

Technology based solutions as enablers for active and assisted living (AAL)

Development of a conceptual system
to assist in ageing

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MASTER THESIS



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LUND
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Abstract

Old age is something that affects everyone, sooner or later and in different ways. The question on how to take care of older persons and support them when getting older might be more relevant now than ever, as the population over 60 years old is expected to grow with 40 percent in the coming 10 years.

In an older human being, every age is preserved. In an 80-year-old mind there might live a little girl, a defiant teenager, a tired parent and a successful middle-aged woman, all at once. Life is full of memories, both happy and sad, the different experiences make each person unique. This is why it is important to see every person individually.

This project has the individual in focus and aims with technology to ease the inevitable difficulties of ageing by giving the older adult more control and insight in their care.

The result of this project is a study on how welfare technology can be implemented in an older person's home to create a safe environment and how it should interact with its users. This is presented through two deliverables, a concept of a final product and an external booklet including a compilation of tools. The booklet is seen as a byproduct of the project that summarizes important parts of the process and creates a framework with connected tools to be used in future concept development of welfare technology.

The concept and the booklet created in this thesis are based on literature, stakeholders and users. The material is meant to work for a wide range of people, but is designed with a changing, ageing human in mind.

Keywords: eldercare, welfare technology, smart home, safety, technical design

Sammanfattning

Ålderdomen berör oss alla, förr eller senare och på olika sätt. Frågan i hur vi ska ta hand om äldre personer och stötta dem i åldrandet är kanske mer aktuell nu än någonsin, då populationen över 60 år beräknas öka med 40 procent de kommande 10 åren.

I en äldre människa finns alla åldrar bevarade. I en 80-åring kan det bo en liten flicka, en trotsig tonåring, en trött småbarnsförälder och en framgångsrik medelålders kvinna. Ett liv är fullt av minnen, glada som ledsna, och de olika upplevelserna gör varje människa unik. Det är därför viktigt att se till den äldre individuellt.

Detta projekt har individen i fokus och är ämnat att med teknik underlätta åldrandets oundvikliga svårigheter genom att ge den äldre större kontroll och insikt i sin vård.

Resultatet av detta projekt är en studie om hur trygghetsskapande teknik kan implementeras i hemmet hos en äldre människa samt hur den skall interagera med dess användare och berörda aktörer. Detta presenteras genom både ett koncept över en slutprodukt samt en extern booklet över en sammanställning av verktyg. Bookleten ses som en biprodukt av projektet som sammanfattar delar av designprocessen och bildar ett ramverk med tillhörande verktyg för framtida utveckling av koncept inom välfärdsteknik.

Konceptet och bookleten som tas fram i detta examensarbete är baserade på litteratur, inblandade aktörer och användare. Materialet är ämnat att fungera för en bred grupp människor men är designat med en förändrande, åldrande människa i åtanke.

Nyckelord: äldreomsorg, välfärdsteknik, smart hem, säkerhet, teknisk design

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Lund, January 2021

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1 Introduction

This chapter introduces the master thesis and describes the problems it aims to solve along with its purposes and goals.

1.1 Background

Having an ageing global population puts a lot of pressure on eldercare. That the population of 60+ years will grow around 40 percent in the next ten years, makes it very relevant to elaborate the care system that supports ageing (United Nations, 2017). Active and Assisted Living (AAL) is an EU-funded program that has supported the development of many innovative technologies that supports people facing the challenges of ageing (AAL Programme, 2020). This thesis focuses on defining as well as developing products that fit into the AAL-market based on research in ageing, the healthcare system and current technology on the market.

This report is the result of a master thesis in Mechanical Engineering with Industrial design at Lund University. It is performed at the department of Design Sciences, in collaboration with a technology company based in southern Sweden. The end result consists of two parts, a conceptual product referred to as the final concept and a short book containing a compilation of concept development tools, this is referred to as the booklet. The two parts are developed parallel throughout the project and the booklet has the end goal to be delivered to the company for them to use in future development.

1.2 Goal and problem discussion

The main goal is to develop a conceptual model for a possible future system, five to ten years from now, that will use technology to facilitate assisted living for the older population. It is also important to investigate how the company can fit into the market around eldercare. The final concept is designed based on both existing and future products by the company. It is important that the final concept integrates in a good way with other products that the company has in their assortment. It should

also have potential in the AAL-market where the company is strongly represented, USA and western Europe.

During a market analysis and user research, the following questions are to be answered to understand the user needs:

- What are the needs for older people today as well as tomorrow?
 - What problems and frustrations does people of older age feel on a day-to-day basis?
 - What are the different living situations for people of higher age?
- How does eldercare work today?
- How are companies within welfare technology working today?
 - Which products are new on the market?
- What market opportunities can be found?

1.4 Delimitations

Although the USA is considered an important market for the product, the development mostly focuses on the Swedish market since there is more access to people and former studies made in Sweden. However, the final concept is made to work worldwide.

The final concept is developed to be sold to municipalities and senior homes, not privately, even though that could be a possible course of action as well.

Even if the goal is for municipalities and private actors in senior living facilities to purchase the end product, it is decided for the group not to go more into detail on how that implementation would work. The project group decided not to look into the pricing and limitations for municipalities and senior livings when it comes to buying new products.

For the final concept, focus lies in developing the conceptual part and not the soft- and hardware.

Covid-19 restrains the group from both meeting with potential users and from testing prototypes in person, however digital meetings are performed, and the product tested in theory.

2 Methodology

This chapter aims to present the different methods in product development used in the project. This chapter describes the framework methods along with how the development methods are implemented in different parts of the process. The research- and development methods are then presented in more detail in the order that they are implemented.

2.1 Design process methodology

This section describes the framework of the project which is based on a methodology called *The double diamond*.

2.1.1 The Double Diamond

The Double Diamond is a framework for innovation developed by the Design Council in 2004. It is described as a clear, comprehensive and visual description of the design process. As the title might disclose, the method consists of a symbol of two diamonds that represent a process of wide exploring and then more convergent thinking to take focused action (Design Council, 2020). See figure 2.1 below.

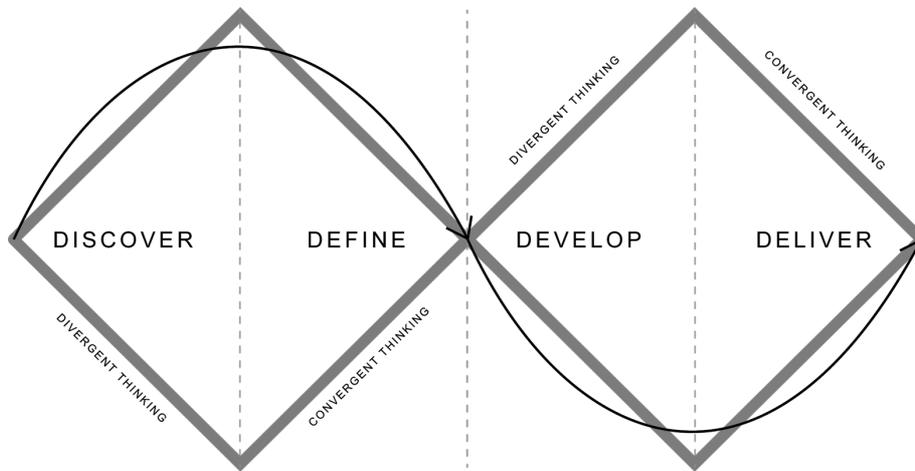


Figure 2.1- Illustration of the Double Diamond.

The process is not as linear as its straight lines and many times the framework helps the user learn something more about the underlying problems that, as the Design Council themselves call it, “might send them back to the beginning”. The different phases of the design process are: Discover, Define, Develop and Deliver.

1. Discover - A question for the designers to ask themselves here is: What is the problem? This phase involves doing research and spending time with people who are affected by the issues to explore it more widely and deeply.
2. Define - The insight and research already gathered helps in this phase to define the challenge in a different way.
3. Develop - In this more divergent phase, the designers are encouraged to find different solutions and develop them.
4. Deliver - Here it is included to take focused action in the form of improving the best working solution (Design Council, 2020).

2.2 Implemented process

When innovating and designing, reflection and iteration are big parts of the process, making every Double Diamond use unique. The implemented process has the Double Diamond as a framework and contains a number of different methods chosen to suit this specific project, they are described in detail further on in this chapter. Figure 2.2 is an illustration of the implemented design development and where the different methods take part.

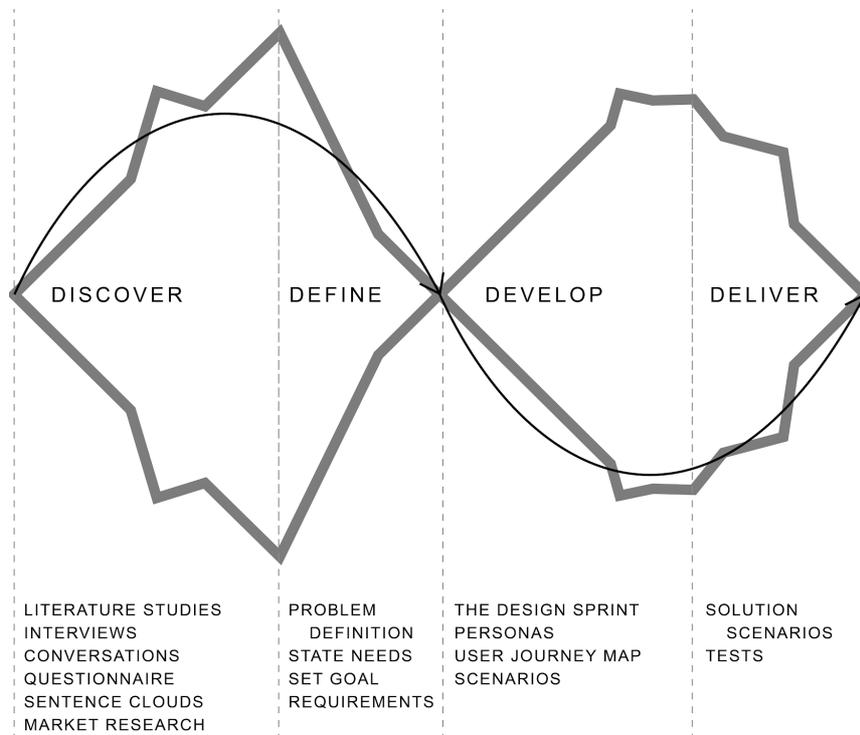


Figure 2.2 - Graphic illustration of where the methods are implemented.

The different methods implemented in this iterated figure will be described in detail in the sections that they are used.

2.3 Planning method

To manage a project, planning and coordinating resources and tasks is necessary. A Gantt chart is used as a planning method and consists of a horizontal timeline with bars representing the tasks to be performed during the project. It is easy to see which tasks depend on each other and which tasks can be completed in parallel (Ulrich & Eppinger, 2012).

Gantt charts are useful to show:

- What activities that are to be done
- When they begin and end
- How long each activity should last
- If activities overlap with others

- The start and end date of the entire project (Gantt, 2020)

The chart created for this thesis project can be found in Appendix A along with an iterated version that shows a timeline more accurate to the reality of the project.

2.4 User Experience

The group has found inspiration and guidance in the methodology of user experience. It is a process where the designer focuses on the user and their needs and follows a product's usage. It is about how people using a product feel about it when touching, looking at and holding it (Sharp, Rogers & Preece, 2015).

The chosen methods are used for creating helpful material in defining the user as well as highlighting important findings (UIUX Trend, 2020).

In this project user experience is applied to create a wireframe of the problem and an understanding of the user. It is mainly used in processing material from both market research as well as user research. Examples of methods that will be later described are:

- Personas
- Scenarios
- User Journey Map

2.5 The Design Sprint

A design sprint aims to compress a design process into one week with the purpose to effectively solve problems in a short period of time. The design process doesn't lead to a detailed ready-to-ship product but provides rapid progress and gives an idea if the project is headed in the right direction (Knapp, Zeratsky & Kowitz, 2016).

Below is a shorter description of the different days of a sprint. Since the three later days focus more on prototyping, they are not a part of this particular project and the implemented version of the sprint is described in section 5.1.

Monday

In summary the steps included during Monday are: creating a long-term goal, setting the sprint questions, creating a map and choosing a target. The sprint starts with looking at the desirable end point of the project and a long-term goal is created. During the afternoon the perspective of the experts is stated and discussed. At the end of the day an ambitious but manageable piece of the problem is picked, and that becomes the target.

Tuesday

In summary Tuesday includes: a review of existing products and sketching following a four-step process that emphasizes critical thinking over artistry. The sketching is individual and contains individual brainstorming.

Wednesday

In summary Wednesday will provide a step-by-step plan for your prototype based on a storyboard created by a selection of Thursday's storyboards.

Thursday

The main goal for Thursday is to turn the storyboard into a realistic prototype. The prototype has to be realistic enough that the test persons don't have to use their imagination, otherwise the prototype will not provide information, in the test the reaction has to be honest and natural.

Friday

Friday is for testing the concept and prototype. This will show how far the project has gone and if it is in the right direction. During the week a test group of relevant persons should have been gathered. Five people are necessary to be able to see patterns in the usage (Knapp et al., 2016).

3 Discover

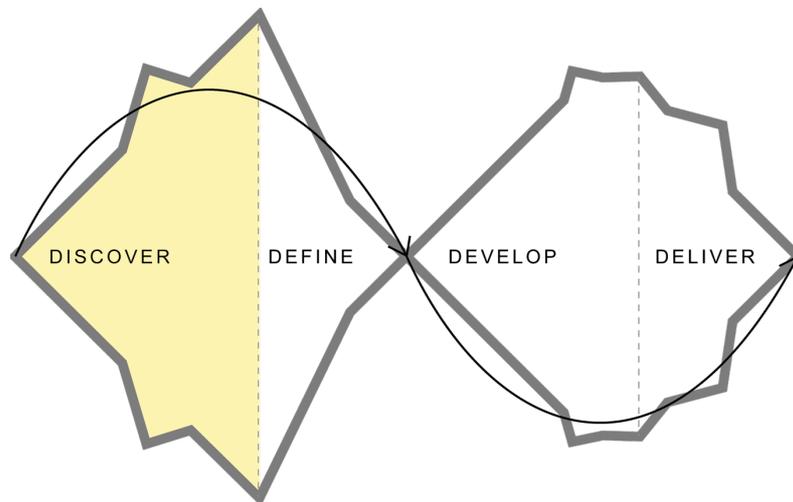


Figure 3.1 - Discover in the double diamond framework

The phase shown in figure 3.1 aims to provide the needed research in understanding the problem and the need. The information is used as a base for the upcoming chapters. To understand the problem, research is made on the problem area and the users that are to interact with the concept.

