prototypical attributes, attitudes, behaviours and characteristics
- to develop general use cases including scenarios of use of digital solutions

1.1.2 Key inputs and outputs

The main aim is to deliver European evidence-based personas and use cases that mirror the basic types of users adapted to the requirements of the target groups of SHAPES. Applying a human centred co-design process, basic personas and general use cases are planned to be developed to represent a knowledge base that will be subsequently further developed and adapted within particular WPs and Tasks. Despite basic personas and general use cases being planned to be a kind of prototypes in nature, they are not final versions, since they will be modified, adapted, and fine-tuned

during further development of SHAPES. Thus, basic personas and general use cases developed within Task 2.5 "SHAPES Personas and Use Cases" are considered to be starting points for future development, modifications, and adaptations for particular conditions, i.e. Pilot Sites, applications, cultures, and target groups.

The main deliverable of Task 2.5 is a report. This report presents the basic SHAPES personas and use cases as the foundation for the design of the SHAPES architecture and system requirements. The report is a part of the SHAPES quality policy ensuring high quality output of the action, following successful implementation of the SHAPES plan and promoting models, approaches, and solutions for the extended independent living of older people.

1.1.3 Structure of the document

The report consists of eight chapters. Chapter one provides a rationale of the Task 2.5 deliverables and explains the deliverable objectives and its interconnections and synergies within the whole project. The scope and sense of an updated versions of this deliverable will be developed in the subsequent stages of the SHAPES project. Chapter two is dedicated to the theoretical background of the two main deliverables: personas and use cases. Chapter three outlines the methodology of the personas development, introduces the categories represented by the personas and the main aspects that play a role in understanding the personas. At the end of Chapter three the seven final personas are presented. Chapter four is dedicated to the use cases, and presents the methods of use case development and also thirteen general use cases. Chapter five deals with the ethical aspects of the preparation of these deliverables. Future challenges and risks are described in Chapter seven, and the last Chapter eight summarizes the fulfilment of the tasks, mainly the development of personas and use cases, that are presented in this report.

1.1.4 Interconnections of outputs of Task 2.5 to SHAPES strategic objectives

The development of basic personas and general use cases including scenarios is in accordance with the SHAPES strategic objectives (OBJs). For example, with OBJ 1: To build and deliver the innovative European-led SHAPES Platform, providing a broad range of interoperable solutions to improve the health, wellbeing and independence of older individuals, while enhancing the long-term sustainability of H&C systems in EU. The development of basic personas and general use cases including scenarios is a first step towards the fulfilment of this goal since the targeting of the users´ attributes, attitudes, behaviours and characteristics prepare a suitable background for the subsequent identification of best practices focused on the elimination of psychological and physical effects of isolation, and loneliness in the elderly.

Furthermore, the development of basic personas and general use cases including scenarios also support the fulfilment of OBJ 2: To create, enlarge and consolidate the

SHAPES Ecosystem for active and healthy ageing allowing stakeholders to exchange knowledge and expertise, identify current and future solutions for active and healthy ageing, provide mutual advice, training and support and exploit the collective knowledge for social and commercial purposes. As a matter of fact Task 2.5 contributes to the development of knowledge and expertise needed for future solutions for active and healthy ageing.

And last but not least, the development of basic personas and general use cases is important also for OBJ 3: To promote the adoption of standards in the EU field of integrated care of older individuals, and the identification of standardisation priorities to facilitate the deployment of open and interoperable Platforms. As a matter of fact Task 2.5 contributes to the improvement of integrated care of older individuals in the EU.

1.1.5 Interdependencies and synergies of Task 2.5 with other SHAPES actions

Task 2.5 is an important part of WP2: Understanding the Lifeworld of Smart and Healthy Ageing Citizens. WP2 is designed to create the knowledge base (data, information, best practices, experiences and solutions) addressing real-world information on how ageing populations live, including empowerment models for healthy living, care pathways, age-friendly environment and social inclusion. Thus, WP2 is the knowledge foundation of the SHAPES Integrated Care Platform (see Figure 1: SHAPES WP Structure and Interdependency to gain a more detailed insight into the links and synergies within the SHAPES project).
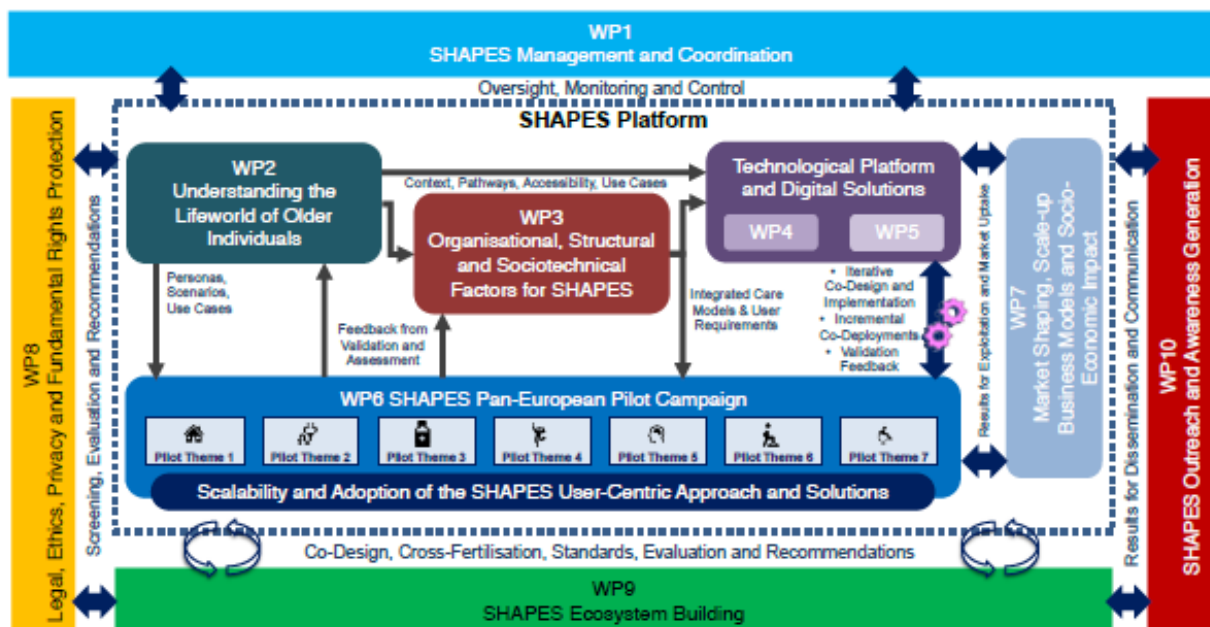
Figure 1: SHAPES WP Structure and Interdependency

The interdependency of various tasks within the SHAPES project is relatively high. For example, Task 2.5 is an important input for the WP4, especially Task 4.1: SHAPES

TP Requirements and Mapping a Reference Architecture. Based on the use cases developed within Task 2.5, the Task 4.1 will start with the assessment of the functional and non-functional requirements of the technological elements to support the anticipated services. At a subsequent phase, the task will address the specification of the reference architecture for the core SHAPES TP, identifying its main elements, their functionality and their interdependencies.

Task 2.5 can be also considered to be a background in which subsequent pilot activities of SHAPES will be conducted. Almost all the Pilot Themes of WP6: SHAPES Pan-European Pilot Campaign is fed by Task 2.5 by providing personas and general use cases of users. In other words, Task 2.5 provides knowledge base for further development, modifications, and adaptations for particular conditions within the preparation of the SHAPES small-scale pilots and demonstrations and the large-scale pilots to validate the SHAPES Platform capabilities and benefits to care recipients, caregivers and care service providers.

2 Background

This chapter describes the theoretical base for the understanding of the role of the main deliverables of the Task 2.5, personas and use cases, within the main conceptual framework of the person-environment interaction.

2.1 Definitions

The main two objectives of Task 2.5 SHAPES Personas and Use Cases are to develop basic personas and basic use cases including scenarios of use of digital solutions.

How to understand personas and use cases in user experience design?

Persona, known also as "user persona", is a detailed description of a fictional person (often a composite of real individuals) used to communicate the key motivations, concerns, and interests of a user group (Bhattacharyya et al., 2019). Personas include fictitious characters described in narrative form in order to help solve design questions. Personas enable designers to better focus on primary users, especially on their behavioural patterns and user needs (Huh et al., 2016) and are widely used in system design organizations as a complement to individual or other user data. They provide a basic prototype of persons/users for the interaction of an individual with a product/digital solution.

A **use case** is generally a software and system engineering term that describes how a user uses a system to accomplish a particular goal. It is a methodology used in system analysis to identify, clarify, and organize system requirements. The use case is made up of a set of possible sequences of interactions between systems and users in a particular environment and related to a particular goal. A use case acts as a software modelling technique that defines the features to be implemented and the resolution of any errors that may be encountered. To represent an actor's participation in a system, all aspects of the interaction of a user with a product or service should be addressed in the use case. Use cases encompass human–computer interaction and address usability, usefulness, desirability, and optimal model of interaction with the focus placed on the quality of the user experience and other relevant solutions.

A use case generally comes as a list of actions, scenarios, or event steps defining the interactions between a role (known in the Unified Modelling Language as an actor) and a system to achieve a goal. The **actor** can be a human or other external system. Actors are roles that a user takes when invoking a use case specifying a role played by a user or any other system interacting with the subject. This simply means that the

actor is a possible role of future user. Different kinds of actors can be distinguished such as a receiving agent or registration operator.

2.2 Theoretical background

The main understanding of the SHAPES digital solutions and innovations can be settled within the framework of the person-environment exchange processes in later life. This framework is built on recent developments within the fields of environmental gerontology and the ecological theory of aging (Chaudbury & Oswald, 2019). This framework is an integrative one enabling a complex understanding of models, approaches and solutions as well as SHAPES ecology and SHAPES ecosystem.

Within this framework, technological systems play a key role in the effective promotion of extended independent living of older people. The SHAPES Digital Solutions like assistive robots, eHealth sensors and wearables, Internet of Things (IoT)-enabled devices or mobile applications (Apps) can be understood as important components within a person-environment interaction supporting three basic dimensions, (a) dimension of independent functioning, (b) dimension of social interaction, and (c) dimension of mobility. All these dimensions contribute to the elimination of the psychological and physical effects of isolation and loneliness that very often accompanies aging.

3 Personas Development

This chapter reviews the commonly used methods of personas development in user centred design and introduces the methodology that was used for the development of the personas within the Task 2.5. Each persona represents different aspects of life in older age. These aspects and the categories represented by the personas are described and the seven personas are presented.

3.1 Methods of personas development

There is no set approach to developing personas, so they can be created at the beginning of a design process or emerge in the design and pilot process (Huh et al., 2016). Many studies emphasize an empirical nature of persona creation (Nielsen, 2019; Schäfer, 2019), but some studies also recognize important input from designers' experiences as well as other possibilities such as *ad hoc* assumptions (Huh et al., 2016). Usual methods to create personas vary between studies. Some studies use only qualitative methods (Goodwin, 2008), where data are gathered mainly using ethnographic techniques, interviews or focus groups, while other studies use mixed methods (Nielsen, 2013) or purely quantitative methods, usually employing a cluster analysis (Huh et al., 2016; Schäfer, 2019).