3.1 Background research

The background research is primarily based on a literature review. Literature reviews are made to summarize the studied field and are a useful component of any design project. It aims to provide the project with information from published sources, giving the current project insights of previous research that has been done in relevant areas (Martin & Hannington, 2012). Published literature to search can be journals, government reports, product information etc. and electronic searches are a very efficient way to gather information (Ulrich & Eppinger, 2012).

A lot of research has been made on topics such as eHealth, Active and Assisted Living (AAL), Active and Healthy Ageing (AHA) and senior care. The relevant information from the literature review in this project is organized by research categories as Martin, B and Hannington, B suggests (2012) and can be found in

chapter 3.1 (Martin & Hannington, 2012). These categories are the ageing population, the Swedish eldercare and health technology.

3.1.1 The ageing population

The global population is ageing. In 1980 there were 382 million, and in 2017 there were 962 million, more than twice the amount. It is expected that in 2050, the older population will have doubled again, making it important for governments and municipalities to implement policies to adapt to this ageing population (United Nations, 2017).

One of the biggest public health issues for older people is falling (Hawley-Hague, Boulton, Hall, Pfeiffer & Todd, 2014). Every year in the EU, almost 40 000 individuals over 65 years die from falling, which equals almost 35% of all injury deaths for older people (Eurosafte, 2016). Products have been developed to detect, protect from and prevent falls using proprietary algorithms and sensors (Infonomy, 2020). Falling is one of many health issues characterized as *geriatric syndromes* and these appear to be better predictors of death for older people than their specific diseases (World Health Organization, 2018). Other common geriatric syndromes are frailty and delirium amongst others, see figure 3.2 for an illustrative description of geriatric syndromes where the largest words are the most common syndromes.



Figure 3.2 - Illustration with common geriatric syndromes

When speaking about aspects of ageing, there are normally two categories used to describe it. Primary ageing is the gradual, inevitable process of bodily changes through life. Changes and damages in muscles that lead to slowed movements, fading vision, impaired hearing etc. Everyone affected by primary ageing at some point experiences reduced ability to adapt to stress, decreased resistance to infections, and more. Secondary ageing processes are different as they result from diseases and poor health as a consequence of no exercise, smoking, obesity etc. Secondary ageing is more often something preventable, through better lifestyle choices or the use of the correct medicine (Fight Aging, 2006).

There are indicators that older adults become more and more likely to live independently (United Nations, 2017). This together with an increasingly older

population implies that it becomes more and more important to assist the ageing population to stay independent by increasing their autonomy. This is something that AAL was initialized to help with in an efficient way for both the aged community, the caregivers and the families (Taleka and Thyagaraju, 2018). Another reason for people to have an independent living environment is to feel more in control. According to Holman and Lorig (2000), health care can be delivered more effectively if the patients are fully involved in the process, making almost all decisions together with the doctors and carers.

Cost effectiveness is also something that is highly discussed when talking about the future health care for older people. The fact that the older generation is growing makes it even more important to consider the most effective way to develop the health care system for older people. According to the Swedish National Board of Health and Welfare the number of people over 80 years old that have interventions under the Social Services Act, will double over the next ten years. Considering that, there will be an increased need for effective solutions within eldercare (Socialstyrelsen 2020).

Economically, it is preferable to prevent or delay chronic conditions instead of curing them at a later stage. Some things that can prevent chronic conditions are to prioritize: preventing injuries, improving physical activities and increasing employment for the older persons (World Health Organization, 2002).

3.1.2 The Swedish eldercare

Sweden has a bit of a special challenge. Municipalities in Sweden are responsible for home care, home help services and long-term somatic care, which makes it an economical challenge for the country to care for an older population that is growing (Trydegård & Thorslund, 2003). Municipalities are more often choosing to privatize parts of their eldercare and the persons can choose themselves whether they want to get assistance from public or private operators. However, the municipalities are always responsible for allocating home help or a place in special housings. Some other services the older persons can apply for from their municipality and the extent of certain care is subject to an assessment of need (Sweden.se, 2020).

3.1.3 Health technology

Two concepts that are especially relevant in this report are eHealth and Welfare Technologies.

eHealth is a broad term about using digital tools and information and communication technologies (ICT) in healthcare (Innovatemedtec, 2020). Some examples of subdomains when it comes to eHealth are:

- Electronic Medical Records
- Health IT systems
- Virtual healthcare
- Mobile Health (also called mHealth)

The World Health Organization (WHO) works with partners at both global and regional level to promote the use of ICT in health development, among other reasons since eHealth has shown to increase access to health information and promote positive changes in health behaviors. WHO has also stated that there is a potential in eHealth to improve quality and safety of care. Therefore, they encourage incorporation of eHealth into health systems and services everywhere (World Health Organization, 2020).

A second concept mainly used in the Nordic countries is Welfare Technology. One of many definitions is that it is the technology used to improve the services provided by the welfare society. Such services can be nursing, care, rehabilitation, physical therapy, etc., and parts of these services are technological solutions that therefore are called welfare technologies. They are not restricted to any specific sector and could therefore as well as in healthcare also extend into education, training, employment and social services (Nordic Centre for Welfare and Social Issues, 2010). Some areas where welfare technology is used are:

- To increase security for people
- To help people with disabilities to participate in activities
- For older persons to keep their independence
- To maintain or increase physical activity
- To support relatives (with ICT services)

According to Nordic Welfare Centre, welfare technology is all technology that in some way improves the lives of those who need it, and an important way to reduce the pressure on care and welfare (Nordic Welfare Centre, 2020).

3.2 User research

To investigate the field, other than through literature, different stakeholders needed to be heard. The three different methods used to gather information are interviews, conversations and questionnaires. The questions asked and subjects discussed can be found together with the full questionnaire in appendix B. A complete list over insights from these methods can be found in appendix C and the result is highlighted through sentence clouds in the section 3.2.4.

3.2.1 Interviews

Interviews are a fundamental research method to collect more personal opinions, perceptions and attitudes. There are many ways to conduct interviews. Key informant interviews concentrate on a targeted audience with expert knowledge in the area, while stakeholder interviews focus on information from specific roles with a vested interest in the matter (Martin & Hannington, 2012).

The methodology chosen is for semi-structured interviews. Semi-structured interviews allow the interviewer to adapt the order of the questions depending on the situation and ask follow-up questions if needed (Sharp et al., 2015).

Examples of questions asked in a semi-structured format is:

- *Could you tell the group a bit about how you work with eHealth today?*
- *What type of technology are you familiar with?*

Interviews are held with nine different people, all with different experiences within eldercare. Almost all of the interviews are done face-to-face using a video conference system and they are recorded and/or transcribed to prevent misunderstandings. An overview can be seen below:

- Three municipal workers
 - Working or have been working in Helsingborg, Lund and Hörby
 - In some way responsible for eHealth or Welfare technologies in their municipality
 - Key informants with specialized knowledge in health technology
- Three caregivers
 - Working or have been working with older people in Sweden
 - Have insight in the use of technology in health care
 - Stakeholders that have worked with home care at some point
- Three older people
 - Between the ages of 75-87 years
 - All of them living at home
 - All of them with some form of geriatric syndrome but only getting assistance regularly from relatives

3.2.2 Conversations

Conversations around a particular subject are like open-ended or unstructured interviews. They are exploratory data collections and can often go a bit deeper than structured interviews (Sharp et al., 2015).

Conversations with various stakeholders are conducted throughout the project. The initial ones are held to gain insight into the product market and the stakeholders' expectations. Several meetings are held with staff from the company that usually

are involved in product development. The aim of these conversations is to get a deeper understanding of what is needed from the company's perspective and also to discuss the progress being made by the group. Some areas that were discussed in the conversations are:

- *What is new on the market right now?*
- *If there were no limits to technology in the future, what would we develop?*

The people involved have various insight in the products being developed at the moment. The conversations take everything from 20-90 minutes each depending on the situation and they are all unstructured.

3.2.3 Questionnaires

Questionnaires are efficient tools for collecting bigger quantities of data, however careful attention should be paid to how the questions are formulated since an online format of research gathering very easily can be misinterpreted (Martin & Hannington, 2012).

Data gathering with questionnaires should be thought out carefully and it is important not to focus on just one data gathering technique. Therefore, methodological triangulation is a common way to investigate data and it basically means to use more than one technique (Sharp et al., 2015).

The questionnaire formed for this project is sent out to people of all ages and requires the respondent to fill out the age in order for the group to compare respondents of different ages. The questions are divided into two parts: Firstly, the group wants to get an insight in what makes a person, no matter age, experience a feeling of well-being. Secondly the questionnaire asks how familiar the respondents are with using technology and what type of technology is used by them on a daily basis.

3.2.4 Result of user research - key points

A way to organize and communicate the conversations, questionnaires and interviews are through word- or sentence clouds. Word clouds are a great way to tell user stories and display quick insights as a graphic shape. Typically, the more a word or phrase occurs in a certain context, the larger it appears in the cloud. (UX for the masses, 2020). Three different sentence clouds are developed by taking quotes and common responses from the user research methods above and putting them in a cloud. This is done to communicate thoughts of caregivers, municipality workers and the main user, see figure 3.3 below.

The insights from interviews, conversations and questionnaires are used as inspiration for product requirements in section 4.2.3.



Caregiver

Important that the solutions are attractive to its users Older persons don't trust their safety alarms

"It is important with integrity based solutions" Welfare technology used by older persons is not appreciated because it feels like help for sick people

Older persons enjoy using tools like skype to keep in touch with relatives

Depression caused by lack of context and independence is a problem



Older adult

Welcomes welfare technology, but doesn't use a lot of technology today

"We wish to live at home for as long as possible" Uses smart phone and tablet every day

Asks for help from relatives Feels restricted in mobility

The most desired feature for a smart home system is safety and security

Tech solutions today do not integrate with to each other

Concerned about not being able to get help in case of an accident First contact with municipalities are usually the need of a safety alarm

It is not a problem to integrate older people with technology

Have to start working preventive

Solutions today: Alarm bracelets Important to focus on
 Camera for night supervision involuntarily loneliness
 Digital signing Solutions have to be
 Digital locks easy to learn
 Ipad



Municipality worker

Figure 3.3 - Sentence clouds summarizing different interviews, conversations and the questionnaire.

3.3 Market research

To understand the market, research is made on what products already exist and how their solutions work.

Having an understanding of competitive products is critical to the development of a new one. It can provide a great source of ideas for the product design and reveal information on the strengths and weaknesses of the competition. By benchmarking concepts, the designers push the design to match or even exceed their competitors' (Ulrich & Eppinger, 2012). Technology based eldercare is a growing industry and both potential competitors and complementors can be found globally. The list of companies was put together when researching the area and from information in interviews.

Examples of companies on the market with competitive or complementing products that are found during benchmarking can be seen in figure 3.4:



Figure 3.4 - Pictures of benchmarked products from A - Google (Google Blog, 2020), B - Doro phones (Stjarna Fyrkant.se, 2020), C - Vayyar (Attentive Connect, 2020) and D - Doro (Doro, 2020-a).

Vayyar

Vayyar Home is an emergency response system that calls a responder service or emergency contact if it detects a fall after scanning the environment and persons' body positions without using cameras or wearables. Instead, it creates high-resolution images using radar. It can also track breathing and sleep to monitor the caretaker (Vayyar, 2020).

Google Home

The Google Home system is defined as a smart speaker. While it can play a lot of types of sound from its speaker, it is primarily designed as a vehicle for Google Assistant, the voice activated helper that Google has developed. It listens to some specific commands and can connect the user to a lot of compatible devices such as thermostats, smart lights, smart locks, sprinklers, security systems and even some cars (Gebhart, 2020).

Response by Doro

Doro is a tech company focusing on senior users. Their phones have a built-in response button to contact a relative or a member of a care team for personal support (Doro, 2020-b).

Alarm bracelets

Alarm bracelets are produced by a large range of companies, one being Doro. Their bracelet (or it can also be used as a necklace) works together with their own phones. If the user pushes the button on the bracelet, their phone automatically sends out an alarm or calls a number that is chosen before wearing the bracelet. The button should always be worn and is waterproof (Doro, 2020-a).

4 Define

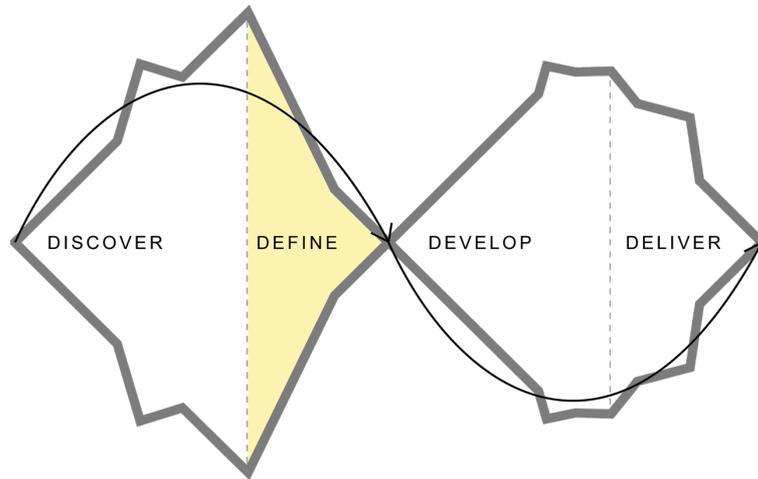


Figure 4.1 - Define in the double diamond framework.

The phase shown in figure 4.1, aims to define the mission of the project, which is a key point to steer the development in the right direction.

Based on the discoveries in the previous chapter a problem definition is formulated and from that, needs and requirements are stated.

4.1 Problem definition

The problem definition is formulated based on the design method of *The Double Diamond* (Design Council, 2020).

4.1.1 Concept description

The goal of the final concept is to create an increased level of well-being with focus on the individual. It is something that the group saw a need for during the background and user research described in chapter three. The final concept should integrate with the older person as well as create a safe environment where he/she is in control.

It is to be placed in the home, either a senior living facility or in a private home. It is important that the final concept is easy to use, as well as in a natural way blend into the home environment. The final concept should enable self-determination of the older person as well as increase independence and encourage activation, both cognitive and physical. To do this the system needs to work preventive, assistive and integrative.

The final concept should be a system containing features already developed by the company or being created within a ten-year future.

4.1.2 Target group and market

The main focus is to support the person who experience changes connected to primary ageing. The primary users for the product are the older people, as well as senior living facilities where the product can be implemented, both private and public. The target group consists of those who experience geriatric syndromes in different degrees as well as older adults experiencing gradual bodily changes as a consequence of primary ageing. The final concept will not focus on people experiencing immobility and cognitive impairment, such as severe dementia. The challenge is to move focus from isolated diseases to complex health problems and is important not to define the target group from chronological ageing but rather from biological ageing.