Due to the limited time, the methodology of creation of personas in the SHAPES project was a combination of literature study and qualitative methods while making use of the rich experience with the target population of older adults within the UP and NUIM teams. We consulted the creative process with the partners from our WP on this stage of the project. We also incorporated the new approaches suggested by The World Federation of Deafblind (persona 8) and Intracom Telecom (indexing of the personas and use cases). The process of persona creation had four phases – see the Figure 2 below.
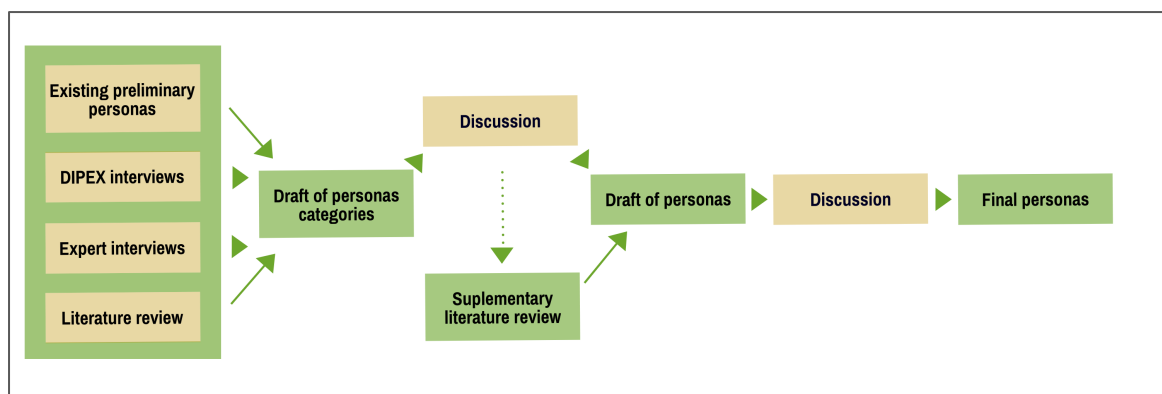

Figure 2: Personas Development

The first draft of persona categories aimed at identifying the preliminary persona types and was based on the following data:

1. previous persona files, which were developed for the project submission
2. data from the DIPEx study on active ageing, from the Czech Republic
3. literature review – case studies, qualitative studies on various types of older adults according to health status and behavioural patterns
4. expert interviews with four geriatric doctors (one of them leading a major geriatric clinic in the Czech Republic) and two social workers who work with older adults
5. discussion with SHAPES experts/members, with long-term former experience in an ethnographic study of older adults

At first the most common types according to health status and behavioural patterns were identified and the first draft of persona categories was prepared, followed by extensive team discussions (within the UP team and later also with the expert team from NUIM). After the additional literature was reviewed, the draft personas were written based on personas categories and sent to the team members for a second round of discussion, which led to the final personas. However, being so early in the project timeline, we consider these still preliminary as a basis for further discussion with other technological partners, designers, pilot leaders etc.

3.1.1 DIPEx methodology

As the data from the DIPEx study has a significant role in the development of personas, we will shortly introduce the DIPEx and its methodology.

Developed in 2001 by the Oxford University Health Experience Research Group (HERG), the Database of Individual Patient Experiences (DIPEx) methodology uses rigorous qualitative research methods to collect interviews on patient experiences of selected health conditions. The data not only serve as a basis for the analysis (usually qualitative thematic analysis (Ziebland, & McPherson, 2006), but also other methods are often used such as grounded theory or narrative analysis) and publications in scholarly journals, but also as a foundation for extensive online information for the lay public and also as a source of training materials for medical staff training. Thanks to the inspiration by the success of the UK DIPEx site, up to date 12 other countries launched their own DIPEx chapters and joined with the UK to form DIPEx International.

DIPEx research is usually organized within individual modules, while each module presents a particular health condition of a specified target group. In this project we use data from the module "Active ageing" that was realized in the Czech Republic between 2014-2015. Within this active ageing project 50 in-depth interviews were conducted with older adults (age 65+) that explored several important aspects of ageing. Maximum variation sampling was employed, with the aim of approximating the sample to the demographic characteristics of the older Czech population. Despite the fact that

we could not aim for representative sampling, our goal was to at least simulate a typical demographic distribution. For the recruitment of our participants, we employed a combination of the snowball technique, approaching older-adult organisations and advertising through social networks. Data were analysed using thematic analysis and narrative analysis (Dubovská et al., 2017).

3.2 Categories (or segments) representing personas

3.2.1 Active, healthy older adults[P1]

The first persona represents a distinctive group of younger older adults (65 – 75 years of age), that is 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.

While the term "active ageing" implies mainly to associations with a physical activity, for many older adults it also means autonomy, interest, excitement and "lust for life" (Stenner et al., 2011). The physical activity is one of the main determinants of keeping the satisfactory health in older age and is facilitated by the subjective enjoyment of the particular exercise, wish to maintain a good appearance and also by the social relationships that are associated with the particular activity. A substantial factor that affects the level of physical activity in older adults is the quality of the natural environment. Some environments such as accessible parks or forests support higher levels of physical activity (Franke et al., 2013; Jones et al., 2020)

3.2.2 Older adults with mild, but multiple chronic conditions[P2]

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. Accumulation of diseases in older age may result in the loss of resilience and homeostasis and could also bring an onset of accelerated aging (Fabbri, 2015).

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. Older adults may experience tension between the need to change, e.g. improve one´s diet, stop smoking, reduce alcohol intake, etc., and one´s wish to be able to keep the lifestyle as usual. This can lead even to some kind of resistance to change (O´Neil & Peterson, 2017), due to the attachment to familiar patterns or in order to keep one´s agency and autonomy.

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. Facilitating behavioural change should take into account the importance of internal motivation, while supporting one's own feelings of autonomy, competence and connectedness (Ryan et al., 2008; Arnautovska et al., 2018).

Another problem that this population is often confronted with is the navigation within the complexity of the health care system. Older adults with multiple conditions consult their GP and a couple of other specialists (for each of the conditions), but not always do these doctors have access to the entire history of the patient, rarely knowing about the chronic conditions they had not prescribed for. As a result the delivery of the care tends to be fractured, which may cause problems with prescribing errors (Lavan et al., 2016). Furthermore, this may be complicated by lower health literacy, which is more common in less affluent older adults (Matthews et al., 2012). Lower health literacy has a negative effect on the overall quality of communication with the doctors and reduces care efficiency - these patients often ask fewer questions as they feel shame and fear associated with the situation (Aboumatar et al., 2013).

3.2.3 Older adults with chronic musculoskeletal disorders[P3]

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 hobbies and often may lead to increased social isolation. In order to preserve the quality of life of this population it is important to maintain their functional capacity for as long as possible (Fejer & Ruhe, 2012).

An important element associated with this condition is the risk of falls, and even more critical, the fear of falls. This has been associated with many negative consequences such as limited movement, decreased muscle strength, higher risk of disability and threat of social isolation (Sheffer et al., 2008). Fear of falls can also develop in people who have never experienced an actual fall, and is a predictor of future falls and is also associated with functional decline (Auais et al., 2018).

Older adults with mobility problems are more likely to experience difficulties also with basic daily activities like dressing, combing one´s hair, taking a shower or going to the toilet, and also more instrumental tasks such as preparing meals, shopping or lifting things. The inability to execute routine tasks may cause frustration and embarrassment (Iezonni, 2003). Moreover, they may have to cope with many inconveniences and difficulties at home, such as stairs, narrow doorways, missing railings or other supports. A frequent strategy to overcome these threats is, for example, leaving several walking sticks in strategic places around the house or so called "furniture cruising" or "furniture surfing" (Iezzoni, 2003): placing the furniture

strategically, such so it can be grabbed for keeping balance. Most common house adaptations are installing grab bars or special railings, using shower chairs, raised toilet seats etc. (Iezzoni, 2003). Notable characteristics of the in-house and also outside-the-house movement is extended planning of each, even short, journey.

Whether an older person will cope with all these setbacks depends on many factors, one of the most essential being their resilience. It can be characterised as the ability to achieve good outcomes in spite of serious threats to adaptation or development (Masten, 2001), capacity to bounce back following adversity or trauma (Bonanno, 2004) or simply finding a way to 'keep going' (Richardson et al., 2014). Resilience is associated with inner strength or resourcefulness and can be eroded after experiencing several difficult falls or other unpleasant or embarrassing situations (for example such as not being able to get out of the shower).

3.2.4 Older adults with neurodegenerative diseases[P4]

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 realized through the sharing of narratives - even if these might be fractured, less coherent or even not believable presenting a modified or not real sequence of events, sharing them helps the affected older adults to better keep their sense of identity and social roles (Tatzer, 2019). This form of narrative care (Randall, 2009; Berendonk, 2020) has good results even in more severe phases of the illness (Tatzer, 2019).

As the condition is progressive, so are the care costs, and that is an important factor especially from the view point of socio-economic inequality. Prolongation of the time while still in-home care may have big consequences for the individual as well as for societal costs. Therefore, it is crucial to understand and support informal caregiving, which is the most common type of caregiving for patients suffering from this condition.

Caregivers of people with dementia are often exposed to social isolation, frustration, exhaustion, burnout and many other negative consequences of their role (McCabe et al., 2016). The first group of identified unfulfilled needs of informal caregivers are associated with the caregiving itself, such as information, respite care, formal care support, informal care support such as peer support groups and help with managing behavioural and psychological symptoms of the recipients of care, such as aggression or agitation. The second type of needs is more personal, and is related to managing

the carer´s own mental health and managing their own lives (McCabe et. al, 2019, McHugh et al., 2012).

3.2.5 Lonely and/or socially isolated older adults[P5]

The purpose of this persona is to highlight the problem of loneliness, which is a phenomenon that has serious implications for the health and well-being of older adults. Loneliness can be described as subjectively felt 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 with similar interests (de Jong Gierveld & van Tilburg, 2010).

Social loneliness in older adults is connected to a number of factors. It is often evoked by social dislocation, when older adults move away from their former community, so they lose some of the ties to their friends and colleagues. According to many studies the important determinant of social loneliness is the subjective evaluation of neighbourhood quality (Sharf & de Jong Gierveld, 2008), as well as the perceived vulnerability to crime and a resultant a fear of crime, thus the perceived neighbourhood safety (Sharf & de Jong Gierveld, 2008; Kemperman et al., 2019).

Regarding the physical characteristics of the living environment, the following aspects were found as influencing the perceived quality: attractiveness of buildings and the area; quiet and peacefulness of the area; accessibility and quality of parks and open green spaces, sufficiency of street lighting, and paths and pavements (Kearns et al., 2015). In terms of housing, there are some clues that poor social and mental health outcomes of occupants can be associated with living in high-rise flats, caused by the lower familiarity of neighbours and high turnover of residents in high-rise housing, but the evidence is somewhat mixed (Kearns et al., 2005).

Another factor that influences the subjectively felt quality of the neighbourhood is neighbourhood attachment, which means the level of involvement with the neighbourhood, feelings of affinity and shared values and an overall sense of community (Kemperman et al., 2019). Older people might be also adversely affected by changes in the physical appearance of cities, as some urban spaces are increasingly developed to meet the needs of affluent, younger inhabitants (Sharf & de Jong Gierveld, 2008).

3.2.6 Older adults with alcohol or drug dependency and severe chronic conditions non-complying to medical recommendations[P6]

Alcohol and drug dependency is problematic also in the population of older adults (Busse, 2010) and this issue is even more pronounced when there are associated multiple chronic illnesses (such as diabetes, heart conditions, COPD etc.). This group

of older adults usually does not comply with doctor´s recommendations, or even do not visit their GPs and many acute health crises are solved by calling emergency or visiting an emergency room (Choi et al., 2015). Emergency services thus may be often their only point of contact with the health care system. This situation carries a substantial burden for the health care system, and not only in means of financial costs, but it may also create frustration and feelings of helplessness in medical workers.

The idea behind the highlighting of this persona is that, even if it does not have to be a numerous group of older adults, if there is a solution found to somehow help them to better manage their health situation and reduce the number of emergency room visits, it would mean 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. Therefore, it is viable to consider employing methods of harm reduction, i.e not try to cure or change the older person, but offer some solution that could enable and strengthen their own means of controlling and managing their health status.