The final concept should be suitable for both the older person without the need of a caregiver, but want assistance in everyday life, as well as for those who are in need of assistance from a caregiver.

Since the final concept also addresses the persons moving into senior living facilities, it makes the stakeholders of the facility a primary market as well. The final concept should be possible to implement and be installed by the facility owners before the resident moves in. The final concept should also assist relatives of the older person in the same way as if any caregivers were involved. The secondary users will be the caregivers and the relatives since they will be using the final concept as well.

4.2 Needs and requirements

To ensure that the final concept is focused on customer needs, Ulrich and Eppinger (2012) mention a number of steps to help identify these needs. The three steps used by the team for this project are:

1. Gather raw data from possible users
2. Interpret the raw data in terms of needs
3. Organize the needs into a hierarchy of their importance

User needs are based on problems identified in raw data from the user research. The most important insight from the raw data was stated as sentence clouds in the previous chapter. The needs are then translated into product requirements which create a base for the final concept and make sure the goal is achieved.

4.2.1 Establishing needs

There is no “typical” older person and assisted living is needed at various ages and in different degrees. One challenge is moving the focus from problems and solutions connected to isolated diseases towards solving more complex health issues such as geriatric syndromes. The solution to this is to find the least common denominator and then set a long-term goal as a beacon for the final concept. To find this the problems have to be categorized into needs and goals for the concept to achieve.

Inspiration for the categorization of the needs is found in *Maslow’s Hierarchy of needs*. These needs are portrayed in a pyramid. From the bottom of the hierarchy upwards, the needs are physiological, safety, love and belonging, esteem, and self-actualization (McLeod, 2020).

The needs identified by Maslow are translated by the group into more accurate categories fit for this project and its target group. Deciding what are suitable categories is done by reviewing the user research and analyzing what are the basic needs for the target group for this project. From that, the final categorization is set to physiological-, social- and safety needs.

Below, a table over *problems, needs and goals* is listed (table 4.1). As mentioned earlier, the problems are identified from user- and literature research, they are then interpreted and categorized into the three need categories. Lastly, the group discussed what an overall solution would be to the different problems.

Table 4.1 - Categorization of problems, needs and goals.

<i>Problem</i>	<i>Need</i>	<i>Solution</i>
<ul style="list-style-type: none"> - Loss of integrity due to decreased level of control - Difficulty in performing everyday chores - Increasing health problems - Limitations in physical activities and exercise - Poorer memory - Problems in getting the right aid inserted in time - Problems in communication with home care or health care - Feeling of being a burden - Problem with using modern technology 	<p>Physiological Needs Have control over a functioning life</p>	<p>A system that assists in everyday life and enables independency and self-determination</p>
<ul style="list-style-type: none"> - Increased risk of accidents - Not being able to let people know if you get hurt - Getting lost while outside - Worrying about break-ins - Needing nightly supervision - Does not trust the alarm bracelet 	<p>Safety Needs Feel safe and secure</p>	<p>A system that enables a safe environment and feeling with focus on detection and prevention of accidents</p>
<ul style="list-style-type: none"> - Involuntarily loneliness - Does not have anyone around in a similar situation that relates - Depression - Decreased social activity due to distance and death amongst friends and family - Have no way of getting new friends - Lack of role or context 	<p>Social Needs Have a sense of belonging, feel appreciated and needed</p>	<p>A system that promotes and enables social contact as well as gives a sense of belonging</p>

4.2.2 Long-term goal

To find the long-term goal the needs together with the goals are considered, if the sub-goals are achieved the team agreed through discussion the person should be feeling well. The least common denominator for all sub-goals is therefore: *the feeling of wellbeing*.

The needs are considered sub-goals for the long-term goal and are portrayed like *Maslow's Hierarchy of needs* (McLeod, 2020). The sub-goals lead to the top of the pyramid to the long-term goal, which is stated to: *The goal is to create an increased level of wellbeing for the older population*. This is illustrated in figure 4.2.



Figure 4.2 Illustration of the pyramid of goals

4.2.3 Product requirements

Development teams usually set out specifications to describe in detail what the product should do. The specifications (or requirements) tell what the development should focus on achieving to meet the customer needs (Ulrich & Eppinger, 2012).

The product requirements for this development are primarily based on the needs established in the previous section. They also address expressed needs from interviews with municipalities and are made to meet the market research. They follow the categorization of the needs and added are system requirements such as general, technical and feasibility requirements.

An example of how a requirement is made is by translating a quote such as:

"I sometimes forget my medicine" - The product will assist with remembering tasks

See figure 4.3 below for the full list of requirements that was put together from the insights from user research stated in appendix C.

The product...		The product...	
GENERAL	<ul style="list-style-type: none"> Will be an interactive system Will be modular Can be transported when moving Will be alterable Will work with other products Will fit in a home environment Will enable independence 	SOCIAL	<ul style="list-style-type: none"> Will encourage social contact Will connect people Can contact relatives and friends Can create communities
FEASIBILITY	<ul style="list-style-type: none"> Will have high usability Will be easy to install Will be reliable Will be user-friendly for health workers Will be fun to use 	SAFETY	<ul style="list-style-type: none"> Will try to prevent accidents Will detect accidents Will assist in case of accidents Can connect to alarm central Can track people inside their home Will keep track of journals Will have a security system integrated
TECHNICAL	<ul style="list-style-type: none"> Will be voice activated Will be internet connected Will be battery driven Will have two-way communication Will cover the area of a living space Can analyze data Will collect data Will have cameras Will have radar Will have sensors 	PHYSIOLOGICAL	<ul style="list-style-type: none"> Will measure vitalities Will enable physical activation Will enable cognitive activation Will assist with remembering tasks Will assist with medication Can provide information about the user Will have a calendar function Can adjust environment in home Can make purchases and orders

Figure 4.3 - Matrix of product requirements

4.3 Conclusion from the definition-phase

The extensive research done in the discovery-phase evolved to form a definition of the problem in this phase and the project from here has a clear goal: *to develop conceptual technology that increases the level of well-being for the older population.*

That a final concept should be developed was a clear goal for the group from the start, but after discussions with mentors and stakeholders for the project, a different focus area is being developed. As the project had a wide area of interest in the beginning, the team had to define the problem together with the target group multiple times and in different ways. This resulted in developing material for creating a deeper understanding of the problem at hand. At first this material is seen as a byproduct of the project but through further discussions the team decided it should become one of the deliverables and therefore the material should be developed further. The team believes that this material can be valuable for the tech company when moving forward in this field of interest. Therefore, the material is to be developed into a set of tools to use for future concept development such as generating new concepts, selecting final concepts as well as validating the chosen

concept. The tools can also be used as visuals in presentation material as well as a quick access to information for a new listener.

Therefore, moving into the development phase the group decides to focus on two tasks shown in figure 4.4:

- 1 Developing tools that facilitate in creating new technology based concepts for people experiencing geriatric syndromes
- 2 Using the tools to create a final concept

Figure 4.4 – Illustration showing the two focus tasks for the project

5 Develop

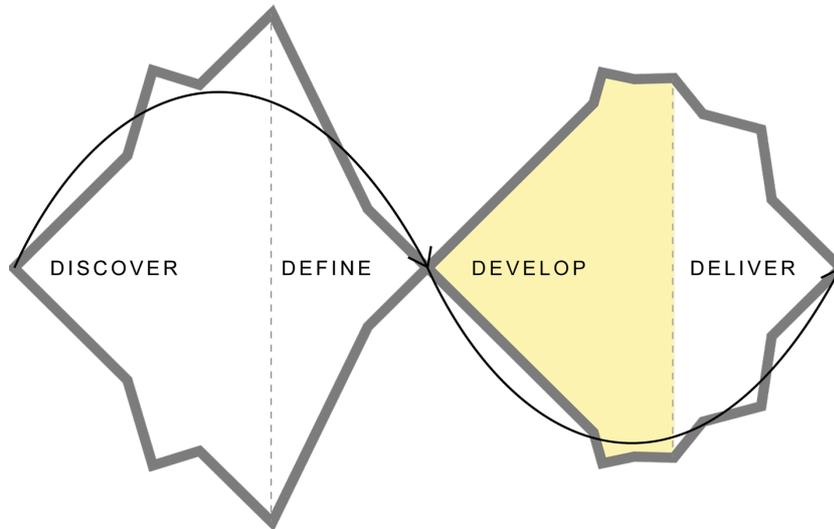


Figure 5.1 - Develop in the double diamond framework

The develop-phase as seen in figure 5.1 aims to explain the design process that generated the ideas for the concept. This is an explorative phase where new ideas are produced and developed. The phase begins with creating tools that are used in the concept generation, the goal for these tools is to describe the problem in a narrative way and they are meant to be used again by the company to create future concepts. The tools work as building blocks for the concept. They are based on the research and problem definition stated in the earlier chapters, Define and Discover.

The phase continues with a development of a final concept using the tools, this is done through brainstorming sessions, sketches and conversations.

5.1 Concept development

The development of a conceptual model began with using a method called *The Design Sprint* by Google Venture, described in section 2.5.

The Design Sprint is in the current project modified to be relevant to this particular project and therefore only a small part of the original sprint is performed. What parts that are used is described below.

5.1.1 Defining the problem

During the first part of the sprint focus lies in working with the problem definition to create a base. This part is considered necessary for this project because it helps set out a framework of where the project is headed. From the problem definition the team asks so called “sprint questions” that will lead to the long-term goal, these questions are to be considered during the concept generation later:

- How will we integrate the product into the company’s line of products?
- How can we reach the long-term goal?
- How can we make the product attractive to the target group?
- How can we make the product both modular and mobile?
- How will we make the product easy to use?
- What features do we prioritize?

The long-term goal: *To increase the level of well-being for older persons*, is to be used as a beacon during the development.

The sprint starts with looking at the desirable end point of the project, the long-term goal, and then by working backwards a map of events is made. This is based on the information gathered during the earlier chapter, *Discover*.

The main result of this sprint section is a map that shows the sequence of events from development to achieving the long-term goal. The map highlights the interactions between the product and its actors of interest. The resulting map can be seen in section 5.1.2 and is later used as an early iteration of a journey map.

5.1.2 Brainstorming a conceptual model

During the second part of the sprint, focus lies in working on developing the idea of the final concept as well as a physical product. The team starts with a review of existing products to use for inspiration. This combined with the first parts framework represents raw material for the concept solution. With that in mind, the team individually brainstorm solutions through sketching.

According to the sprint the sketching itself follows a four-step process which include notes, ideas, crazy 8s and solution sketches. Below the steps are explained in detail.

1. Notes are taken through reviewing previously conducted research and provisions.
2. With the notes each person individually puts down ideas, diagrams, sample headlines, stick figures doing stuff and doodles.
3. The crazy 8s starts with choosing the strongest sketches and then rapidly develops these eight variations in eight minutes. This is carried out through folding a paper into 8 squares and using a timer set to 60 seconds.

4. The solution sketch is a sketch with a three-panel storyboard drawn on post-its, this sketch is each person's best idea on paper in detail. It should be self-explanatory with a title, it is okay to use words in the storyboard to make it easier to understand (Knapp et al., 2016)

The ideas brainstormed by the team members are not very different from each other and it becomes clear that the vision of the final concept is some kind of smart system. However, a few variations of the system were brainstormed such as:

- a voice-activated digital pet for company and activation
- a hub system that focuses on social contact
- a more anonymous system that measures vitals etc.

Through conversations and voting (Knapp et al., 2016) the team decides that a hub system is going to be the base for the final concept. The reason for the team's decision is the modularity and multifunctionality of a hub system where the features can be altered and individualized. The system is to be implemented in the apartment and should accomplish the goal of being individual, modular and see to the user's needs as well as fulfill the long-term goal.

The remaining parts of the sprint are considered less relevant to this project as they are more about building prototypes and test them. Since this thesis focuses on a conceptual system, focus instead lies on developing that system.

5.2 Development of tools

The development of tools is inspired by user experience methods to create a descriptive narrative of the problem at hand. This is done by working with the problem definition from different angles, as well as further developing the previous material such as ideas during the design sprint.

The tools aim to summarize in an illustrative way the research, the problem definition and the end-users as well as other actors that are affected by the developed system. They together create a portfolio for concept development, from generating new concepts to presenting the final concept. The tools can be reused by the company when developing new concepts in the field of interest.

The thought set of tools is a constellation created by the team without proof of a working concept. These tools, although untested as a combination, have been carefully chosen to give an extensive image of different stakeholders' point of view. The methods used are: personas, scenarios, a user journey map, a pyramid of needs and a list of features.

5.2.1 Personas

Personas are helpful for any designer, some parts that could help describe a persona are key aspects of his or her life situation described in detail. Also, behaviors relevant to the design inquiry are interesting.

To try to design for everyone often results in unfocused or unorganized solutions, and quantitative information gathering such as questionnaires can result in an abstract target group. Therefore, personas created from information about real users provide better and more relatable profiles (Martin & Hannington, 2012).



Figure 5.2 - Illustrations of personas.

Since this product development is for a system to interact with multiple actors, personas are created for six different people. They can be seen in figure 5.2 above: two older adults, one caregiver, one relative, one caregiver in private care and a municipality worker. These are all based on actual people and stakeholders that were heard during the interviews mentioned in previous chapters. However, some modifications were made. The collected information gathered earlier through interviews and research is summarized into one persona representing each actor. They are all given an illustrated face using the software Adobe Illustrator for realization. Then they are presented with living situation and a few describing points, all symbolizing facts that were heard in interviews and conversations. The purpose of the personas is to get a deeper understanding of the end user as well as the main characters that will interact with the journey of the product. The personas

are to be one of the tools that is to be used both in concept generating and for presentation purposes.

More insights on the personas are found in figure 5.3 below. The full descriptions can be found in appendix D.



Figure 5.3 - Illustration of personas with insights.

5.2.2 User journey map

User journey maps give the designers a story about the personas and their interaction with the product that is being developed. It visualizes the experience people have when using the product or service and tells about their feelings and actions. It is very useful when developing a user-centered product, and different types of users might need to be considered when developing such a map (Martin & Hannington, 2012).

User journey maps are tools to study typical *users'* experiences over time. The general method has five different parts to it:

- Timeline - to tell for how long the map stretches
- Scenarios - that describes the user's engagement with the product
- Touchpoints - the actual actions the customer makes
- Channels - where the user performs actions, online or elsewhere
- Thoughts and feelings - what the customer thinks and feels

These maps should be detailed and based on insights from prospective users. (Interaction Design Foundation, 2020-a).

For this specific project, the method is altered to suit the development of a system that is not necessarily a physical product or a service. Therefore, channels are not a part of the groups' map.

To better explain the product from innovation of the system to the actual improved everyday life for the user, a user journey map is developed by analyzing the different ways that a product in older peoples' homes could be implemented. A very early framework is created through the design sprint. This can be seen in figure 5.4 and is an easily illustrated mapping over the sequence of events related to the final product. The map illustrates how the product (system) comes in contact with the older adult through either municipalities or senior livings. The municipality or senior living then together with the user create the perfect system that ensures a safe and secure living situation for the user as can be seen to the very right in figure 5.4. This journey from the product being created and sold is based on information given from the company as well as the municipalities. It was illustrated firstly on a whiteboard and then interpreted in Adobe Illustrator.

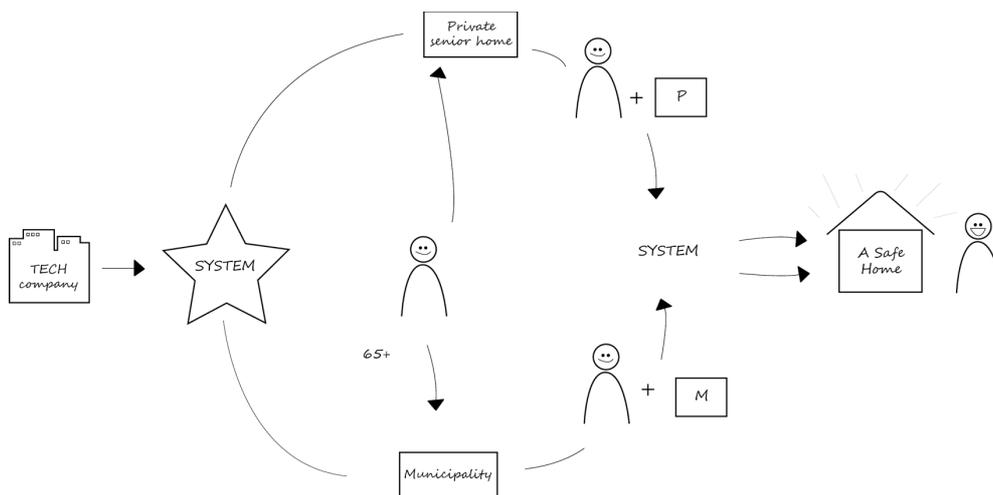


Figure 5.4 - First version of a user journey map. The company creates a system that municipalities or senior homes purchases and personalizes with the user to create a safe home,

The User Journey Map is then developed to a more detailed map with a few iterations. A sketch of the next iteration of the journey map can be seen in figure 5.5 below. The circled areas are where the group thought the map could be complemented with scenarios to give a deeper understanding.

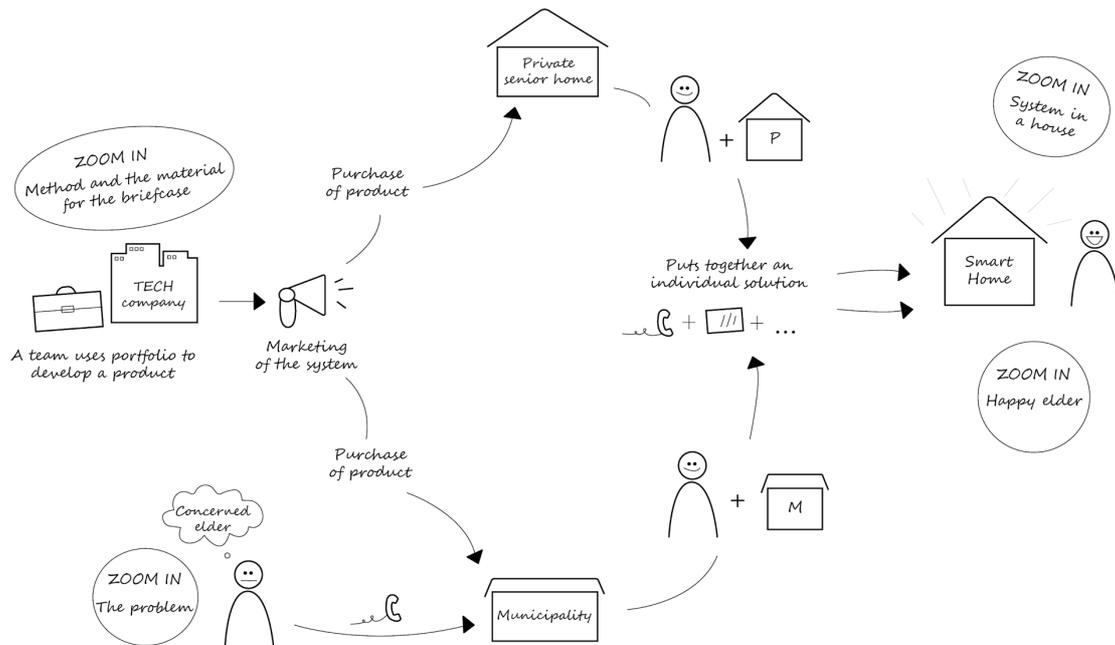


Figure 5.5 - Second version of a user journey map for the product

The user journey map aims to be a tool that shows the outline of the product, its actors and how they interact with each other, it also reminds the concept developers of the long-term goal. The map highlights where the tools are needed through zooming in on different events that need deeper understanding.

The final User Journey Map is presented in the next chapter, Deliver.

5.2.3 Problem Scenarios

A scenario is a narrative that tells a person or multiple persons' sequence of events to achieve some sort of goal. Designers use scenarios to understand peoples' needs and motivations (Interaction Design Foundation, 2020-b).

The user journey map is complemented with scenarios of problems that the personas encounter in their day-to-day life, this to give a deeper understanding to the narrative. They are based on research, sentence clouds and the personas developed earlier and are written in Microsoft Word. The problem scenarios are part of the

tools that can be used for generating new concepts. They are meant to make it easy to follow a person in his or her everyday life and to visualize how and where a new product could come to use.

Klaras day to day life with home care

It is Wednesday morning, Klara is drinking tea and looking at Instagram on her phone. She likes to look at the posts from her family and to be able to engage in what they are doing since they all live far away. She doesn't get to see them except for on holidays, with some exceptions of her daughter visiting once in a while, she is the one living the closest. It gets lonely sometimes not having them close by and living on her own, but she also wants them to live their life. They call and text her as well as send photos, but it has been a long time since they saw each other.

There is a knock on the door and Klara gets confused at first, but then she realizes that it is the home care, of course! She had forgotten that they helped her with the cleaning on Wednesday mornings. She opens the door and is happy to meet the staff, even though she is a little ashamed because she is still in her morning robe, but it is always nice with some company. They make small conversation and then the home care staff gets to the cleaning. Klara gets changed and then continues with her Instagram. When the carer is done with the cleaning Klara offers her a cup of coffee but she kindly turns it down because she has to rush off to the next house, she tells her Wednesdays are stressful but next time she will stay for a cup!

She decides to take a walk even though she doesn't like doing it alone in case something happens or she gets lost but she wants some fresh air and the weather outside is sunny. If anything was to happen, she does have her phone so that she can contact someone. Sometimes the home care accompanies her on the walk but they are not coming again until tomorrow.

Klara gets help from the home care, with things like grocery shopping, cleaning and exercise but mostly she just really enjoys the social interaction with the staff. Klara thinks the home care works fine, they are always friendly and helpful. The only thing she doesn't like is that she has to decide her food for a whole week at once. Every Friday morning someone will sit down with her and they make a list of groceries for the upcoming week and then on Monday she gets the groceries delivered. Today she is not in the mood to eat any of the food she has the ingredients for, so when she comes back from her walk she decides to skip lunch and just drink some more tea.

Klara has been thinking of moving to a senior living, not that it is necessary right now, but because she feels a little unsafe on her own and also it would be nice with some social

interaction with people her own age. At the same time, she loves her house and all the memories it brings her and she is not ready to leave it right now.

Lars and Hilda's day to day life living on their own

Lars lives with his wife Hilda, in a one floor house. Every morning they wake up around 9 a.m, drink coffee together and solve crosswords, followed by watching the local news. It is their routine and has been for a long time. After breakfast Lars takes a walk, he had a surgery for disc herniation some years ago and it is important for him to stay active, however he is limited in mobility and walking is the only thing he has found working. His wife doesn't join him even though they do almost everything together. Hilda is even more limited in mobility. Lars doesn't like leaving Hilda at home because she sometimes experiences vertigo and he is afraid she will fall and hurt herself, and not be able to contact him.

During the walk Lars remembers he has to take his vitamins along with his painkillers for the back and also, he needs to remind Hilda to take her medicine. Hilda is experiencing mild dementia and therefore Lars has to act as her memory.

Lars takes care of all the chores, grocery shopping and cooking at home. Hilda enjoys baking every once in a while but it is getting harder for her to stand for longer periods of time.

Their son Anders lives close by with his family and helps out the best he can, they don't always ask for help, though, they don't want to burden their son and that worries him. He has tried to suggest they should move in to a senior living, they don't have an attachment to the community and there aren't a lot of people their age to socialize with. They feel, however, like it is giving up some of their privacy and they also want to be independent. Lars says as long as he can take care of both of them, there is no need for a third party to get involved.

5.2.4 Features

To further develop the product requirements, the group explored through brainstorming different possibilities of features that can be useful in a system. The result is an extended list of possible features, that then is prioritized through conversations with municipalities, caregivers and the company. The list is meant to cover all possible features that are of interest in the future system but the purpose is not for all features to be integrated into the product, only selected ones. It represents suggestions that create a solid base for each concept generation, they can be combined differently and are divided into necessary features and additional features. The necessary features are the basic features, according to the group, that should be integrated in each concept. See figure 5.6 on the next page for the final list.

5.3 Development of the final concept

The tools mentioned above in section 5.2 together with the sketches made during the design sprint corresponds to the development of both the exterior as well as the interior of the system. The team decides through conversation and discussion to proceed with the idea of a photo frame that is assisted by some sort of sensor. The system is to be implemented at the users' homes or at private living facilities. Since the final concept is to be an example of how the tools should be used, it is not tested with the final users and only outlines a conceptual system.

The sensors are based on a previous master thesis made for the company, which explored different exteriors of a sensor to be put in older peoples' homes. A big part of this hardware is the functionality of a radar, so therefore *radar* is the definition used by that master thesis and also will be used here. The interior of the system is based on the features list as well as product specifications learned from conversations with the company *Vayyar* about their radar product (Vayyar, 2020).

5.3.1 The Hub

The hub is made to be like a digital photo frame. The reason for choosing a photo frame goes back to the goal pyramid under Social Needs: *the need for having a sense of belonging*. By making the hub a part of the interior design of an apartment by giving it a purpose when not in use, the hub becomes less as an intruder and more of a reminder of nice memories. The hub is supposed to be calming through a familiar exterior by displaying the users own photographs, which also reminds the user of people to contact, this can result in feeling less lonely.

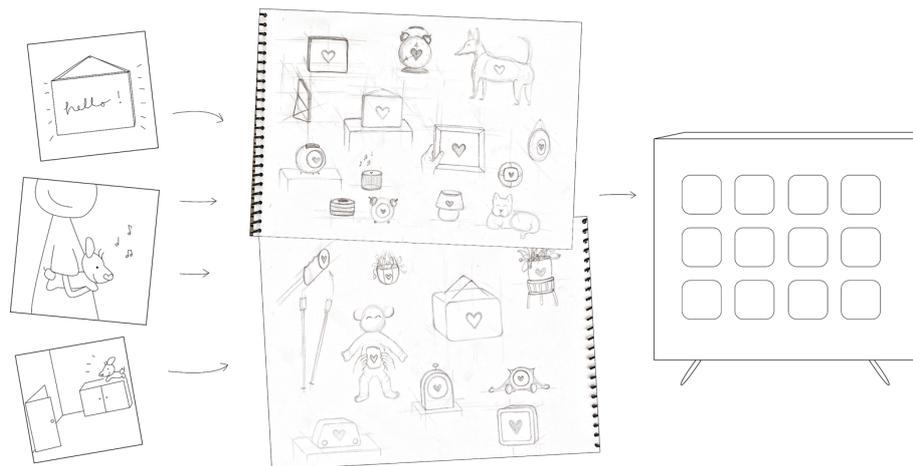


Figure 5.7 - Illustration of the design process leading up to the photo frame

The process of exploring different physical expressions for the hub can be seen in figure 5.7 where the team brainstormed ideas of how the hub can be a part of the older person's home and everyday life. The brainstorm ended up in choosing between two possible physical expressions: a pet-looking hub or a photo frame. The two were chosen due to the comfort in the appearance. The team needed the hub to become comforting but also something the user wants visible in the home and therefore the final decision was to continue developing a photo frame. The photo frame also contributes to promoting social contact which goes back to one of the goals presented earlier.

Since the focus does not lie on the exterior of the system but on the conceptual part, not a lot of time is spent on developing and testing the exterior design. The final design is set by discussions within the group using inspiration from current products on the market such as *Google Nest Hub*, *The frame* by Samsung and *Portal* by Facebook, see figure 5.8 below. The hub is designed considering the design language used in the radar by Bengtsson (2020) as well.



Figure 5.8 - Products used as inspiration for the final design of the photo frame, from left to right: *Google Nest Hub* (BH Photo & Video, 2020), *The Frame* (PNG kit, 2020) and *Portal* (Techcrunch, 2019).

The main usage for the hub is for social contact and health tracking in accordance with the features list presented earlier. The user can make video calls and send messages to friends, family and caregivers. It also gathers data from other sensors, that the caretaker as well as the caregiver can take part of. To illustrate this a simple interface is developed which highlights the features and functions of the hub, the interface only displays a possible first page and is not tested or further developed. The purpose of the interface is only illustrational and is to be used during presentation of the concept.

5.3.2 Radars

The radar units are more anonymous looking devices that are used to gather data in the user's home. The aesthetics of these were examined and developed in a master thesis carried out during the spring of 2020 by Bengtsson (2020).

The technical specifications for the radar are mostly based on information from the company *Vayyar*. As described in section 3.3.1 Benchmarking, their product is an emergency response system that scans the environment by drawing up a cloud of dots where there are people. It can also measure pulse and respiration. However, additional features need to be added to their product such as:

- A smoke detector - to detect fires
- A "digital nose" - to detect gas leaks etc.

In order to add these features, the radar unit would need to be developed further and other sensors than the actual radar would need to be added. The group will however still call these units radars since that is their main functionality.