3.2.7 Oldest old and frail[P7]

This persona is dedicated to the oldest old, which is usually defined as the age category over 85 years of age. An important phenomena in this population is the frailty syndrome, that develops as a natural consequence of age-related decline (Clegg et al., 2013). Frailty is common in some part of the oldest old population (one third to one half) and manifests itself as sudden worsening of the overall condition, especially by frequent falls, exhaustion, unexplained weight loss, acute confusion (even deliriums), that may be triggered by minor stressors (Clegg et al., 2013). It has a dynamic nature, the acute episodes of frailty may be alternated by periods of normal functioning, so it is often described as good days and bad days, or bad time of day, or frailer seasons (Coker et al., 2019). Frailty increases dependency on others and is associated with the need of relocation to institutionalized settings (Granbom et al., 2014; Scheibl et al., 2019)

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 and if the older adults feel pressured, they often feel resentment (Scheibl et al., 2019). Sometimes the decision is made with an altruistic motive to make the family happy, to reduce the burden of informal caregivers (Oswald & Rowles, 2006). The motives of the informal carers for the decision to move an old person to an institutional setting are usually concerned around safety issues, while the older person usually prioritizes their autonomy (Scheibl et al., 2009).

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. Especially if the new space is smaller, this process may cause distress as these possessions are connected to fond memories and can serve as important symbols of identity (Oswald & Rowles, 2006).

3.2.8 Deafblind older adults (older adults with dual sensory impairment)[P8]

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 deteriorates at a later stage of life due to an accident, injury, disease or the aging process.

Representing between 0.2% to 2% of the population, persons with deafblindness are a very diverse yet hidden group and are, overall, more likely to have a lower economical and educational standing (World Federation of the Deafblind, 2018). The fact that vision and hearing plays a significant role in communication leads to the dependency of deafblind people on assistance. Deafblind people are both very varied in their communication requirements due to the differences in the extent, type, and history of their sensory impairments; personal characteristics and the skills they have developed. There is a need for the development of more assistive devices to support communication, additional guide-communicators, and training for hearing and sighted people in communicating with deafblind people (Hersh, 2013).

The following types of techniques are used in communication with deafblind people: spoken languages, sign languages (e.g. drawing onto the palm, finger Braille), contact (tactile) techniques (e.g. holding the other person's wrists or touching the other person's chin, lips, or throat). Barriers to communication, information, and mobility can have serious emotional and social consequences, restrict informed decision making, and reduce functional independence and the ability to perform daily living tasks (Bodsworth, Clare, & Simblett, 2011).

The persons who are deafblind who have high quality lives have several things in common. First, they have each, in their own way, come to accept themselves as individuals who have unique experiences of the world, and valuable gifts to share. This fundamental acceptance of self can occur regardless of the severity of the particular sensory losses or other challenges that a person has. Second, they have had educational experiences, which have helped them maximize their abilities to communicate and to function productively (Miles, 2008).

3.3 Final Personas

The personas continue on following pages. Based on the recommendations of the SHAPES partners we incorporated indexing of the specific user requirements and user needs (for example "Staying in good health" - P1-Req-1 In the personas). This was suggested to allow our colleagues - solution developers to trace each of the system specifications to the actual user needs.

Smart and **H**ealth **A**geing
through **P**eople **E**ngaging in supporting **S**ystems

S H A P E S

MEET ERNST P1

Motto: Staying in good health while still actively participating

Name: Ernst

Country: Germany

Age: 75

Area: Small town

Economical situation: Satisfactory

Digital literacy: Low ●━━ High

Health literacy: Low ━━● High

Affinity to technology: Low ━━● High

General description: Ernst is 75 years old, a recently retired former teacher from a college. He lives with his wife Alberta in a small town in Bavaria in their family home with a garden. Ernst loves to sing in the church choir and regularly does volunteer work for the local church charity. He and Alberta go once weekly to an older adults dancing club. They also love travelling – every year they go on a foreign holiday.
Ernst is in very good health, he exercises every day for 30 minutes in the morning. He likes to try new types of exercises according to his actual problems (usually slight knee pain or back pain) and often takes longer walks. Ernst sometimes worries about Alberta, who suffered a stroke 5 years ago and although she recovered very well, she has to go to regular medical check-ups every 6 months and he is always worried about the results. Together they enjoy doing the cognitive training exercises from the book Alberta got from her doctor.

⭐ What is important to Ernst

- Staying in good health P1-Req-1
- Keeping his hobbies P1-Req-2
- The health of his wife P1-Req-3
- Regular contact with his grandchildren P1-Req-4

🏠 Daily living

- Able to sustain all daily activities in the house, has cleaning help who comes twice a week to do the bigger cleaning and helps with the garden P1-Daily-1
- Able to drive P1-Daily-2
- Often meets friends personally and also through a social network P1-Daily-3
- Uses a social network for communication with his grandchildren and the wider family P1-Daily-4

🤝 Own resources, assets, support

- Economically independent, both his and Alberta´s pensions are enough for daily living and they have some savings and investments P1-Resources-1
- Their two sons with families live in a big city some 50 km away and come for regular visits and often help around the house P1-Resources-2
- Has good knowledge of possible care services in the local community P1-Resources-3

❤️ Health concerns **and limitations**

- Almost none, sometimes slight knee pain or back pain P1-Health-1
- Concerns regarding Alberta P1-Health-2
- Needs glasses for driving and reading P1-Health-3

💊 Health tests/ treatments/ medication

- A complete health check once in two years with his GP P1-Tests-1
- Bowel cancer checks every year P1-Tests-2
- Alberta has regular checks every 6 months P1-Tests-3
- Had both knee joints replaced P1-Tests-4
- Has undergone cataract surgery on his left eye P1-Tests-5

👥 Events, issues, personal concerns, technology

- Regular volunteer work for the church charity – helps with organisation of events, fundraising, leading of the church choir P1-Personal-1
- Loves his wife and cannot imagine living without her P1-Personal-2
- They both enjoy a dancing simulator they bought recently P1-Personal-3
- Ernst is using a smart watch to monitor his heart rate and pressure, plus to monitor his steps taken daily P1-Personal-4

🎈 Hopes and dreams/ what brings joy/ quotes

- *"It would be great if I could be sure that Alberta´s condition is not worsening"*
- *"Sometimes I go for a walk alone and it would be nice to have companions"*

✋ Unmet needs

- Ernst thinks he could perhaps benefit from better information about the after – stroke complications and recommended prevention to better support his wife P1-Unmet-1

Figure 3: Persona 1 - Active, healthy older adults

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MEET ROBERTO P2

Motto: Managing behavioural change and multiple conditions

Name: Roberto

Country: Italy

Age: 72

Area: Small town

Economical situation: Less affluent

Digital literacy: Low ●—— High

Health literacy: Low ●—— High

Affinity to technology: Low ——●—— High

General description: Roberto lives with his wife Bianca in a small Italian town, in a house with a garden. He is the owner of a small shop, which is now run by his nephew. Roberto and Bianca are childless and Bianca was recently diagnosed with Parkinson´s, though she has very mild symptoms so far. Roberto is slightly obese, he has diabetes and hypertension and smokes 20 cigarettes a day. Most of the time he feels quite well and does not like it when their family doctor or other specialists order him to change his lifestyle. That really irritates him, as talking, drinking wine and smoking with his best friends in the evenings is the best time of his day and nobody has the right to tell him how to live. Although, recently, when he was walking up the steps from town to his home, he had to stop for a few minutes, he couldn´t breathe and his heart rate was so high, that for a moment he was worried he might have a heart attack. He was also thinking whether the problem could have been caused by the new pills for diabetes that he started to take, as he was reading on Internet forums that some older people had this kind of problem.

⭐ What is important to Roberto

- The health of his wife Bianca P2-Req-1
- To keep his lifestyle P2-Req-2
- Rich social life with friends P2-Req-3
- Family ties with their brothers, sisters, nieces and nephews P2-Req-3

🏠 Daily living

- Still does most of the work around the house and in the garden, but sometimes his nephews come to help P2-Daily-1
- Twice a week goes to check the shop and manages orders P2-Daily-2
- Three to four evenings per week he meets friends in a bar for a few glasses of wine P2-Daily-3

🤝 Own resources, assets, support

- Owns shop, but profitability is seasonal P2-Resources-1
- Big family, there is always help if needed P2-Resources-2
- Also, he has many friends and a good local community that he can rely on P2-Resources-3

❤️ Health concerns and limitations

- Worries that the doctors might not know who prescribes which pills P2-Health-1
- Also worries about Bianca, if she has to go to a nursing home, he would not have the money for that P2-Health-2
- Sometimes he forgets to take his blood pressure pills P2-Health-3

🧪 Health tests/ treatments/ medication

- Takes six different medications P2-Tests-1
- Visits several specialists (diabetes, heart condition) every 3 months P2-Tests-2
- Bianca was diagnosed two years ago and goes for regular checks every 6 months P2-Tests-3

👥 Events, issues, personal concerns, technology

- He sometimes reads about various diagnoses on the internet, but wonders what of that is actually true P2-Personal-1
- He doesn't like to go to the doctors, as he always feels a bit ashamed and irritated P2-Personal-2
- Worries that he will have to change his lifestyle after all P2-Personal-3

🎈 Hopes and dreams/ what brings joy/ quotes

- *"It would be nice to hear some stories from people, who have the same diagnoses as me or as Bianca, but it needs to be somehow checked by doctors, that it is true"*
- *"It would be great if I had something that would tell me what is my health condition like, without having to go to the doctor. This way I could perhaps keep my evening habit with friends and stop worrying too much"*

✋ Unmet needs

- Roberto would also like to know more about Parkinson´s, perhaps meet other husbands whose wives have the condition, what the future holds, what to prepare for, what are the possibilities P2-Unmet-1

Figure 4: Persona 2 - Older adults with mild, but multiple chronic conditions

Smart and Health Ageing
through People Engaging in supporting Systems

S H A P E S

MEET AYESHA[P3]

Motto: Limiting risk of falls while increasing self-sufficiency and mobility

Name: Ayesha

Country: United Kingdom

Age: 79

Area: Outskirts of a big city

Economical situation: Low to moderate

Digital literacy: Low ●━ High

Health literacy: Low ━●━ High

Affinity to technology: Low ━●━ High

General description: Ayesha is a widowed 79-year-old Iraqi woman and she suffers from severe osteoporosis. Ayesha lives with her son's family and their children in a two storey terraced house with a small garden. The family runs a small bistro, she used to help there but now she can´t due to her problems. Fortunately, her room is on the ground floor, as for a few years now she has had a big problem to climb up the stairs, even the five steps that are at the front door take her a long time to manage. She used to meet at the nearby café with other women from the muslim community but now cannot go, as she walks so slowly, that she is afraid to walk on the street - too many cars that cross the road feels like a nightmare. But if she happens to go out on some special occasion, she is very carefully in plotting the route: she thinks beforehand about where the benches are on the way, where there is a small wall to sit on, where there are the missing railings… Sometimes she spends much more time on planning the route than on the actual realization. Ayesha has also problems with movement around the house and after a few unpleasant falls she developed a fear of falls, so she is limiting her movement even more. They rearranged the furniture downstairs, so she has places to grab on and she also has walking sticks in almost every corner. But most of the day she just sits in the living room and watches TV or she sits on the chair in the kitchen. Besides walking Ayesha also experiences problems with smaller movements like combing her hair or putting on socks and two years ago she had a very unpleasant accident in the bathroom where she fell and could not get out of the bath. Since then she uses a bath chair. They talk Arabic at home and Ayesha doesn´t speak English too well, se when the rehabilitation nurse comes, the grandchildren always help to translate.