5.3.3 Placement

To develop a system such as this, it is important for the group to look at the physical usage of the different devices. It is already decided that for the system to be familiar, the radars are to be placed in a similar manner as a regular fire alarm and the hub is to be placed as a photo frame on whatever surface is preferred. According to *Vayyar*, each radar covers approximately 25 sqm so for a 50 sqm apartment, two radars would be needed (Vayyar, 2020). That being if the walls are thin enough for the radar to pass through. An example of device placements can be seen in figure 5.9 below with a more developed version in figure 5.10. Both of these illustrations were created in Adobe Illustrator for visualization.

5.3.4 Implementation scenario

As a part of developing the system, it is discussed how it would be implemented in some of the personas' lives. Therefore, a scenario is written in Microsoft Word to describe how it could look like when Lars and Hilda get information about the system. This is also meant to describe the benefits for a senior living facility with the system.

The scenario is developed by using information from the interviews with older persons and then creating a narrative around a possible future where the concept exists.

Lars and Hilda looking for a new home

Lars and Hilda have started to look at other possible housing situations after some discussions with their son Anders. They have together found a place called Axel Park that is close to their neighborhood and therefore still close to Anders. It is a senior living home that provides staff around the clock, common areas and a private accommodation. Lars and Hilda are headed into a meeting with Lena, who is a caregiver working at Axel park, to find out more.

Lena meets them at an apartment that she thinks is suitable for the couple. She explains how their system works and is meticulous about pointing out that they are all about independence and value integrity, the purpose is to assist everyday life and create a welcoming community.

All apartments are equipped with the same smart system that will ensure a safe environment, enable social contact and give assistance without jeopardizing integrity. The system is called Axel and consists of a central hub, that doubles as a digital photo frame, which is complemented with two radars. One radar is in the bedroom and one in the kitchen and living area. She shows them to Hilda and Lars who comment on them looking nice and almost invisible, "kind of like a fire alarm", Hilda says. Lena answers with "And they work like one too! They have sensors that can smell smoke and will immediately alarm the staff."

Depending on the level of smoke the radar will react in three stages. The first stage is just a soft alarm, as we all know the fire alarm can go off when we burn the chicken a little in the oven and that's not really an emergency, it will communicate with you and you can easily dismiss it if it wasn't an emergency. The second stage will make more sound and also give instructions to evacuate the apartment and where to go. The third one does the same but with a very loud siren, this is programmed to wake you up during the night in case of an emergency. At all three stages the staff gets a notification so that we can assist and in the worst case start an evacuation for the building."

“We change the settings of Axel to make him assist you individually and tend to your specific routine”, Lena continues explaining.” For example if you have medication, we set notifications so you never forget, and when you press “accept” we can be assured you have taken them.”

If you are in need of assistance from the staff, you can either just call us through Axel and we can have a face to face talk or you can send a specific request through a message. For example if you need help to shower you can send a notification with the time and activity to us and you will get a notification back when we have accepted. If we for some reason have our hands full we will propose another time that you can accept. After that you will get a reminder 30 minutes before the activity and if for some reason you don't want to go through with the activity you can let us know then. This works the same for any type of activity from physiotherapy to getting assisted walks or help with groceries. Lars doesn't look at ease and says “We are not in need of a lot of assistance, this seems like a lot of technology.” Lena assures Lars that, “You have to think of this as a smart home, if you are not in need it will not help, but if you are in need it will help, there are a lot of “invisible” features.”

Lena explains how the smart system provides a safe environment. There is a radar that positions you in the apartment but only through showing you as a cloud of red dots, so we can't see what you are doing. If the radar was to detect a fall, it would alarm us or anyone you want, maybe your son if you are more comfortable with that, either through a text message or a phone call or both. We will then contact you to see if everything is okay or if you need help.

There is also a feature that collects data about your routines and patterns. This might seem like surveillance, but we don't take part in the data until we get a notification about a deviation. This can for example be that the radar knows your average time of standing and moving is. If that changes significantly and you are moving significantly less than usual then maybe something can be improved. So we discuss it together, maybe send for a doctor to check on your values or we just increase the amount of physiotherapy. Maybe you from nowhere start sleepwalking, then we can keep an extra track of you during the night so there aren't any accidents. There are alternatives to night supervision, the most common is only using a radar. We can also install a camera that is turned off unless we detect an unusual behavior or if we would detect you fell out of bed, then we can turn the camera on and have a look of what is really going on, since the radar only displays you as a bunch of dots. The camera can also work if there was to be a break in, if the radar detects a movement pattern similar to a break in then it can turn on and record if necessary and we can hand it to the police. But the staff here also get an alarm about the incident.

I know it sounds like a lot but you won't even notice the smart system, it is just there for your safety. Through Axel's dashboard on your photo frame, you can also see your own information about vital values and journals if you want. It is a form of self-tracking and this feature is added because we want our residences to be a part of their own health care and well-being.

Lars and Hilda left Axel Park with some brochures and an offer for the apartment that they were to think about for the week to come. Since Hilda had felt a little like a burden to Lars because she couldn't help out as much around the house she thought this would be a nice opportunity for them while Lars seemed to be the harder one to convince, she thought. Lars however got the impression they really valued their residence independency and that they would age well there. The benefits of living close to Anders without needing his help and in a safe environment were weighing heavy, maybe they would get some new friends as well, since many of their older friends had passed away or moved to another city.

They moved together to Axel Park that same year and now thrive in the community.

6 Deliver

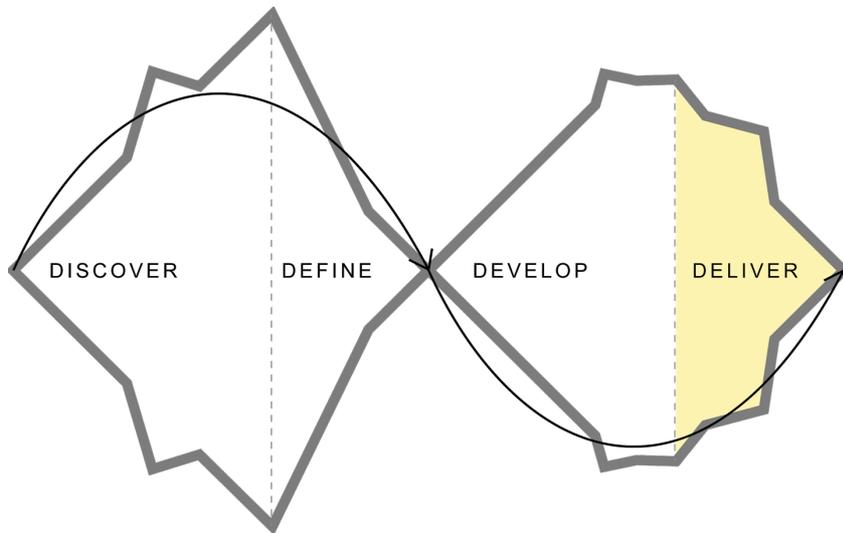


Figure 6.1 - Deliver in the double diamond framework

The phase shown in figure 3.1 aims to conclude the final deliverables of the master thesis. These include the tools developed for the company to use in future development as well as an example of a final concept generated using the tools.

Presented below is the final concept and the compilation of tools. The result is tested through conversations and feedback, where the concept is sent to the municipalities interviewed earlier and the compilation of tools is given to the company. The purpose of the feedback is to get an idea if there is a possible interest in the product and if the information will be useful and how it can help in future development. The final deliverables are not tested further, and the result of these smaller tests is discussed in the next chapter, *Discussion*.

6.1 The final concept

The final concept presented shows an example of the interface for both an older person, as well as for a caregiver. The focus for the final concept is only the conceptual part and therefore the interface as well as the exterior of the hub is illustrated for visual purposes only. The exterior design of the radar is provided from the previous master thesis conducted by Robin Bengtsson (Bengtsson, 2020).

The final concept is a smart system implemented in the older person's home. It enables communication with the caregiver or another person of the users choosing. The system works preventively by collecting information of the users' living patterns as well as assisting in case of an accident or unexpected events such as break-ins or fires. The system ensures safety and maintains the person's integrity and self-determination. The system opens up for the possibility to live at home for as long as possible.

The information collected by the hub and the radar is stored in a cloud using Wi-Fi. The radar communicates and sends information to the hub through the same cloud but will act independently of one another in case one of the devices is not working.

6.1.1 Hub

The hub represents the center of the system and is the device interacting with the older person. The hub acts as a photo frame when not in use and is designed to not interfere with the interior of the living space. It can be mounted on the wall and have a more permanent position or placed on a stand and therefore be more mobile. It connects to a power outlet but is chargeable and has battery time. The main purpose of the hub is to give the user more control and insight. Its purpose is also to facilitate in communicating with friends and family and caregivers. Below the final design of the Hub is presented in figure 6.2 along with an interface for the user in figure 6.3. The interface is merely an example of what the screen could look like for a user. Different users could then have different interfaces depending on their individual needs. The features of the hub are presented in figure 6.4.



Figure 6.2 - Prototype of the final design of the hub.

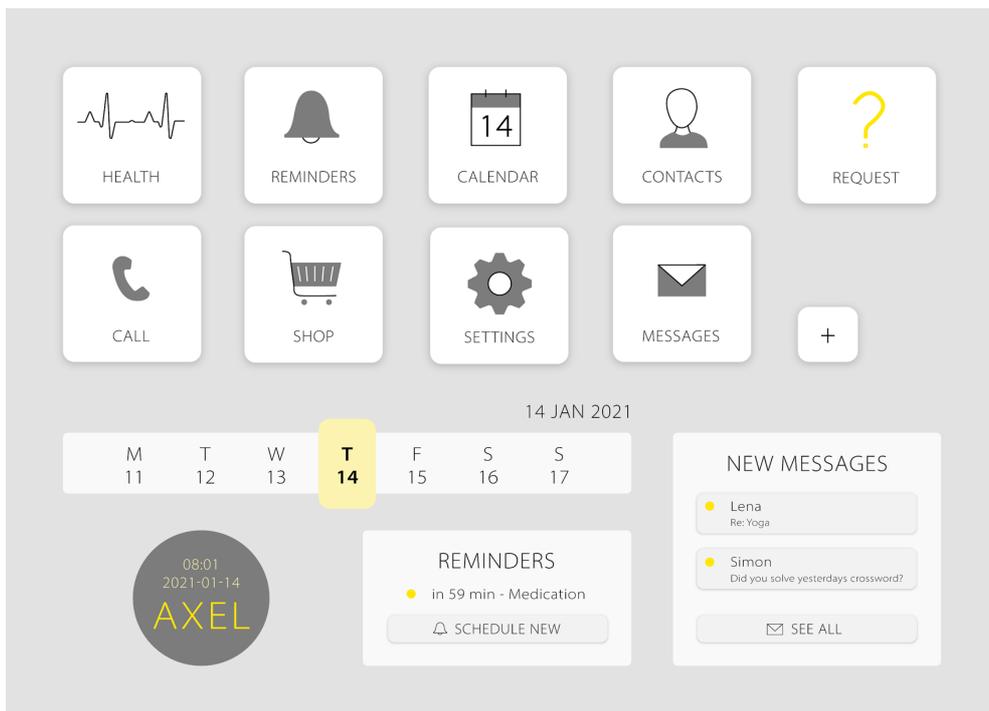


Figure 6.3 - Illustration of an example of the interface displayed on the hub for the caretakers. This is made to suit a hub screen.

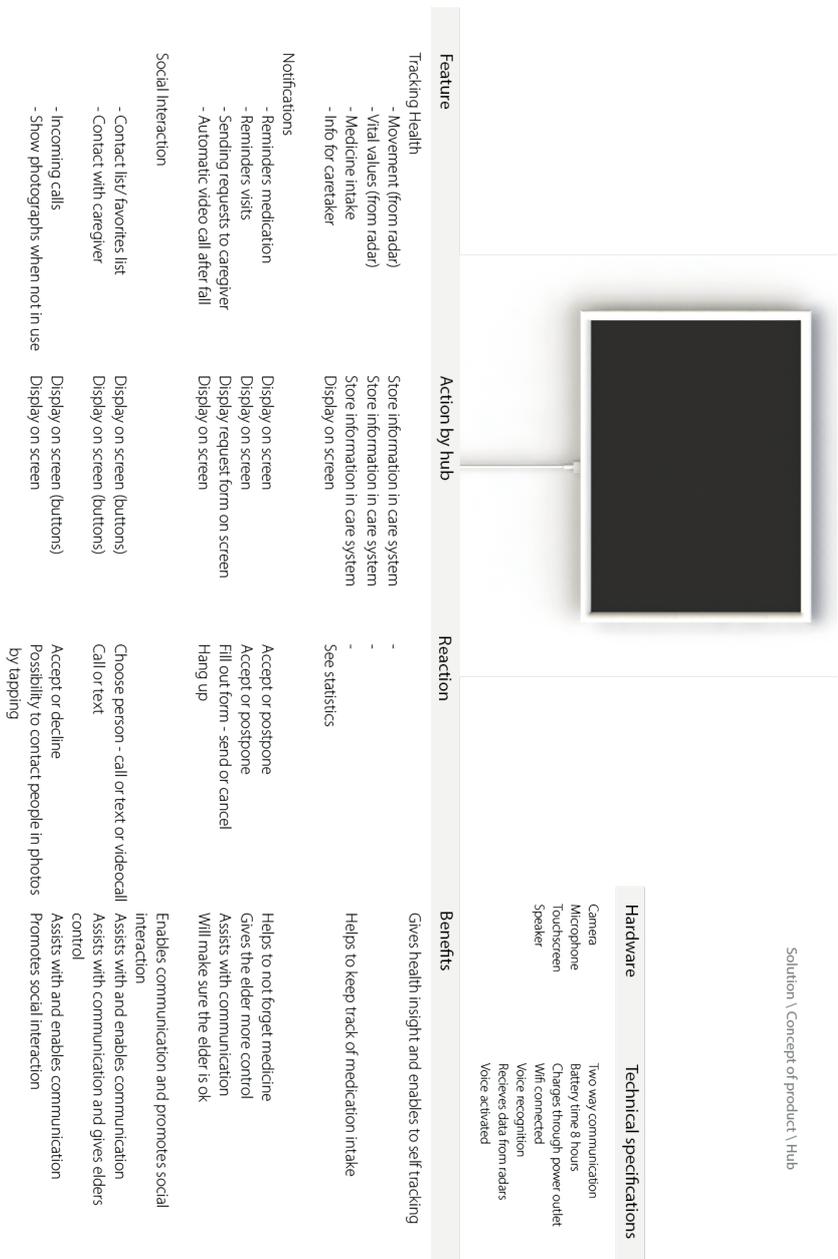


Figure 6.4 - Features of the hub

6.1.2 Radar

The radar is a complement to the hub and will facilitate in collecting data along with detecting accidents, fires and break-ins. It has a microphone as well as a speaker and therefore creates a two-way communication. The radar is mounted on the wall or in the ceiling and is connected to a power outlet. The radar covers an area of 25 sqm and can only travel through thin walls. It is recommended that the apartment is equipped with enough radars to achieve full coverage. The features are presented below in figure 6.6 as well as the design made by Robin Bengtsson in figure 6.5.



Figure 6.5 - Prototype of the final design of the radar (Bengtsson, 2020).

The Radar



Hardware	Technical specifications
Anonymizing radar	Coverage 25 sqm
Microphone	Two way communication
Positioning sensor	Plugs into power outlet
"Smell" sensor	Wifi connected
Smoke detector	Sends data to hub
	Stores data in cloud

Feature	Trigger	Primary Action - private house/senior living	Primary Action - senior living
Gather Data			
- Vital Values	If irregular values are detected	Send notification to chosen person	Send info to care system
- Movement mapping	If unusual behavior	Send notification to chosen person	Send notification to care system
- People counting	If new people appear	Store information in care system	Send notification to care system
- Positioning	If elder is in wrong apartment	-	Send notification to care system
	When caregivers are in the apartment	Store information in care system	
Safety			
- Fall detection	If fall occurs	Call to chosen person	Call caregiver + send notification to care system
- Positioning	If fall occurs	Call to chosen person	Call caregiver + send notification to care system
	If no movement within [Set time] is made	Send notification to chosen person	Send notification to care system
Security			
- Fire alarm	If smoke is detected	Start siren and give instructions + call to chosen person	Start siren and give instructions + send info to care system
	If sound from a different alarm is detected	Start siren and give instructions + call to chosen person	
- Digital nose	If gas is detected	Notify people in house + send info to chosen person	Send info to care system + notify care taker
- Burglar alarm	If break-ins are detected	Call to chosen person	Send info to care system + notify care taker

Figure 6.6 - Features of the radar

6.1.3 Interface for caregivers

To illustrate how the caregiver interacts with the system a simple interface is made to fit a computer screen. This is only for visual purposes as well as inspiration for further development. The interface highlights the key features of the radar and hub through showing alarm, messages, requests and more.

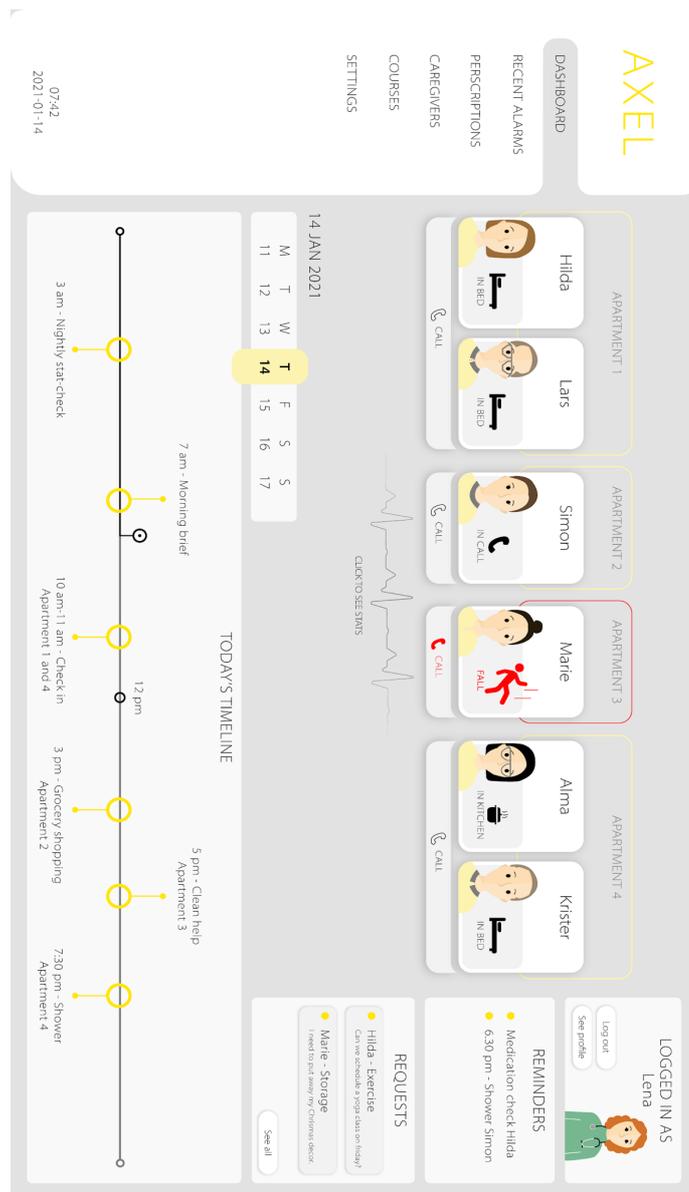


Figure 6.7 - Illustration of an example of the interface for caregivers.

6.1.4 Solution Scenarios

The specifications and images of the system are now complemented with new scenarios that will describe how the previous problem scenarios now are solved by the new system. They are describing the solution, as a final narrative of the concept.

The solution scenarios aim to tell how a user engages with the product being developed and to explore the future use of the product from the user's point of view (Martin & Hannington, 2012).

Klara's everyday life with the new system

It is Wednesday morning, Klara is drinking tea and looking at instagram on her phone. She likes to look at the posts from her family and to be able to engage in what they are doing since they all live far away. She doesn't get to see them except for on holidays, with some exceptions of her daughter visiting once in a while, she is the one living the closest. Today, however, since it is Wednesday they always eat dinner together, virtually. Klara uses her photo frame Axel to make face calls to her family a couple times a week, usually they just speak at random times but they always meet up on Wednesdays to eat at the same time. The premise is that they cook the same thing to increase the feeling of being together at the dinner table again. Both her son and daughter join in with their families on Wednesdays.

While scrolling on instagram she gets a notification on her photo frame, she walks over to see what the Axel wants. She forgot to bring her glasses, so she taps the button "read out loud": "Hi Klara, I am on my way to help you with the cleaning. I will be there in 30 min, accept the notification so I know you got it / Lillemor." She had forgotten about that, but it is always nice with a bit of company, so she accepts the notification. Klara finishes her tea and then gets dressed just in time for when there is a knock on the door. They make small conversation before Lillemor gets on with the cleaning. After she is done they sit down and drink a cup of coffee together. They discuss if Klara is in need of any help the rest of the week since she is entitled to a few more hours of home care. Klara says that a refill of the fridge on Friday would be nice and Lillemor makes a notification on her work phone to contact Klara on Friday morning for an eventual grocery shopping.

Klara asks if Lillemor has time for a walk since the weather is sunny. Lillemor is supposed to visit Simon who lives close by and says that she can contact him and see if he wants to join their walk since they usually take walks together and Simon is not able to take walks on his own because he gets lost but enjoys them when the weather is nice.

They all go for a stroll in the neighborhood and when Klara gets back, she starts making herself some lunch. While she is waiting for the chicken in the oven she sits down and watches the Axel. He is showing pictures that are over 20 years old and that she almost

forgot about, but they are from a trip she took with a friend to Mallorca. She decides she wants to call this friend and taps the photo on the screen. Axel asks her: "Would you like to call Berit?" Klara presses yes and a call starts. Berit is eight years older than Klara and now lives in a senior living home not too far away. Berit is alert and feeling well today and asks if Klara wants to visit. "Yes, why not! I will call for transportation service and then I will see you in a while." They hang up and Klara uses Axel to send a request for transportation service to Berit's senior living.

Lillemors Day to day life working in home care using the system

It is Tuesday morning and Lillemor started her shift at the home care. She opens her laptop and logs in to the home care portal. This is a cloud service where all information is collected from the caretakers and viewed by the caregivers. There she can see that all her five patients slept through the night except for Klara who went to the bathroom three times, this is however normal for Klara and nothing she will have to make note of. However, the system has flagged Simon, a caretaker, and she can see it is because the shifting in his pulse is slightly unusual during the night. She sends a request for an EKG and an appointment with a doctor at the local health center and then makes a note of this in the system to remember to discuss this with Simon as well..

After the update, her morning check-in with the caretakers starts. Some caretakers want and are in need of a call every morning while others she only checks in with once or twice a week. Klara is one of the caretakers that she calls only on Tuesdays and she is first on the list. She answers and they have a webcam meeting about what Klaras plan is for the day, how she is feeling this morning and if she is going to have any visitors. Klara answers that her daughter is coming over with lunch and she is going to help her with the garden. Since Klara is independent in many areas Lillemor asks if she needs any help from hemtjänsten today and when she thinks she needs help with the grocery shopping. Klara explains that her daughter is visiting and that she is picking up some groceries on her way, she will help her with the garden during the day and then they will have dinner together. Since her daughter is visiting who lives a little further away, Lillemor knows Klara will have company for almost the whole day. Her daughter will help out with anything urgent and the system will alarm if there is an accident.

Lillemor moves on to calling her next caretaker, Simon. Simon lives in the same neighborhood as Klara but is in need of much more assistance. Simon answers and tells her he is feeling fine and that he would like help with a shower today, preferably during the afternoon because he is going for a virtual cycling tour with a friend at 2 p.m. Lillemor tells him that it is fine she will stop by then and makes a note in the system that will remind Simon and herself 30 minutes before her arrival. Lillemor can also see that he has played a cognitive game during the morning. The system doesn't tell you which one just notifies her that an activity has been performed, but this is good because Simon has mild dementia. She makes some conversation about what game he played and then they hang up and she

moves on to make the next call. She doesn't bring up the request for an EKG, since she is visiting him later the same day it is better to discuss the matters in person.

After making her last call, her phone notifies her of an accident. The system has detected a fall in Klara's apartment and Lillemor calls her to check in, however there is no pickup so the system automatically connects a video call to the caretakers screen. Klara cannot be seen since her Axel is put faced away from the kitchen but she responds from across the room and she is fine. She had slipped in the kitchen but the fall hadn't hurt her, but she wanted to sit still for a while and therefore didn't want to get up and answer right away. Lillemor asked if she wanted her to check in on her in person but Klara told her that her daughter was just a few minutes away anyway, so it was fine.

6.1.5 The User Journey Map

The user journey map mentioned earlier is developed to involve the personas and their journey to receive a hub system. Illustrated below in figure 6.8 is the journey following the product from being developed to ending up in the users' homes. To fully understand the different phases of the journey, figure 6.9 is created.

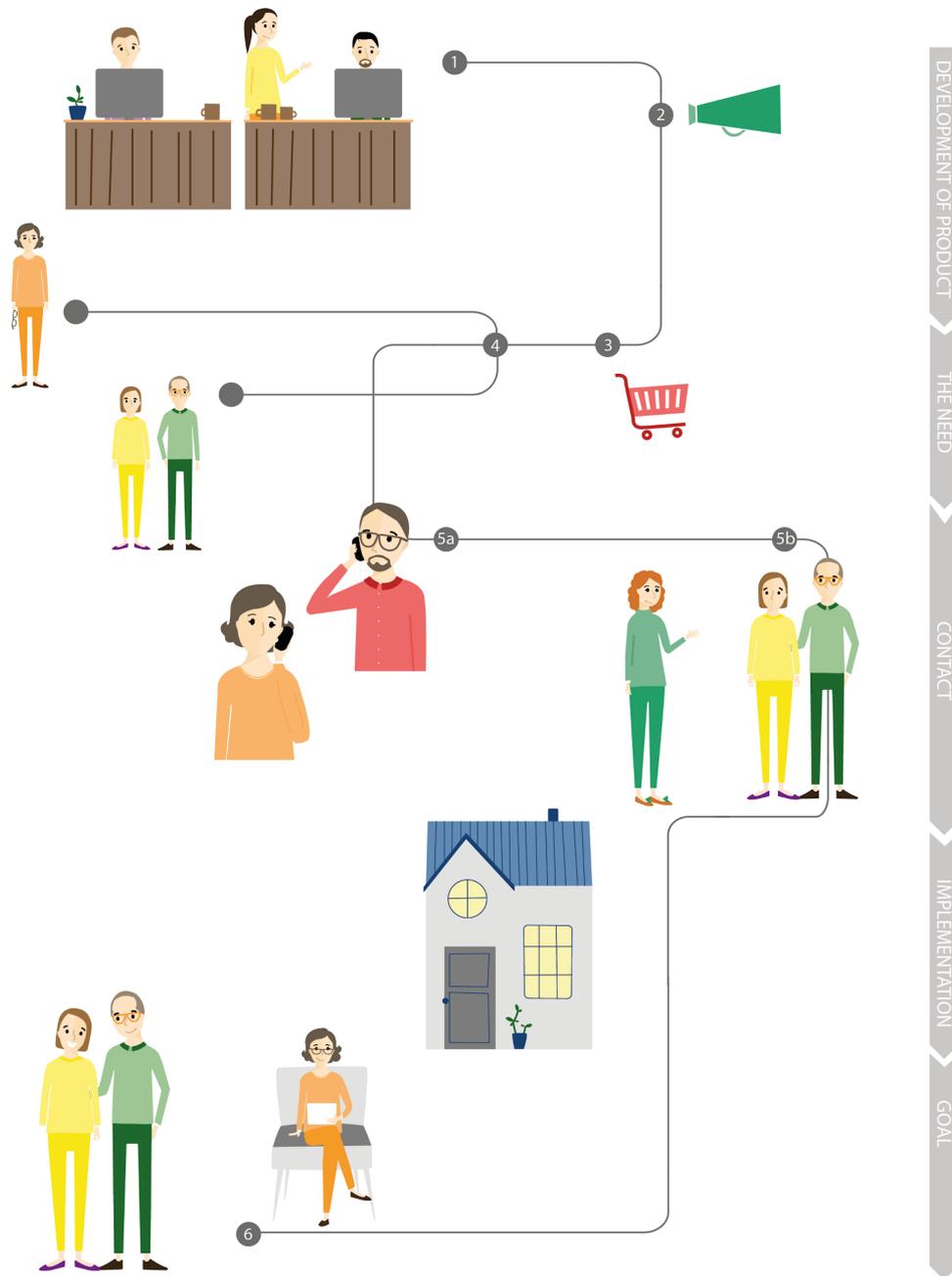


Figure 6.8 - Illustrated final user journey map.

PHASES AND TOUCHPOINTS

Development of final concept

- 1 The team uses the tools to develop a final concept of a smart system for eldercare.

The team sees a need for creating a smart system that is innovative and extensive within safety and security. With the tools they feel it is easy to quickly understand the market and the end-user as well as get an overall picture of the problem definition.