What is important to Ayesha
- Keeping social ties with the community and with her family [P3-Req-1]
- Limiting risk of falls [P3-Req-2]
- Staying self-sufficient [P3-Req-3]

Daily living
- She is able to do some light work around the house, but only on the ground floor [P3-Daily-1]
- Usually sits in her room or in the kitchen and watches TV [P3-Daily-2]

Own resources, assets, support
- The family offers big support, but that makes Ayesha often feel like she is a burden [P3-Resources-1]
- Loves cooking for the whole family but it is getting more and more difficult [P3-Resources-2]

Health concerns and limitations
- Limping, limited shoulder movement, severe back pain [P3-Health-1]
- Often relies on pain medication and worries she could become addicted [P3-Health-2]

Health tests/ treatments/ medication
- Rehabilitation helps, but the nurse comes only once in two weeks [P3-Tests-1]
- In case of a fall she often has to wait until somebody comes home and helps her [P3-Tests-2]

Events, issues, personal concerns, technology
- Mobility restrictions led gradually to more isolation [P3-Personal-1]
- She is often feeling lonely and would like to go out to see friends [P3-Personal-2]

Hopes and dreams/ what brings joy/ quotes
- *"It would be great if I could see my friends and hear all their news more often"*
- *"I would exercise on my own, but I don´t know if I am doing it right"*

Unmet needs
- Support of better movement, better coping of domestic tasks (cooking, etc.) [P3-Unmet-1]
- Some physiotherapy that she could follow on her own [P3-Unmet-2]
- Easier pain management, that would not require a personal visit to the doctor [P3-Unmet-3]
- Adapting some leisure activities so she can still participate [P3-Unmet-4]
- Spending more time with friends and her community [P3-Unmet-5]

Figure 5: Persona 3 - Older adults with chronic musculoskeletal disorders

Smart and Health Ageing
through People Engaging in supporting Systems

S H A P E S

MEET ISABELLA AND MARCO^{P4}

Motto: Reimagining care while maintaining dignity; support of informal caregivers

Name: Isabella and Marco

Country: Spain

Age: 75

Area: Small town

Economical situation: Less affluent

Digital literacy: Low ●— High

Health literacy: Low —● High

Affinity to technology: Low ●— High

General description: Isabella is divorced and lives alone in a two-room apartment. She was diagnosed with Alzheimer´s two years ago and her illness is in the early to middle stage. After the diagnosis she just got the results and pills and was told to come for a check-up three years.

Isabella is already experiencing some problems with worsening of her memory: she started losing things: recently she misplaced her purse and could not find it for a week. The most embarrassing situation happened when she went out to the town and she got lost, couldn´t find her way home. And what was even worse, she met her old friend and could not remember her name. Recently she also accidentally switched off the electricity in the whole house and the heating was off for two days. Due to often forgetting, Isabella started keeping a notebook with the most important information but sometimes she just could not remember where she had put it. Her son Marco (46) lives nearby with his family and visits Isabella every day, does the chores, brings food. But he also has a part-time job in a factory, so he is often tired, worried and frustrated. He started to experience strange mood swings, especially when Isabella is asking the same question repeatedly. It happened a few times that he raised his voice at her, than he felt ashamed and guilty for his impulsiveness. Marco often worries about his mum when he cannot be with her, and he also worries she will get lost somewhere outside. They also have the help of a field nurse, but only twice a week for a few hours.

What is important to Isabella and Marco

- Maintain dignity and self sufficiency^{P4-Req-1}
- Keep social contacts^{P4-Req-2}
- Stay in home care as long as possible^{P4-Req-3}
- Help Marco to better cope with the caregiving situation^{P4-Req-3}

Daily living

- Able to do lighter chores, but keeps losing things^{P4-Daily-1}
- Often experiences a lack of meaningful activities, feels bored^{P4-Daily-2}

Own resources, assets, support

- Isabella has a small pension, but partly dependent on Marco and also on his wife, who sometimes comes to do the chores^{P4-Resources-1}

Health concerns and limitations

- Cognitive impairments^{P4-Health-1}
- Unhappy with the thought of her son taking care of her, she does not want him to help with hygiene, always waits for the nurse to visit^{P4-Health-2}

Health tests/ treatments/ medication

- Complete health exams every 2 years^{P4-Tests-1}
- Pills for cognitive symptoms^{P4-Tests-2}
- Often forgets to take her medication^{P4-Tests-3}

Events, issues, personal concerns, technology

- Isabella is most frustrated when she forgets names of close ones^{P4-Personal-1}
- Marco is worried that something will happen to her^{P4-Personal-2}

Hopes and dreams/ what brings joy/ quotes

- *"What about some electronic box to which I could store all my memories and it would talk to me and I could ask it whenever I can´t remember" (Isabella)*
- *"If there was some possibility to keep an eye on mum, something that wouldn´t scare her, but would alert me if anything goes wrong, that would be great"(Marco)*

Needs of caregiver

- Be able to have up to date information on the development of the illness^{P4-CgNeeds-1}
- Monitoring of all sorts of possibly dangerous situations in the house (fire, gas, electricity)^{P4-CgNeeds-2}
- Peer support groups, information, education, nutritional help, emotional support^{P4-CgNeeds-3}
- Respite care to be able to go on holiday^{P4-CgNeeds-4}
- Some technology that would help to keep his mother busy and focused^{P4-CgNeeds-5}

Unmet needs

- Missing some cognitive training^{P4-Unmet-1}
- Increase personal safety to be able to get out of the house more^{P4-Unmet-2}
- In-home activities customized to her interests and capabilities^{P4-Unmet-3}

Figure 6: Persona 4 - Older adults with neurodegenerative diseases

Smart and **H**ealth **A**geing
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MEET ROISIN [P5]

Motto: Support social contact and autonomy

Name: Roisin

Country: Ireland

Age: 84

Area: Suburb of a big city

Economical situation: Less affluent

Digital literacy: Low ●—— High

Health literacy: Low ——●—— High

Affinity to technology: Low ——●—— High

General description: Roisin used to live in a village in western Ireland. She has been a widow for 15 years. As she struggled to keep the house financially, her daughter Ciara persuaded her to move to the city and live with Ciara´s family (husband and two kids, who are 14 and 17). They live in a big flat in a new block of flats. Ciara´s husband works in IT and she is a nurse in a hospital.

Soon after moving to the city Roisin realized that it might have been a mistake, as most of the time she had nobody to talk to and started to feel quite lonely. Ciara´s family, for most of the day, are at work or at school, and Roisin doesn´t want to interfere too much with their lives in the evenings. Moreover, she does not feel very well in this city. The buildings are too high, pavements too narrow and too many cars everywhere. A few times she went for a walk or to the grocery shop, but it was not a pleasant experience. Once she even went to the nearest park, some 20 min walk, and came home quite terrified as all the benches were taken by some teenagers probably drinking or consuming something even worse. She also worries about the high crime rate in the neighbourhood and when she is outside she feels like an easy target.

What is important to Roisin

- Going to church, which is a 40 min walk, sometimes her daughter or grandkids accompany her, but feels like it is too much of a burden [P5-Req-1]
- To have something to fill the day, to look forward to [P5-Req-2]
- To have somebody to talk to [P5-Req-3]

Daily living

- Most of the days she is in the flat alone and she is afraid to go outside [P5-Daily-1]
- Some weekends the family goes together to the park for a coffee or a meal out, she feels very good when she can talk about her memories [P5-Daily-2]

Own resources, assets, support

- Although she has a small pension, economically she is dependent on her daughter Ciara [P5-Resources-1]
- Misses her old house with a garden and old friends from the village [P5-Resources-2]

Health concerns and limitations

- Arthrosis on both knees, sometimes feels moderate pain [P5-Health-1]
- Lately stopped sleeping well, keeps waking up at night and worries [P5-Health-2]
- Has hearing impairment and uses a hearing aid [P5-Health-3]

Health tests/ treatments/ medication

- Complete checks every two years [P5-Tests-1]
- Does regular exercises for the knees [P5-Tests-2]
- Uses a hearing aid, but not in public, as she feels ashamed [P5-Tests-3]
- Takes sleeping pills occasionally [P5-Tests-4]

Events, issues, personal concerns, technology

- During the day she likes watching TV, but in the evenings she worries that it is too loud [P5-Personal-1]
- She used to love bingo, but now does not have anybody to go with [P5-Personal-2]
- Also likes reading historic books [P5-Personal-3]

Hopes and dreams/ what brings joy/ quotes

- *"Oh, if there was someone who would just like me want to go out for a walk, without it feeling like a burden"*
- *"In an ideal world, I would jump on a teleport and play a session of bingo tonight!"*

Unmet needs

- Help with feeling more secure when going out [P5-Unmet-1]
- Help to find some companion for bingo, church and walking [P5-Unmet-1]
- Help being more independent in a big city [P5-Unmet-1]

Figure 7: Persona 5 - Lonely and/or socially isolated older adults

Smart and Health Ageing
through People Engaging in supporting Systems

MEET JARDA[P6]

Motto: improve quality of life while reducing burden on a healthcare system

Name: Jarda

Country: Czech Republic

Age: 68

Area: Big city

Economical situation: Very low

Digital literacy: Low ●——— High

Health literacy: Low ●——— High

Affinity to technology: Low ———●——— High

General description: Jarda has been, as he likes to say, "happily divorced" for the last 20 years. He lives in a small flat in a housing estate on the outskirts of a big city. Jarda used to play bass guitar in a once quite well known punk rock band called "And it will get worse". He still belongs to the punk rock community, although some of his mates have already died or, what is even worse according to Jarda, they changed their life style and stopped drinking. That is not a threat to Jarda – he loves going to punk events and to his favourite pub. Sometimes it is just a few pints, but other times, it can revert to a three day drinking binge. These binges are quite challenging and lately Jarda has not been able to cope with them very well. The last time his son found him sleeping in front of the house and called an ambulance. Jarda took this as a betrayal.

Although Jarda has severe hypertension and COPD, he refuses the regular visits to his GP, as he is bored with the repeated advice to stop smoking, stop drinking, to exercise and so on. Over the last 15 years he has not visited his GP and his only contact with the healthcare system was in the emergency room. He found out that if he feels bad (often has problems breathing or high blood pressure) and calls emergency, they usually don´t ask too many questions as they are too busy. A few times they wanted to keep him in hospital, but he always signed the release papers and left (as he was starting to feel withdrawal symptoms). A few times he also caused a conflict in the emergency room, as they wouldn´t let him go out for a smoke. Once the doctor even wanted to call the police. Another time a nurse told him that he was obnoxious. But Jarda didn´t really care and told them to shut up and do their job.

What is important to Jarda
- The punk-rock community, friends, events and the pub [P6-Req-1]
- To live his life the way he wants [P6-Req-2]

Daily living
- When he is at home, he usually sleeps or watches TV and eats junk food [P6-Daily-1]
- Likes to connect with the punk community through social networks [P6-Daily-2]

Own resources, assets, support
- He lives from a small pension and sometimes also works at the music shop owned by his friend [P6-Resources-1]
- His son supports him financially despite the fact, that Jarda sometimes doesn´t even talk to him (he is usually nicer when he needs to pay for his bills) [P6-Resources-2]

Health concerns and limitations
- COPD and high blood pressure [P6-Health-1]
- Alcohol dependency [P6-Health-2]

Health tests/ treatments/ medication
- Refuses regular GP visits [P6-Tests-1]
- States of severe breathing and pressure problems leading to ER visits [P6-Tests-2]

Events, issues, personal concerns, technology
- Jarda functions almost normally some of the time, but then once in a few weeks comes the drinking shift and resulting problems [P6-Personal-1]
- His son has an agreement with the neighbour that when Jarda disappears for a few days to make sure to call him [P6-Personal-2]
- Following repeated conflicts the rest of the family (ex-wife and daughter) do not communicate anymore [P6-Personal-3]

Hopes and dreams/ what brings joy/ quotes
- *"If only I could drink so much as I want without these bloody problems"*
- *"Maybe if I got some warning early on, I could avoid these incidents with the ER, but it would have to work without going to the GP"*

Unmet needs
- Jarda´s son would welcome some sort of monitoring, to know when his father has problems, and he also thinks that maybe some online peer group of ex-rockers could help [P6-Unmet-1]

Figure 8: Persona 6 - Older adults with alcohol or drug dependency and severe chronic conditions non-complying to medical recommendations

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SHAPES

MEET HELENA^{P7}

Motto: Safe and cared for while still autonomous

Name: Helena

Country: Slovakia

Age: 93

Area: Small village

Economical situation: Less affluent

Digital literacy: Low ●— High

Health literacy: Low ●— High

Affinity to technology: Low ●— High

General description: Helena is widowed and lives in her own house with a garden, with her two old cats. Except for arthrosis (it hurts to walk more than a few metres) and worsening of memory Helena had always enjoyed good health, until recently. But during the last year she started to have some bad days, and then she felt extremely exhausted and weak. There were some crisis situations recently: she was making herself a tea and started a fire accidentally. A few times she fell and could not get up and had to wait for her daughter for a few hours. Than the doctor said that she forgot to drink enough water and was dehydrated. Her daughter lives in the nearby village with her own family, so she visits almost every day and brings her food. Her grandchildren also come often and sometimes they stay for the weekend. The daughter is often worried that something bad will happen to mum. After these incidents the family started talking about possible placement into a nursing home. Helena was at first totally reluctant, but then a few more incidents happened, and she started considering this possibility more seriously. The daughter took her to the nursing home for a short visit, just to look around. It was not so bad, but the rooms were just too small Helena was sure that she would not be able to take all of her stuff with her. Since that visit she is constantly thinking about how she could live in such a tiny little room, not allowed to bring her favourite chair and pictures… and what about the cats?! And then, sometimes she thinks that maybe, if she moved, it would be better for her daughter´s family, they would be relieved. So during the last few months Helena has kept thinking about this and she is too afraid to make a decision.