- 2 The company markets the product through explaining the benefits of a system that increases well-being specifically for elders.

By creating independence and self-determination for the elderly as well as working preventive and assistive, the system will not only contribute to a healthier older population but also make it more cost effective as well as relieve the caregivers.

The Need

- 3 Municipalities need a solution for solving more complex health issues and to relieve the caregivers in their work. They buy a set of products which are provided if needed for the elderly contacting the municipalities.

A private senior living facility is in need of creating smart apartment solutions. They are looking for a complete system that can be integrated in every apartment and create a mutual platform for the caregivers and caretakers to communicate with ease.

- 4 The elderly is starting to be concerned over his/her living situation since he/she is experiencing geriatric syndromes. Limitations in mobility make everyday life harder and there is a need for more assistance but the elder doesn't want to burden relatives or friends and therefore there is an increased risk of accidents.

The elderly is feeling more and more depressed over limitations in everyday life but still want to live independently. When losing more control over life and being in need of assistance the elder is concerned this will lead to a loss of integrity.

A relative is concerned about the elderly's safety and not being able to help out as much as needed.

Contact

- 5a The elderly contact the municipality and get a smart system implemented in his/her apartment.

- 5b Elderlies start to look at different housing opportunities and get in touch with a private senior living facility. They visit the site and the caregiver shows the housing as well as explains the selling point of moving into a smart home.

Long-term goal

- 6 After the system is implemented in the elderly's apartment he/she has better contact with caregivers and feels more secure. Everyday life is easier and the elder still feels independent and in control at home. In the long-term it creates an increased level of wellbeing for the older person.

Caregiver has good contact with caretakers and does not feel stressed during visits.

Figure 6.9 - Phases and touchpoints explaining the different parts of the user journey map.

6.2 The booklet: Lilla Gula

Lilla Gula is the name of the booklet that includes a compilation of tools to be given to the company as a complement to the report. The purpose of the booklet is to create a framework that steers the company in the right direction during concept generation. It consists of tools that facilitate the entire concept development process. Inspiration for the development process is taken from methods used earlier in the project. The steps of the process are illustrated in figure 6.10. The complete booklet is found in Appendix E.

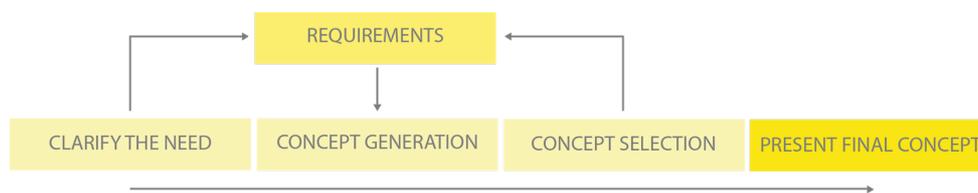


Figure 6.10 - The development process presented in Lilla Gula

To carry through a concept development process, it is important to understand the market and its actors as well as to set a goal for the final concept to achieve. During *Clarify the need* a basis is built through explaining for whom the final concept is designed and why it is needed. This material should be considered throughout the whole process.

The outcome of the previous step is summarized into product requirements that become the input for continuing with the concept generation. During *Concept generation* three tools are presented to facilitate when generating ideas. Product requirements create a framework to ensure the goal is met. They are complemented with scenarios describing the problem along with a list of features that can be implemented.

In *Concept selection*, the process returns to the product requirements and the different concepts can be evaluated on how well the goal is met.

Once the final concept is selected it is important to present it at its best, both visually and verbally. The *final concept presented* here in section 6.1 is developed through using the tools so as an inspiration, at the end of the booklet, the final concept is presented as well. The personas are used again to illustrate new scenarios integrating the final concept and the placement along with selected features are presented, made easy to understand.

7 Discussion

This chapter discusses the development process for both the final concept and the booklet that was created. The discussion touches not only what parts of the process that turned out to be good decisions but also covers what could have been done differently.

The starting point for the project was the company's interest in eldercare and welfare technology. This is not a primary market for them today, although some of their products can be used as enablers. Therefore, part of the task was to define the project and set out a specific direction, which turned out to be harder than anticipated. When conducting research, the team realized the width of the subject and therefore had to work iteratively between defining and discovering. Most of the time during the startup of the project was put into defining the question and problem discussion. Through research, conversations and interviews the material gathered was extensive and therefore the team tried to process the information in different ways, this led to using user experience methods such as personas, scenarios etc. Reflecting over the project now afterwards, it is more of a field study rather than a pure development process and therefore the tools used naturally became a part of the deliverables. The team decided to develop the material for the tools visually and present it as tools for further development for the company to have. The decision to deliver not only a final concept but also a set of tools is a decision that took some time to define but something that the team feels can bring more value to the thesis project.

Ethics

An important discussion in eldercare and therefore also this master thesis is the aspects of ethics. It is a balance between having technology that is helpful and facilitating, yet not integrity compromising. One question is if nightly supervision in person feels better or worse than having a camera that checks in on you every once in a while. If one prefers having a camera for nightly supervision, then this concept with a positioning sensor might be an even better solution that does not tell anything apparently compromising about the sleeping user. However, there is also a question on how it might feel to have technology to watch over you at all times. Even if it does not see you imaged, it knows for how long you stay in bed, knows how rarely you have friends visiting and can communicate to your caregiver if you are sleeping less than usual. Maybe that is too much for a person that enjoys living an anonymous, independent life. These questions are very hard to answer as it all comes down to the individual users. We believe there might be many people that

feel surveilled but also many people that are fine with a solution of this kind. Karlsson, Arvidsson, Cuesta, German Millberg & Nilsson (2018) did a more extensive research on ethical issues and asked, among others, caregivers what types of ethical issues they meet when it comes to welfare technology. Something that they pointed out is that it is important that the customer or user is a part of the integration of technology and gives their approval. In some cases, this could be really difficult as we hope our concept could work for people with different levels of decision-making abilities, and it is not always easy to get an approval even if the person is okay with the technology.

At the same time, it is important that welfare technology is available for anyone, with disabilities and without (Karlsson et al., 2018). That is also something that is important to us as a group, that the individualization we worked to achieve makes the concept usable for any ageing person. In this project the focus lies in development of a concept from a user's perspective, this is because the technology should give added value for the user in order to be developed for the right purpose. When integrating the technology, it is important to also look at the other users and their different needs. We are therefore very excited to see how the development of this concept continues in the future.

7.1 The final concept

Since one of the criteria in the project outline was to include products possibly being current in 5-10 years from now, the team put more effort into making a conceptual system rather than a detailed product, which also made developing the hardware and software rather irrelevant. Creating a conceptual system is something that was fairly new to the team and there has been a lot of trial and error when moving forward with the project. Something that could have used more time and attention is the aesthetic design of the photo frame that is a part of the final concept. When getting to the finishing line of this thesis, the team made a conscious choice to instead focus on the technical specifications, placement and features of the product.

There are several parts of the final concept that were decided to only be “scratched on the surface”, and the project created a shell for a conceptual system along with a booklet of tools that can be used when developing a finalized product. Further research can be valuable to the final concept and are mentioned in the next chapter, *8 Conclusion and further research*.

Testing of the concept was done very briefly with four different people. Three of them are municipality workers and one works as a caregiver. They were, as mentioned earlier, sent a short presentation of the concept along with the necessary features for the final concept. The reason this was done less in-depth is simply because of lack of time. The team was still given valuable input although if it would

have been possible, this input could have been interesting to take more consideration of and use to further develop the system. Some of the most important insights are however listed below:

- The orientation that was chosen seems well grounded and the concept presented is based on important basic principles found during research.
- The fact that understanding the target group is such a big part of this project gives the solution great importance.
- Something that would be interesting to look at is if the interface for the user would be different for different users.
- Using the product as a digital photo frame is a nice way to individualize the product and makes it usable for a large group of people.
- What would the Swedish business model look like for this product? It would be interesting to look at the difference if the municipalities or the regions were to pay for it.

Unfortunately, since the team decided to focus on the primary users of the concept being the older adults and the caregivers, time for tests and development for relatives was deprioritized. This is something that municipality workers commented on when receiving information about the final concept and a question that is left unanswered is: What would it mean for the system if the older persons' friends and family were to get access to some of the information that the system collects? This is a complex question since security is very important when it comes to private information.

7.2 The booklet

Since this thesis took a bit of a turn to create material not only in the form of a final concept, but also as a booklet with tools for the company, the tools presented need to be discussed as well. The booklet is meant to be relevant for the company only and therefore the final testing was made through conversation with stakeholders from the department whom the master thesis was conducted for.

There will be another master thesis built on the conclusions of this one and therefore the company considers the booklet to be useful for those students. The company can see them using the booklet when continuing to investigate the eldercare market. Since the different tools can be used both when developing and evaluating concepts, the team rests certain that the material will be useful in some way.

The company representatives also express that they can use the booklet to present the idea of an exploration in the welfare market. This is as mentioned earlier not an area that they currently are involved in but something that could be relevant in the future, which makes the material in the booklet useful.

The team was able to modify the compilation of tools according to the received feedback before presenting a final version and some of the changes wanted was:

- Capture the reader quicker with explaining the purpose and goal at the beginning and then present the tools created as support.
- Create a better order for the reader to follow.
- The booklet has some large chunks of text, some of the scenarios might not be needed.

One thing that has limited the development of tools in the booklet is the fact that the tools presented by the team have all come naturally from the design process of the project. The tools are packaged as a booklet to help in development processes, but they should be complemented with other methods depending since it doesn't cover an entire development process. For example, testing methods and prototyping are not mentioned in the booklet but are parts in a design process.

8 Conclusion and further research suggestions

As mentioned early in the report, eldercare is a relevant question for all of us, maybe more so now than ever. The project team has had their hands full researching and exploring the issues and possibilities in this area and believe that it is a very relevant market for the company. Today's eldercare is in need of an extensive sustainable solution that integrates all actors, maintains the older adults' integrity and self-determination as well as enables easy and effective communication between a caregiver and a caretaker. The market is not in need of another quick fix and therefore the team believes that with some development and time this will be a profitable market with many opportunities of development for the company.

Since this master thesis represents a framework that defines the needs and the market, the project naturally creates a basis for further development. The main areas of development include generation or further development of concepts and testing them more thoroughly. The final concept presented can be used and developed further through designing the esthetics from a user-centered point of view, especially for the interface. It is important that the final concept considers the change over time of increased geriatric syndromes, such as reduced cognitive capability.

To create useful testing of the final concept or any new concepts a low-fidelity prototype demonstrating the interaction and features of the product should be developed. The testing should include actual users and actors that match the target group presented.

In the final concept some products of the company today as well as in the future are integrated, however, the team believes that the company has more products useful to eldercare. Combining existing products in different ways can create an individualized package, with a base of standard features along with add-ons of the users choosing it becomes competitive on the market. A suggestion for further development is to integrate and develop more of the company's existing products into the solution and explore different combinations of concepts and products.

During the development sprint questions were asked, they were used as a guide and by answering them further explains and concludes the project. The direction changed in the form of developing a concept and not a product.

- *How will we integrate the product into the company's line of products?*

The features developed are created through keeping the company's line of products in mind. All the thought technology that exists or that is to be developed is in the line of the company's interest and therefore will integrate nicely.

- *How can we reach the long-term goal?*

The long-term goal was set to be achieved by addressing the physiological-, safety- and social- needs. By creating a framework through the concept requirements, the features developed coincides with the needs and therefore the long-term goal will be achieved. However, since this is a concept and not a finished product there is no way of knowing if the concept will accomplish this, further testing with the users should be done in order to establish this correctly.

- *How can we make the product attractive to the target group?*

Through making the hub a photo frame adds value to the system when not in use as well as acts as a part of the interior design. The hub is addressed to be mainly for its user and the features are developed to facilitate the older person in the way they choose. Since the development is in relation to the goal pyramid and has the user in focus the concept should be attractive to the target group.

- *How can we make the product both modular and mobile?*

The idea of the concept is that the basis in the features list are labeled necessary and the additional features creates the modularity in order to individualize each system. The hub is mobile through having battery time and has the possibility to be carried around in the home. Since it can be placed on the wall for a permanent position as well as on the table so that its user can pick it up.

- *How will we make the product easy to use?*

The concept has both manual and automatic features, this means that the most important actions of the system are integrated to be automatic and doesn't require anything more than having wi-fi connection and being plugged into a power outlet. As for the manual features the sequence of actions is described in a simple way and demonstrated through a simple interface. This is a further development area where user testing should be conducted in order to establish if the concept is easy to use.

- *What features do we prioritize?*

The development of the concept focused on creating a basis of necessary features to create a standard for each system, and then as a second prioritization additional features were presented. The features prioritized were directly linked to either physiological-, safety- or social needs. Since the concept should integrate the company's line of products this was also considered. As a final conclusion the team believes that with some further development using the presented tools, the long-term goal of: *Creating an increased level of well-being for the older population*, is achievable and that the market is in great need of sustainable solutions using technology.

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Appendix A - Time plan and work distribution

A.1 Work distribution

The authors of this thesis (earlier referred to as the team) are both students at the same department in Lund. They have similar backgrounds and therefore have been equally involved in all activities during this thesis. Occasionally the tasks have differed slightly due to the fact that the group has had to sit at different locations, but all tasks have however been discussed thoroughly and reviewed by both group members. If any task distribution was to be mentioned, it would be that the layout responsibility for the booklet mainly was on Fiona and the illustrations of personas mainly were done by Amanda.

A.2 Time plan

A Gantt chart was created the first week of the project. This was then updated into a more accurate chart over the actual outcome.

As seen in the two following figures A.1 and A.2, the chart planned at the beginning of the project differs from the actual outcome. The main reason for this is that the team decided to focus on not only presenting a final concept but also a compilation of tools. In the original Gantt chart, time for concept selection and testing with the target group was scheduled. Instead, the time was focused on developing the two main parts.