⭐ What is important to Helena

- The cats and their wellbeing ^{P7-Req-1}
- Being clean and comfortable, regular food and drink, feeling safe ^{P7-Req-2}
- To keep old relationships^{P7-Req-3}
- Having always something to do^{P7-Req-4}

🏠 Daily living

- Daughter brings food and does more difficult chores ^{P7-Daily-1}
- Due to the arthrosis she cannot go far, just to the front garden to sit on her favourite bench ^{P7-Daily-2}
- Frequent visits by grandchildren ^{P7-Daily-3}

🤝 Own resources, assets, support

- Dependent on the support from her daughter ^{P7-Resources-1}
- The neighbour sometimes visits and feeds the cats when she feels weak ^{P7-Resources-2}

❤️ Health concerns and limitations

- Severe arthrosis, difficult walk ^{P7-Health-1}
- Frailty – some days are better, some are just bad, when she feels exhausted and often falls ^{P7-Health-2}

🧪 Health tests/ treatments/ medication

- Regular health checks by the GP ^{P7-Tests-1}
- Had cataract operation ^{P7-Tests-2}
- Takes sleeping pills ^{P7-Tests-3}

👥 Events, issues, personal concerns, technology

- The biggest issue is the hard decision about the possible movement to a nursing home ^{P7-Personal-1}

🎈 Hopes and dreams/ what brings joy/ quotes

- *"It would be great if I could just stay here and daughter would not worry about my health"*

✋ Unmet needs

- Monitoring of the risk situations around the house (electricity, fire, falls)^{P7-Unmet-1}
- Support of healthy nutrition and drinking regime (with frailty often the risk of dehydration and malnutrition) ^{P7-Unmet-2}
- Encourage continued participation in social, neighbourhood and civic activities ^{P1-Unmet-1} ^{P7-Unmet-3}
- Support more movement / exercise

Figure 9: Persona 7 - Oldest old and frail

MEET FREDRIK [P8]

Motto: Support guide-interpreter communication help to retain independence

Name: Fredrik

Country: Norway

Age: 75

Area: Big city

Economical situation: Semi-affluent

Digital literacy: Low ●——— High

Health literacy: Low ———● High

Affinity to technology: Low ●—— High

General description: Having vision and hearing impairments since birth, Fredrik went to schools for the deaf as a child, before becoming a certified tablet fitter as a young adult. He also enjoyed quite ordinary activities like dancing, sports, outdoor life and advocacy work, also had a strong interest in chess. Living alone since his divorce in 1980, he has maintained a close relationship with his three kids, grandkids and great-grandkids. After becoming deafblind in the 1980s he acquired a degree in Law at the University of Oslo and started working as a Political Consultant and active self-advocate representing persons with deafblindness.

Fredrik once experienced an acute illness at home and his kids helped him to the hospital. The preliminary examination ended with him being dismissed in spite of being in agony, as the doctor assumed that Fredrik had understood the questions and responded to them, which was not the case. Understanding of deafblindness would have revealed that he had just responded to sounds, not words. Another doctor noticed the disagreement and intervened and finally a more thorough examination was conducted, revealing a potential severe infection, leading to Fredrik being committed to hospital for a week. No interpreter-guides were made available during the initial and critical admission phase.

What is important to Fredrik

- To remain living independently at his own house as long as possible [P8-Req-1]
- To have access to guide-interpreter services [P8-Req-2]
- Relationship with family and friends [P8-Req-3]

Daily living

- Home-help is essential for Fredrik to be able to remain at home. It comes twice per week and must be trained in communicating with deafblind people, otherwise there would be a need for a guide-interpreter [P8-Daily-1]
- Regular physical actiivity, exercising at home [P8-Daily-2]

Own resources, assets, support

- His friends are mostly persons with deafblindness themselves, and they are to a certain degree able to communicate directly. [P8-Resources-1]
- His children and grandchildren provide significant support [P8-Resources-2]

Health concerns and limitations

- Fredrik has had difficulties learning Braille and therefore has not been able to use modern assistive products like Braille readers/writers to communicate. [P8-Health-1]

Health tests/ treatments/ medication

- He got CI implants 15 years ago, that enabled him to communicate hearing familiar voices in accommodated environments. Without these implants he would now be totally deafblind. [P8-Tests-1]
- Slight hypertension, medicated, controls every 6 months [P8-Tests-2]

Events, issues, personal concerns, technology

- Due to the fast developing virtual world Fredrik has started feeling isolated and more and more unable to interact with society at large without assistance by interpreter-guide services. [P8-Personal-1]

Hopes and dreams/ what brings joy/ quotes

- *"It would be so nice if there was some technical solution that would at least to some extent replace the human guide/interpreters. Though it must be adaptable to individual needs."*

Unmet needs

- Ernst thinks he could perhaps benefit from better information about the after – stroke complications and recommended prevention to better support his wife [P8-Unmet-1]

Figure 10: Persona 8 - Deafblind older adults (older adults with dual sensory impairment)

4 Use Cases Development

This chapter is dedicated to the use cases. The persona-based method of use case development is explained, as well as the PACT criteria for an effective development of use cases and scenarios. The relationship between the personas and the use cases are outlined and the thirteen general use cases are presented at the end of the chapter.

4.1 Methods of use cases development

A persona-based method was used for the subsequent development of use cases. This method includes a kind of prototyping procedure. During the personas development, the basic needs of older people without any serious health problems, with multiple chronic conditions and the frail elderly (i.e. involving serious health problems, low social support, or low income) were characterized, focusing on the intersection of functional and emotional needs with medical and personal needs. An approach that addresses functional needs could improve health outcomes and meeting the fulfilment of emotional needs may contribute to a better well-being of older people. Thus, the combination of the personal, emotional, functional, and medical aspects is considered to be suitable also for the development of use cases since it has the potential to orient care so that it can better manage the coping with life in the elderly (see Figure 11).

Under this task use cases were generally conceptualized as user stories with plots describing the actions and decisions of a user in a particular context (Bhattacharyya et al., 2019). This scenario-based approach can help future SHAPES designers foster a better understanding of user needs, and develop a suitable service options and tools.
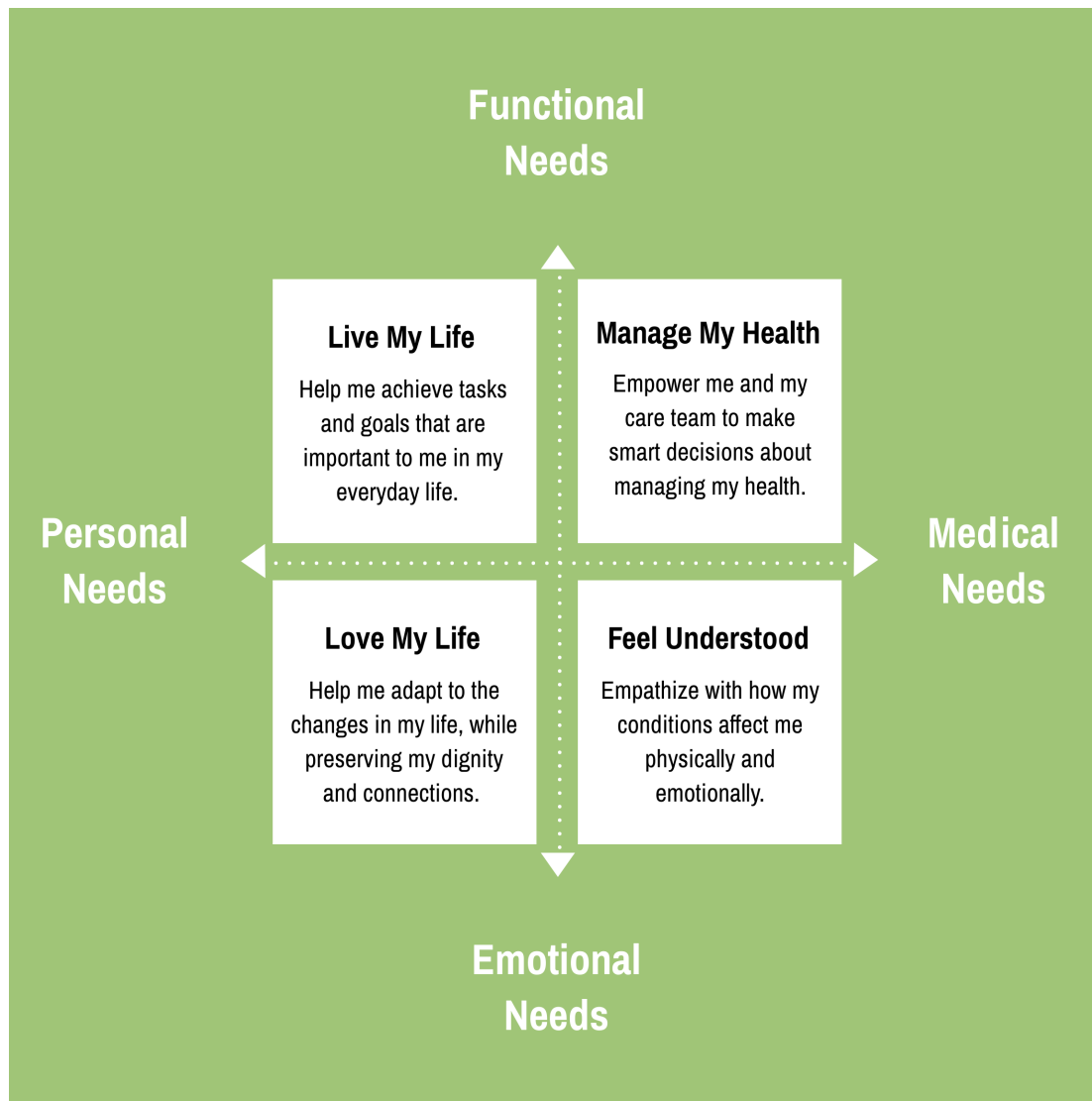
Figure 11: The Intersection of Needs (Source: Bhattacharyya et al., 2019)

The development of use cases proceeded in several steps. At the beginning, rough prototypes of use cases were created and shared with the team members to gain feedback on the usability and functionality of the tool. These initial prototypes were designed following the PACT criteria (see table 4) for an effective development of use cases and scenarios (Huis in't Veld et al., 2010). Furthermore, the following criteria were used to select the initial use cases: a) usefulness for Receiving Agent (Registration Operator), b) appropriateness toward personas developed in the previous step of Task 2.5, c) possible risks that may emerge during the use of particular technologies, and d) possible ethical issues that may arise from the application of the digital or technological solution in practice. Based on the feedback from the team members, rough prototypes were subsequently revised and refocused if needed to provide a suitable basic path of a scenario. This sharpening of the rough prototypes of use cases was very important for gaining a fine-tuned use case that mirrors well the needs of typical users and typical context of use.

Table 4: The PACT Criteria (Source: Huis in't Veld et al., 2010)

Criterion	Definition
People	Roles and/or actors of typical users involved in delivering and receiving the telemedicine intervention.
Activities	Activities to be performed by the actors in order to successfully provide and receive the telemedicine intervention.
Context	Puts the telemedicine intervention in a health-care context. Activities always happen in a context, so there is a need to analyze these two together.
Technology	Typically, to realize telemedicine, technology needs to transform some input data into some output data which can be used by the medical expert and patient to support the activities defined earlier. The features of the technology are input, output, communication and content.

After the sharpening of the rough prototypes, the basic forms of use cases were developed including the descriptions of the basic path of a scenario (i.e. Main Success Scenario), the main scope of the SHAPES use case, and actors included (e.g. RA - Receiving Agent; RO - Registration Operator). After this step, the subsequent task was to suggest suitable components and digital solutions for each use case. Three main sources of available information were used for seeking the most suitable components and digital solutions for each of the basic forms of use cases:

a) components and digital solutions included in available scientific literature (based on an extensive literature review of papers published in relevant journals, e.g. Journal of Telemedicine and Telecare, Telemedicine and E-health, Journal of Medical Internet Research, Journal of the American Medical Informatics Association, Interactive Learning Environments, Informatics for Health Social Care, BMC Bioinformatics, or International Journal of Medical Informatics);
b) components and digital solutions available in offers of providers;
c) components and digital solutions included in the SHAPES project proposal. Based on a synthesis of these sources of information, the most suitable components and digital solutions were chosen and inserted into the use cases.

The general use cases were then subjected to a collaborative evaluation by the team members and were also discussed within SHAPES Calls (teleconferences of the SHAPES network). Based on this collaborative evaluation, use cases were revised and improved. Furthermore, alternative paths of scenarios, i.e. variations and extensions, were also developed and added to the basic path of scenarios, i.e. Main Success Scenario. Finally, all use cases were evaluated by the team members in

terms of usefulness for Receiving Agent (Registration Operator), appropriateness toward personas developed in the previous step of Task 2.5, possible risks that may emerge during the use of particular technologies, and possible ethical issues that may arise from the application of the digital or technological solution in practice. After this evaluation, the use cases were finalized.

Based on the recommendations of the SHAPES partners we incorporated indexing of the specific user requirements and user scenarios in the use cases (for example "RA switches on the device" - UC1-Scenario-1). This was suggested to allow our colleagues - solution developers to trace each of the system specification to the actual user needs and test cases.

4.2 Final use cases and their relationships to personas

Finally, 13 different general use cases were developed. Following the goals of Task 2.5, these general use cases are aimed to illustrate the breadth and variability of the technology used for the improvements of the quality of life of older adults, rather than specific use cases developed for designing concrete digital solutions (this will be done in subsequent stages of the SHAPES project, however). Thus, the final set of general use cases include:

- Assistive Technology for Reading
- Self-Management of Chronic Conditions
- Home Environment Monitoring
- In-Home Cognitive Training
- In-Home Glucose-Monitoring
- In-Home Self-Management Heart-Monitoring
- In-Home Post-Hospital Aftercare
- In-Home Video-Monitoring
- Location Tracking
- Meal Ordering
- Medication Reminder
- Motor Exercising with Robot
- Summarizer of Information from Internet

Connection to personas is as follows. Some of the general use cases are serviceable across most of personas developed in the previous step of Task 2.5, e.g. Assistive Technology for Reading, Summarizer of Information from Internet, Meal Ordering, or Medication Reminder. The general use case Self-Management of Chronic Conditions providing relatively broad and universal spectrum of assistive support, e.g. assisting in daily health and care activities, recommending appropriate dietary recommendations, etc., can also be serviceable across most personas, however, there is a requirement of the absence of neurodegenerative changes as these changes could possibly lead to ignoring or misleading of recommendations provided

by the Self-Management of Chronic Conditions application. Thus, this use case is not suitable for Persona 4. In contrast, merely use case In-Home Cognitive Training is supportive for this group of older adults (Persona 4) as it can support the possible improvement of the cognitive functions. For Persona 3 that is typical by various musculoskeletal problems, a general use case Motor Exercising with Robot is very useful as it can improve motoric abilities and flexibility of a body.

The set of general use cases includes various kinds of monitoring, Home Environment Monitoring, In-Home Glucose-Monitoring, In-Home Heart-Monitoring, In-Home Post-Hospital Aftercare, In-Home Video-Monitoring, and Location Tracking. These monitoring devices serve different functions. For example, Home Environment Monitoring is focused on the control and monitoring of home conditions like the regulation of the Self-Management temperature, light, or various electric devices of daily use. This may help frailty people that are represented by Persona 7, but also people suffering from serious and chronic diseases - e.g. Persona 6, Persona 4. In contrast, In-Home Video-Monitoring is much more focused on the detection of falls and the actual state of the clients that are at the risk of falls, i.e. Persona 7, Persona 5, Persona 3. The general use case Location Tracking is specifically designed for Persona 4, i.e. demented people that are at a greater risk of being lost when they are travelling or moving uncontrollably from place to place. Furthermore, the general use case Home Post-Hospital Aftercare is designed for the situation of post-hospital aftercare for in-home patients after a surgical operation or another serious medical intervention.

In the following pages, all 13 general use cases are presented to gain a detailed information about the contents of the general use cases:

Smart and **H**ealth **A**geing
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S H A P E S
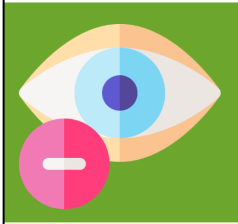
READING ASSISTIVE TECHNOLOGY^{UC1}
Compensatory assistive technology for patients with poor eye sight (use case)

Description: Older people suffering from poor eye sight need assistance technology that enables them to read information on the computer screen

Digital Solution Proposed

- Digital application that processes the image/video on the computer screen and adjusts it to the quality of sight of the Receiving Agent (RA)^{UC1-Solution-1}

Components

- Series of filters within the digital application for smart phones and notebooks^{UC1-Components-1}

Actors

- Receiving Agent (RA) ^{UC1-Actors-1}

Scope

- To enable the image/video to be clearly visible on the computer screen for the RA ^{UC1-Scope-1}

Preconditions

- RA is able to use the compensatory digital application ^{UC1-Precon-1}
- RA is familiar with the type of device technology ^{UC1-Precon-2}
- Device is working properly and is charged ^{UC1-Precon-3}

Main Success Scenario

1. RA switches on the device ^{UC1-Scenario-1}

2. RA opens the required application and inserts the search term ^{UC1-Scenario-2}

3. RA uses the compensatory digital application that processes the image/video on the computer screen^{UC1-Scenario-3}

4. The proportion of the image/video on the computer screen is adjusted ^{UC1-Scenario-4}

5. RA reads or watches the content of the image/video on the computer screen ^{UC1-Scenario-5}

6. RA ends the application and turns off the device ^{UC1-Scenario-6}

Figure 12: Use case 1 - Assistive Technology for Reading

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SELF-MANAGEMENT OF CHRONIC CONDITIONS ^{UC2}
For patients with chronic illness (use case)

Description: Patients with a chronic illness needs continual monitoring and reminding of various features, e.g. control of medication, assisting in daily health and care activities, recommending appropriate dietary recommendations, and saturating their social needs. Therefore, there is a requirement for a complex system that would cover these needs.

Digital Solution Proposed

- Self-Management of Chronic Conditions tools ^{UC2-Solution-1}

Components

- Health care system ^{UC2-Components-1}
- System for control of medication ^{UC2-Components-1}
- System for being interconnected with relatives as well as medical personal ^{UC2-Components-1}

Actors

- Receiving Agent (RA) ^{UC2-Actors-1}

Scope

- To provide a complex care to patients with chronic illness ^{UC2-Scope-1}

Preconditions

- RA is able to use the system on an expected level ^{UC2-Precon-1}
- System is set up for the RA in a proper way to achieve the following instructions by the RA ^{UC2-Precon-2}

Main Success Scenario

1. RA gets close enough where he/she can see, hear, and communicate with the customized Self-Management application ^{UC2-Scenario-1}

2. The Self-Management application communicates with the RA in an interactive dialog ^{UC2-Scenario-2}

3. The Self-Management application reminds the RA about medication as well as important daily health and care activities, involving also dietary recommendations ^{UC2-Scenario-3}

4. RA performs the medication as well as important daily health and care activities according to the Self-Management application ^{UC2-Scenario-4}

Variations/Extensions

- The Self-Management application can be associated with a smart cup holder that registers the consumed amount of liquid and transfers the gathered data wirelessly to a software assistant. A software assistant can automatically store the amount of consumed liquid and compare it to adaptively adjusted ideal values ^{UC2-Variation-1}

Figure 13: Use Case 2 - Self-Management of Chronic Conditions

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S H A P E S

HOME ENVIRONMENT MONITORING^{UC3}

Sensors for assisted living (use case)

Description: Older people, whether with some chronic disease or not, want to stay at home as long as possible. However, there is a problem that they often are not able to manage. For example, the regulation of the temperature, light, or various daily-used electric devices. There is a need for an integrated sensor system to enable elderly people, or those at risk, to live independently in their own homes longer, while providing reassurance to their family and carers.

Digital Solution Proposed

- Integrated sensor system for assisted living ^{UC3-Solution-1}

Components

- In-home devices (sensor unit measuring the temperature, light levels, noise and motion; power monitors) ^{UC3-Components-1}
- Platform for transfer of the data through the Internet (social application, web application, server and database) ^{UC3-Components-2}

Actors
^{UC3-Actors-1}
- Receiving Agent (RA) ^{UC3-Actors-1}
- Registration operator (RO)

Scope
^{UC3-Scope-1}
- To indirectly monitor the older person´s wellbeing and allow family members or carers to remotely check on their safety and wellbeing

Preconditions
^{UC3-Precon-1}
- The installed system of wireless sensors is fine-tuned by the RO ^{UC3-Precon-2}
- Battery is charged up ^{UC3-Precon-3}
- The sensor system is tuned correctly for proper operation
- Internet connection is working correctly ^{UC3-Precon-3}

Main Success Scenario

1. The system is indirectly monitoring the RA´s activity and wellbeing within the RA´s house during their daily living activities ^{UC3-Scenario-1}

2. All the gathered data are transformed into online graphs of activity, accessible through the web application to the RA and selected family members, caregivers, etc. ^{UC3-Scenario-2}

Variations/Extensions

- The on-person device may allow the RA to simply make a phone call to a predefined telephone number or send the current GPS location via an SMS message to a different, or the same, predefined phone number in situations when he/she is away from home ^{UC3-Variation-1}
- The social interaction application allows messages, pictures and videos to be securely shared by the RA's friends and family to a tablet running the application, located within the RA's home ^{UC3-Variation-1}

Figure 14: Use Case 3 - Home Environment Monitoring

Smart and Health Ageing
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SHAPES

IN-HOME COGNITIVE TRAINING^{UC4}
For patients in the early stages of neurocognitive deficits (use case)

Description: Older people at risk of further neurocognitive decline should be stimulated to improve their cognitive functions.

Digital Solution Proposed

- In-home digital application enabling mental stimulation exercises ^{UC4-Solution-1}

Components

- Systems and games for mental stimulation ^{UC4-Components-1}
- Digital communication cards ^{UC4-Components-2}

Actors

- Receiving Agent (RA) ^{UC4-Actors-1}

Scope

- To engage the RA with a cognitive stimulation task supporting the improvement of memory, attention skills, etc.^{UC4-Scope-1}

Preconditions

- RA is able to communicate with the application on an expected level ^{UC4-Precon-1}
- RA is familiar with a similar type of device / technology ^{UC4-Precon-2}
- Device is working properly and is charged.^{UC4-Precon-3}

Main Success Scenario

1. RA switches on the device ^{UC4-Scenario-1}

2. RA opens the application ^{UC4-Scenario-2}

3. RA creates and customizes the interaction mode for the engagement ^{UC4-Scenario-3}

4. RA chooses the interaction mode ^{UC4-Scenario-4}

5. RA plays mental stimulation games ^{UC4-Scenario-5}

6. RA ends the application and turns off the device ^{UC4-Scenario-6}

Figure 15: Use Case 4 - In-Home Cognitive Training

Smart and Health Ageing
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IN-HOME GLUCOSE-MONITORING[UC5]

Remote glucometer automatically sending the measured data to the care-provider system (use case)

Description: For patients with diabetes, regular glucose measurements are one of the basic ways to prevent deterioration. There is a need for a simple system that immediately uploads the measurement results to the care-provider's system.

Digital Solution Proposed

- Digital application that provides sending the data from the glucometer to the care-provider's system [UC5-Solution-1]

Components

- Remote glucometer [UC5-Components-1]
- Smartphone [UC5-Components-2]
- Platform for transfer of the measured data through the Internet [UC5-Components-2]

Actors

- Receiving Agent (RA) [UC5-Actors-1]
- Care-provider [UC5-Actors-2]

Scope

- To facilitate patients with diabetes to measure glucose regularly [UC5-Scope-1]

Preconditions

- RA is able to use the device on an expected level [UC5-Precon-1]
- Device is working and a charged spare battery is always available [UC5-Precon-2]
- Glucometer is working and data transfer is possible [UC5-Precon-3]

Main Success Scenario

1. RA turns on the remote glucometer [UC5-Scenario-1]

2. RA makes a blood glucose measurement [UC5-Scenario-2]

3. The smartphone application downloads the glucose readings from the glucometer via the Bluetooth adaptor, than uploads the information to the health-care provider system [UC5-Scenario-3]

4. Glucose data are immediately available to view by the RA via the Personal health record (PHR) [UC5-Scenario-4]

5. RA turns off the glucometer [UC5-Scenario-5]

Variations/Extensions

- Using the insulin pump [UC5-Variation-1]

Figure 16: Use Case 5 - In-Home Glucose-Monitoring

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IN-HOME SELF-MANAGEMENT HEART-MONITORING^UC6
(use case)

Description: Heart failure patients often do not seek medical help in the early phases of deterioration, due to the decreased possibility of recognizing worsening symptoms. Therefore, it is important for patients to record symptoms and regularly take medication. However, a big part of the elderly does not use computers and Internet. Therefore, there is a requirement for a user-friendly system that would enable elderly patients to report their health status and medication use and their professional caregivers in detecting early signs of deterioration.

Digital Solution Proposed

- Simple and user-friendly home tele-health system ^UC6-Solution-1

Components

- Tablet, touchscreen ^UC6-Components-1
- Health diary forms in the form of an application for a tablet ^UC6-Components-2 (possibility to use slider or choose values from a pre-existing list)
- Blood pressure monitor ^UC6-Components-3
- Oxygen saturation monitor ^UC6-Components-4
- Web-based care-provider application ^UC6-Components-5

Actors

- Receiving Agent (RA) ^UC6-Actors-1

Scope

- To submit regular health reports using a medical diary in and an application for a tablet ^UC6-Scope-1

Preconditions

- RA is familiar with the system and can use the tablet ^UC6-Precon-1
- All devices are charged ^UC6-Precon-2
- Limits are set correctly ^UC6-Precon-3

Main Success Scenario

1. RA fills in "health diary form 1" (shortness of breath, intake of as-needed medications, morning weight) using the application on a tablet ^UC6-Scenario-1

2. The data are transferred from the application via mobile Internet from the RA's home to the appropriate caregiver/physician ^UC6-Scenario-2

3. Sent data is displayed to the RA´s professional caregiver/physician as numbers and graphs in the Web-based interface ^UC6-Scenario-3

4. If the measured values are above or below the limits (set by responsible caregivers), the system will generate a notification ^UC6-Scenario-4

Variations/Extensions

- If the RA´s professional caregiver/physician thinks there is an indication of the necessity of receiving daily blood pressure and oxygen saturation values. RA uses the blood pressure monitor and the oxygen saturation monitor and reports the measured values using "health diary form 2" ^UC6-Variation-1
- RA´s caregiver/physician can also see an exact digital image of the health diary form as filled in by the RA ^UC6-Variation-1
- In some cases, the system should generate SMS alarm text messages to a nurse's mobile phone ^UC6-Variation-1

Figure 17: Use Case 6 - In-Home Self-Management Heart-Monitoring

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IN-HOME POST-HOSPITAL AFTERCARE UC7

Post-hospital aftercare for in-home patients after a surgical operation or another serious medical intervention (use case)

Description: In-home patients after a surgical operation or another serious medical intervention often need special coaching and communication with a specialist. Therefore, there is a requirement for a complex system that would cover these needs.

Digital Solution Proposed

- Tele-coaching tools UC7-Solution-1

Components

- Online communication platform with health care specialists UC7-Components-1
- System for control of medication

Actors

- Receiving Agent (RA) UC7-Actors-1
- Registration Operator (RO) UC7-Actors-2

Scope

- To provide a complex online in-home care to patients after a surgical operation or another serious medical intervention UC7-Scope-1

Preconditions

- System is working properly, charged and is tuned for user usage UC7-Precon-1
- Internet connection is working correctly UC7-Precon-2
- RA is able to communicate with the system on an expected level UC7-Precon-3

Main Success Scenario

1. RA gets close enough where he/she can see, hear, and communicate with the customized tele-coaching application UC7-Scenario-1

2. The customized tele-coaching application communicates with the RA in an interactive dialog UC7-Scenario-2

3. The customized tele-coaching application contacts the RO UC7-Scenario-3

4. RO has a dialog through the online platform in which he/she informs the RA about the actions required for his/her recovery UC7-Scenario-4

5. RA conducts the actions required for his/her recovery UC7-Scenario-5

Variations/Extensions

- RO may have a dialog through the online platform in which monitors the RA´s actual state and the continuation of recovery UC7-Variation-1

Figure 18: Use Case 7 - In-Home Post-Hospital Aftercare

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IN-HOME VIDEO-MONITORING[UC8]

Remote monitoring and fall detection system for older people (use case)

Description: Many older people live at home alone and want to stay independent. Frail older people and people with substantial problems with their locomotor system often face the risk of falling down and getting fatal or terminal injuries. Falling is one of the most common and dangerous accidents for elderly individuals and a significant factor affecting the living quality of the elderly. There is a need for remote monitoring to gain an on-going access to the actual state of these patients and to detect falls of older people in the home telecare environment.

Digital Solution Proposed

- A Multimodality Fall Detection and Telecare System [UC8-Solution-1]

Components

- Multimodality signal sources (accelerometer, activity sensors, pressure sensors, door sensor, microphones, systems of video-cameras for monitoring the Receiving Agent) [UC8-Components-1]
- Platform for transfer of the data through the Internet [UC8-Components-2]
- Home-server [UC8-Components-3]
- Information-sharing platform for the Receiving Agent (RA) and caregivers [UC8-Components-4]

Actors

- Receiving Agent (RA) [UC8-Actors-1]
- Registration operator (RO) [UC8-Actors-2]

Scope

- Continuously monitor the movement of the RA in his/her home and provide immediate assistance in case of a fall [UC8-Scope-1]

Preconditions

- The installed system of an accelerometer, microphones, and cameras fine-tuned by RO [UC8-Precon-1]
- System is working properly, charged and is tuned for user usage [UC8-Precon-2]
- RA agrees with the system [UC8-Precon-3]

Main Success Scenario

1. All the movements of the RA are monitored by the accelerometer communicating with the home-server via Bluetooth [UC8-Scenario-1]

2. If triggering conditions are met, the RA's audio message can be used as a speech recognition function to confirm or cancel the alarm [UC8-Scenario-2]

3. When a fall has been detected, an alarm e-mail is sent to the caregivers (doctor and the RA's relatives) [UC8-Scenario-3]

4. When the caregivers receive an alarm e-mail, they can review the fall scene video through the Information-sharing platform [UC8-Scenario-4]

5. Otherwise, the system terminates the current detection and goes back to the initial state [UC8-Scenario-5]

Figure 19: Use Case 8 - In-Home Video-Monitoring

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LOCATION TRACKING^{UC9}

Remote monitoring of frail older people with dementia (use case)

Description: Frail older people with dementia are at a greater risk of getting lost or falling when they are travelling or moving from place to place. There is a requirement for a system capable of tracking the senior's position and in case of a fall contact the caregiver.

Digital Solution Proposed

- Location tracking and fall detection system ^{UC9-Solution-1}

Components

- Wearable device (accelerometer sensor, GPS, GSM, Wi-Fi module, microcontroller) ^{UC9-Components-1}
- Platform for transfer of the data through the Internet ^{UC9-Components-2}
- Cloud server ^{UC9-Components-3}

Actors

- Receiving Agent (RA) ^{UC9-Actors-1}

Scope

- To track an elderly person constantly and in the case of emergency or fall inform the caretaker ^{UC9-Scope-1}

Preconditions

- Device is charged and ready to go ^{UC9-Precon-1}

Main Success Scenario

1. RA puts on the portable device (attached to a belt) ^{UC9-Scenario-1}

2. Device is activated from sleep mode by movement ^{UC9-Scenario-2}

3. The device monitors the RA´s position constantly ^{UC9-Scenario-3}

4. Device goes to sleep mode without movement to save battery ^{UC9-Scenario-4}

Variations/Extensions

- The global coordinates of a location of the RA can be sent to the mobile application in the caretaker's mobile phone. After receiving the latitude and longitude, the global location of the RA can be viewed on Google Maps ^{UC9-Variation-1}
- In case a fall is detected, the system can send alert messages to the caretaker via SMS and email with the location information, which was obtained by using a GPS module ^{UC9-Variation-2}
- RA can manually activate the system to send alert messages by pressing the button if necessary ^{UC9-Variation-3}
- The emergency messages can also be uploaded to a dedicated cloud server for the caretaker to monitor or check the recorded fall history through a web application ^{UC9-Variation-4}

Figure 20: Use Case 9 - Location Tracking

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MEAL ORDERING^{UC10}
Food delivery for elderly people (use case)

Description: Older people living at home alone are often unable to prepare their own nutritious full-fledged meal. There is a need for a simple meal ordering and delivery system.

Digital Solution Proposed

- Smart application for ordering a ready-to-eat meal, which is then delivered to the Receiving Agent (RA) by the care service _{UC10-Solution-1}

Components

- Platform for ordering a meal through the Internet _{UC10-Components-1} _{UC10-Components-2}
- System for delivering the prepared meals to the RA

Actors

- Receiving Agent (RA) _{UC10-Actors-1}
- Registration Operator (RO) – Meal Service Provider _{UC10-Actors-2}

Scope

- To provide a food delivery system for elderly people living alone at their home _{UC10-Scope-1}

Preconditions

- Internet connection is working _{UC10-Precon-1}

Main Success Scenario

1. RA uses the platform to select and order the meal _{UC10-Scenario-1}

2. The order data is transferred to the RO via the Internet _{UC10-Scenario-2}

3. RO registers the request and delivers the selected meal to the RA _{UC10-Scenario-3}

4. The meal supplier delivers the meal _{UC10-Scenario-4}

5. RA confirms delivery of the meal _{UC10-Scenario-5}

Variations/Extensions

- System can inform RA about data transfer failure _{UC10-Variation-1}

Figure 21: Use Case 10 - Meal Ordering

Smart and **Health** **Ageing**
through **People** **Engaging** in supporting **Systems**

MEDICATION REMINDER^{UC11}
(use case)

Description: Older people often show worsened memory as well as insufficient discipline and motivation to follow the doctor´s recommendation of medication. There is a need to remind them about their medication in a suitable time.

Digital Solution Proposed

- Digital application that elicits a sound reminder in time when the Receiving Agent (RA) should take their pills or another form of medication [UC11-Solution-1]

Components

- Automatic digital timer with a sound system [UC11-Components-1]

Actors

- Receiving Agent (RA) [UC11-Actors-1]
- Registration Operator (RO) [UC11-Actors-2]

Scope

- To provide the RA with a sound signal in a suitable time for the pill intake or another form of medication [UC11-Scope-1]

Preconditions

- Sound volume is set to the conditions of the RA or more speakers are used to cover the living space of the RA [UC11-Precon-1]

Main Success Scenario

1. RO programs the timing of pill intake within the device - automatic digital timer with a sound system [UC11-Scenario-1]

2. RO installs the device into the home of the RA [UC11-Scenario-2]

3. The device - automatic digital timer with a sound system - performs a sound signal in a suitable time for the pill intake [UC11-Scenario-3]

4. RA hears the sound signal [UC11-Scenario-4]

5. RA takes his/her pills or another form of medication [UC11-Scenario-5]

Variations/Extensions

- Device can notify RA repeatedly in case the sound signal is ignored [UC11-Variation-1]

Figure 22: Use Case 11 - Medication Reminder

Smart and Health Ageing
through People Engaging in supporting Systems

MOTOR EXERCISING WITH ROBOT^{UC12}
(use case)

Description: Older people with low mobility should be stimulated to improve flexibility and increase muscle strength. There is a need for a system for a workout that reduces the possibility of injury due to falling from improper balance.

Digital Solution Proposed

- Socially assistive robot performing the chair workout game ^{UC12-Solution-1}

Components

- Socially assistive robot programmed to provide chair exercise ^{UC12-Components-1}
- Remote control ^{UC12-Components-2}

Actors

- Receiving Agent (RA) ^{UC12-Actors-1}

Scope

- To engage the RA to workout supporting the improvement of motor skills ^{UC12-Scope-1}

Preconditions

- RA is able to use the robot ^{UC12-Precon-1}
- Robot and remote control are working and ready to go ^{UC12-Precon-2}

Main Success Scenario

1. RA sits in a chair in front of the robot ^{UC12-Scenario-1}

2. The robot prompts RA to exercise ^{UC12-Scenario-2}

3. RA starts the exercises by pressing the button on the remote control ^{UC12-Scenario-3}

4. The robot demonstrates the arm exercises with its own arms and asks the RA to imitate ^{UC12-Scenario-4}

5. The robot gives the RA feedback in real time, providing corrections ^{UC12-Scenario-5}

6. RA successfully completes the sequence and ends the exercise ^{UC12-Scenario-6}

Variations/Extensions

- RA can request a rest break at any time during the interaction by pressing the button on the remote control ^{UC12-Variation-1}
- Robot can be replaced by X-BOX with the exercise application ^{UC12-Variation-2}

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Figure 23: Use Case 12 - Motor Exercising with Robot

Smart and **H**ealth **A**geing
through **P**eople **E**ngaging in supporting **S**ystems

SUMMARIZER OF INFORMATION FROM INTERNET ^{UC13}

An assistive technology supporting the accessibility of information from the Internet (use case)

Description: The everyday leisure activities of active, healthy, older people should be supported. Therefore, the information about various events that active, healthy, older people could take part in should be accessible to them.

Digital Solution Proposed

- Digital application that processes the information from various online sources, filters them according to the Receiving Agent´s (RA) needs and presents them to the RA in an easily and accessible form ^{UC13-Solution-1}

Components

- Automatic digital application summarizing various online sources ^{UC13-Components-1}

Actors

- Receiving Agent (RA) ^{UC13-Actors-1}

Scope

- To provide the RA with information that could be important for his/her engagement in various everyday leisure activities together with other active, healthy, older people ^{UC13-Scope-1}

Preconditions

- RA is able to use the device and is familiar with it ^{UC13-Precon-1}
- Device is working, charged and ready to go ^{UC13-Precon-2}
- Device is preconfigured for relevant information interesting for the RA ^{UC13-Precon-3}

Main Success Scenario

1. RA switches on the device ^{UC13-Scenario-1}

2. RA opens the application ^{UC13-Scenario-2}

3. Automatic digital summarizer of information excerpts the customized information from various online sources ^{UC13-Scenario-3}

4. Automatic digital summarizer presents the selected information to the RA ^{UC13-Scenario-4}

5. RA reads or watches the content ^{UC13-Scenario-5}

6. RA ends the application and turns off the device ^{UC13-Scenario-6}

7. RA fastens the device to the charger ^{UC13-Scenario-7}

Variations/Extensions

- As a device, a smart TV with a custom application could be used. ^{UC13-Variation-1}

Figure 24: Use Case 13 - Summarizer of Information from Internet

5 Ethics and Security Issues

We declare that all works conducted in Task 2.5 and all works during the preparation of this Deliverable/Report were in accordance with Article 8 of the European Convention on Human Rights [European Court of Human Rights. Case of Roche 32555/96 (19.10.2005)] that serves as an interpretative aid to the member states when it comes to determining the ambit and extent of fundamental rights and fundamental legal principles at the level of their own constitutional law.

All works conducted in Task 2.5 and all works during the preparation of this Deliverable/Report also follows the RESPECT Code of Practice (http://www.respectproject.org/code/), i.e. a code that synthesizes the contents of a large number of existing professional and ethical codes of practice, together with current legal requirements in the EU.

We declare that all data used during the preparation of personas were non-personal and that the handling of these non-personal data was fully in accordance with the Regulation on the free flow of non-personal data (FFD) [Regulation (EU) 2018/1807].

Furthermore, there were no international data flows during the works on Task 2.5 and during the preparation of this Deliverable/Report, however, despite that we fully respected the European rules and values as formulated in The European Strategy for Data [COM(2020) 66 final].

Despite no concrete digital services being provided to end users during the course of Task 2.5, all the general ideas about the proposed future digital solutions (general use cases) were prepared in respect to The Digital Content Directive [Directive (EU) 2019/770] that contributed to empowering individuals by introducing contractual rights when digital services are supplied to consumers who provide access to their data.

Furthermore, all the proposed general ideas about the future digital solutions were prepared also fully in accordance with particular security acts, especially in accordance with the Cybersecurity Act (CSA) [Regulation (EU) 2019/881].

Despite no personal data being gathered within the course of Task 2.5, all the sources used for the preparation of basic personas fulfilled the Data Protection Directive and General Data Protection Regulation (GDPR).

6 Future Challenges and Risks

As mentioned above, the main goals of Task 2.5 were to develop basic personas and general use cases. However, it is necessary to say that the SHAPES team is at the beginning of a 4-year SHAPES project, so initially, the basic personas and general use cases represent a rather basic background than final prototypes. The future challenge will be to adapt and modify the basic personas and general use cases to particular conditions of the pilot sites (for the Pilot Themes of WP6), in other words for the SHAPES small-scale pilots and demonstrations and the large-scale pilots for the validation of the SHAPES Platform capabilities and benefits for care recipients, caregivers and care service providers. This further step of the SHAPES project is a big challenge for future months.

Within these follow-up actions, an acceptance of the digital solutions from the perspective of the final users will be challenged. At this stage and based on the background we acquired during our past research experience, the lack of engagement of the end-users should be considered as a possible risk for the implementation of the SHAPES small-scale and large-scale pilots planned within WP6. Thus, in future stages of the SHAPES project, the potential barriers for users from the population of older people should be explored to open an avenue for further fine-tuning of the SHAPES actions and practical implementations of the digital solutions.

For this purpose, several remarks should be taken into account here. Importantly, the strategy of coping with late life has been revealed to be one of the important factors influencing the adoption of a new digital solution to the life of older people (Golant, 2017). As figure 25 illustrates, the choice between adoption of a new digital solution or inclination towards a more traditional coping solution is influenced by an individual appraisal of a digital solution and its user-friendliness (Figure 25).
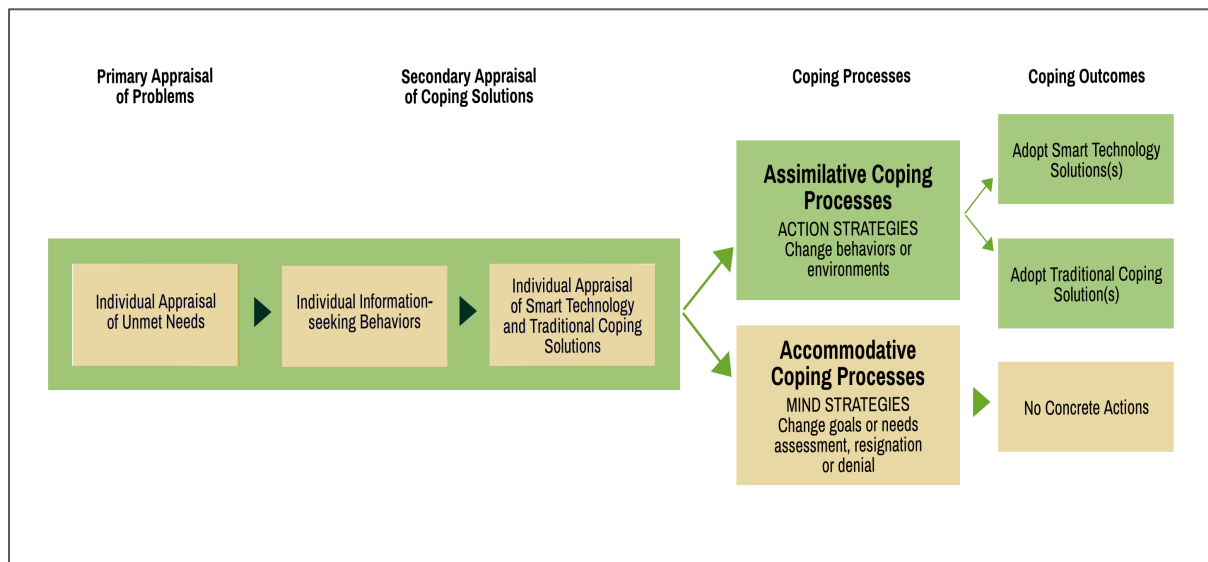
Figure 25: Individual Appraisal and Coping Processes Underlying the Adoption of Coping Solutions (Source: Golant, 2017)

Therefore, further SHAPES actions focused on the implementation of digital solutions into the lives of older people within the SHAPES Pan-European Pilot Campaign should take an individual appraisal of digital technologies into account. Moreover, it is important to seek new ways of influencing the attitudes toward digital technologies in older people who simply do not like digital technologies or new systems at all, because they feel an aversion and show resistance to the use of digital technologies in their daily lives.

7   Conclusions and Fulfilment of Goals of Task 2.5

As proposed in the original project proposal of the SHAPES project, Task 2.5 had two main Deliverable objectives:

- to develop basic personas with their prototypical attributes, attitudes, behaviours and characteristics
- to develop general use cases including scenarios of use of digital solutions

Both of these objectives have been fully fulfilled. The present Report Deliverable presents eight new personas that are ready to be used in future stages of the SHAPES project. These personas with their typical attributes, behaviours and characteristics are considered to be evidence-based knowledge bases that provide models of users of future SHAPES digital solutions and innovations.

Furthermore, 13 general use cases including scenarios were developed. These general use cases including scenarios represent a range of possible SHAPES digital solutions and innovations. However, they are ready to be supplemented by some other, new use cases during future continuation of the SHAPES project.

Both the personas and general use cases represent a preliminary, evidence-based knowledge base that provide general models of users of future SHAPES digital solutions and innovations, respecting also the requirement of a high quality output of the action that will enable successful implementation of the SHAPES plan and promoting models, approaches, and solutions for the extended independent living of older people. The personas and general use cases developed within Task 2.5 contribute to a better understanding of the user needs for future designing of the SHAPES architecture and system requirements. All the works and activities that were conducted during the first five months of the project duration within Task 2.5, is now ready to inform the core SHAPES Platform and its socio-technical deployment and iterative improvement within future diverse Pilot Sites, contributing also to the fulfilment of the proposed objectives of the SHAPES. In the next phase we assume specification of the personas and use cases based on the thematic pilots in WP6 and results of the tasks of WP2. The view of the healthcare systems (WP3) can also be incorporated as one of the next steps.

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