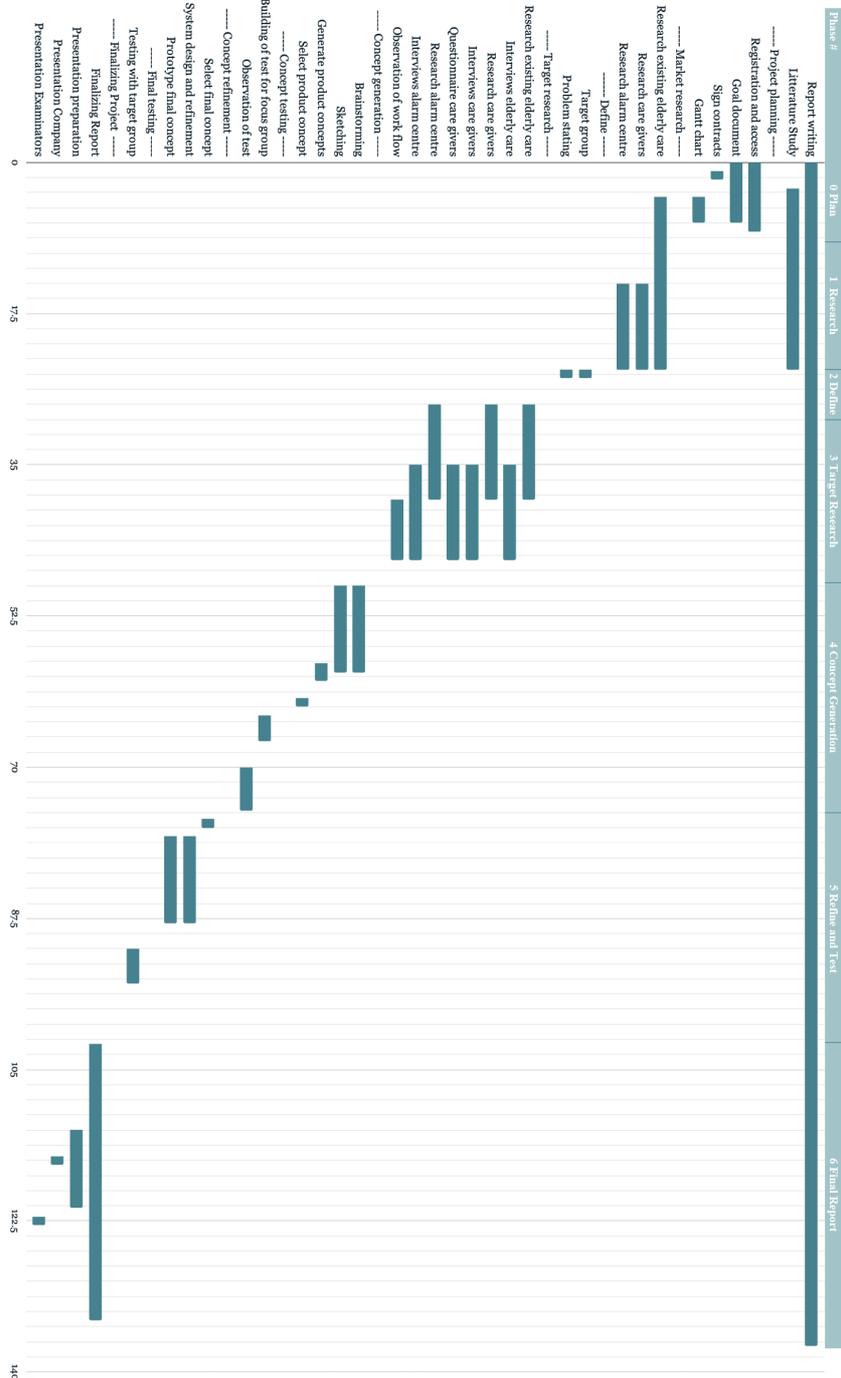


Figure A.1 - Gantt chart created at the beginning of the project.

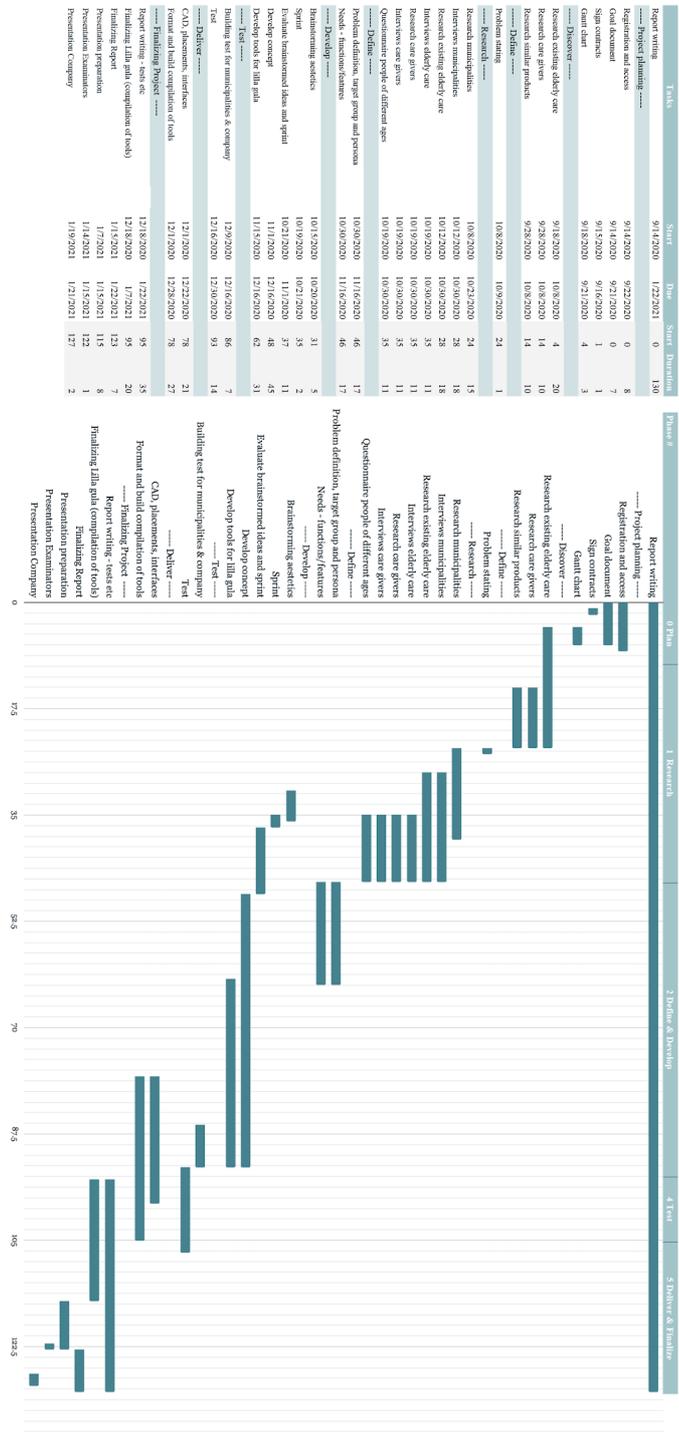


Figure A.2 - Gantt chart showing the actual outcome.

Appendix B – Interview questions and questionnaire

B.1 Examples of questions for municipality worker and caregiver

MANUS

Vi heter Amanda och Fiona och studerar Teknisk Design här i Lund på LTH. Vårt exjobb är i det stora hela en undersökning om hur man kan underlätta äldreomsorgen med teknologi samt hur ett konceptuellt system skulle kunna se ut i framtiden.

Vi är just nu inne i den fasen där vi försöker lära oss marknaden och hur man idag jobbar med ehälsa och hur äldreomsorgen ser ut, och det är där du kommer in. Vi är jättetacksamma för att du har tagit dig tiden att prata med oss. Vi har förberett lite frågor men det gör inget om vi svävar iväg från dem, kan du inte börja med att berätta lite om dig och din nuvarande position?

FRÅGOR

1. Hur arbetar SKR med E-hälsa idag?
2. Hur ser samarbetet med **företag och organisationer** ut?
3. Varför tycker du/ni att teknik är **viktigt**?
 1. Varför är det viktigt med teknik just i äldrevården?
4. Vad finns där för övergripande **problem** i äldreomsorgen idag?
5. Vad finns det för **standarder** för äldreomsorgen i dagsläget?
6. Finns det något som alla kommuner måste ha/ har tillgång till i teknikväg?
7. Finns där några planer på att standardisera mer hur kommuner och regioner jobbar inom äldreomsorg?

KOMMUN

8. Hur har **tekniken blivit bemött** av vårdbiträden?
9. I vilken grad använder **vårdtagaren själv** tekniska lösningar?
10. Vad är (eller tror du är) **vårdtagarnas uppfattning** av tekniken som används?

FRAMTID

11. Vad siktar ni på att **satsa på** i framtiden eller **införa på längre sikt** rent tekniskmässigt?
12. Vad finns det för **framtida mål** för äldreomsorgen?
13. Ingår ni i några större projekt eller insatser med andra företag eller organisationer?
14. Vart **hoppas du** att äldreomsorgen befinner sig när du själv kommer ta del av systemet, vad vore ditt drömscenario?

B.2 Examples of questions to older adults

MANUS

Hej vi heter Fiona och Amanda och skriver vårt examensarbete här i Lund för ett företag som heter Axis, de gör övervakningskameror och säkerhetssystem. Vårt examensarbete går ut på att undersöka hur äldreomsorgen fungerar idag, vilka problem som finns och hur teknik i framtiden hade kunnat underlätta en persons vardag eller någon som tar hand om en person eller möjliggör att man kan bo hemma längre. Just nu har vi intervjuat många som jobbar med äldreomsorg i kommuner och liknande men känner att vi måste prata med personer som kanske kan dra nytta av den här framtida tekniken.

Om er och er vardag:

1. Vill ni börja med att berätta lite om er själva, vad ni har jobbat med?
2. vad ni gillar att göra, intressen?
3. Hur ser er vardag ut? Det hade varit kanon om ni kunde gå igenom en vanlig dag och vad ni brukar göra.
4. Får ni hjälp med några sysslor? Det kan vara av släktingar eller hemtjänst eller vem som helst?
 1. Av vem och hur ofta?

När mår ni bra

5. Vad får er att må bra?
6. Finns det något ni gör varje dag som egentligen inte har någon betydelse men det får er att slappna av och inte tänka. Jag tittar till exempel på samma serie varje kväll som jag har sett flera gånger innan för att jag slipper tänka och tappa bort mig i stunden.

Teknik

7. Vad använder ni för teknik idag? (ge exempel om inget svar fås, mobil, google home, datorer, smart watch)
8. Finns det något som ni har installerat i hemmet?
 1. Vad gillar ni med just den produkten?
 2. Vad ogillar ni med den produkten?
9. Äger ni något säkerhetssystem?
 1. Hur var det att installera dessa tekniska produkter?
10. Hur håller ni kontakten med vänner och familj?
 1. Om ni inte har möjlighet att träffa dem hur hör ni av er?
 2. Hur har det fungerat i covid-tider?

B.3 Questionnaire questions

- Hur gammal är du?
- Du definierar dig som...
- Vad har du för nuvarande sysselsättning?
- Vad får dig att må bra rent fysiskt?
- Vad får dig att må psykiskt bra?
- Under Covid-19, har du gjort något nytt/annorlunda för att må bra?
- Vad använder du för (smart) teknik i din vardag just nu? Lägg gärna till förslag om du använder något som inte finns i listan! Exempel:
 - Smart-klocka (t.ex apple watch, fitbit etc)
 - Smart home-system (t.ex google home, alexa)
 - Smartphone (t.ex. iphone, android)
 - Digital väckarklocka
 - Hemlarm
 - Smart-TV
 - Dator
 - iPad
- Om du har ett smart home-system såsom Google Home eller Alexa, vad använder du det främst till?
- Om du fick plocka ihop FEM smarta funktioner till ett framtida smart hem, vilka hade dessa varit?

Appendix C - Insights from user research

C.1 Interviews

The different interviewees provided the project with various different insights from different points of view, some of the most important ones noted below:

- Three older people
 - It can be a quite big step to ask for help from the health care system, instead it is easier to ask for more from relatives.
 - There is a wish to stay at “home” for as long as possible, however one of the older adults had lived at a senior living for many years and considered that her home.
 - None of the interviewees were against welfare technology as a help in their everyday life but they were also not very used to using technology.
 - One said that an item she could ask things or tell things would be good, but she is not a fan of buttons.
 - They are all mildly restrained in mobility but adjust their everyday lives to move around less.
 - Using a smartphone or tablet is not a problem for many older people but they do not use all functions.
 - There is a growing concern among all of them that they might not get the help they need if something happens to them.
- Three municipal workers
 - It is very common that the safety bracelet or stationary safety alarm is the first step towards having contact with the municipalities regarding assistance.
 - The municipalities cannot themselves own ideas but are encouraging companies to develop ideas that they might come up with.
 - There is a general perception that different technological solutions do not always cooperate very well.
 - A common preconception is that it is usually an issue for the older people to learn and appreciate new technologies and that is in fact rarely an issue.

- They all think that in the future, there should be more focus on data gathering and preventative solutions instead of the technology that helps with issues and conditions that already exist.
- Tools for digital social contact with others are rarely working as well as they could and instead it is more common to have shared iPads that the care workers can help the older people to call with.
- Three health workers
 - Not everyone wants to have social contact with others all the time, but generally it is an issue within eldercare that the people in care are lonely more often than they would want to be.
 - The nightly supervision is often an issue, either the older person wakes up or it does not sleep very well because their integrity is compromised.
 - A lot of people with security alarms do not trust them and therefore wear them wrong or not at all. Wearables are often an issue.
 - Caregivers tend to bring physical keys to the caretakers' homes even if there are digital locks, just in case.
 - Giving the older people the opportunity to use tools such as Skype has been very helpful in situations where they cannot meet their relatives very often.
 - Many times, the welfare technology used by the older people is not appreciated because it feels like help for sick people, something more “attractive” to the target group would help.

C.2 Conversations

The most important acknowledgments from the conversation are ideas for different development directions and also what the expectations might be for the stakeholders. The interviewees all had many different ideas for the project, some being more technological aspects and others being input on more social psychological points of view.

The main points gathered from the conversations are:

- For the company's own interest, the product should be applicable not only in Sweden but also in the USA.
- Early developers could preferably be 70+ senior homes in the USA.
- There are many different technologies already existing at the company that could be used in the solution developed in this project.
- It can be helpful for the group to design for a more specific target group.
- Older people can have very different symptoms from one another.
- When designing for older people, one should have in mind not only the physical aspects of ageing but also the psychological.

The conversations also helped a lot to find new sources of information for the data gathering as well as the benchmarking.

C.3 Questionnaire

The questions of the questionnaire were primarily formulated in a way to bring the research gathering more quantitative data on peoples' usage of technology in different age groups. It asked everyone in two different Facebook groups about what technology they use on a daily basis and what they would want from a smart home system.

- 67 out of 69 people use a smartphone
- 64 persons have a computer
- 9 people have a smart home system
- 3 out of 24 people over the age of 60years have a smart home system
 - Only one of them uses it for multiple tasks
- The most wanted features for a smart home system are safety and security related such as fire alarm, burglar alarm, surveillance cameras
- Another highly wanted feature is smart lighting (see figure XX)

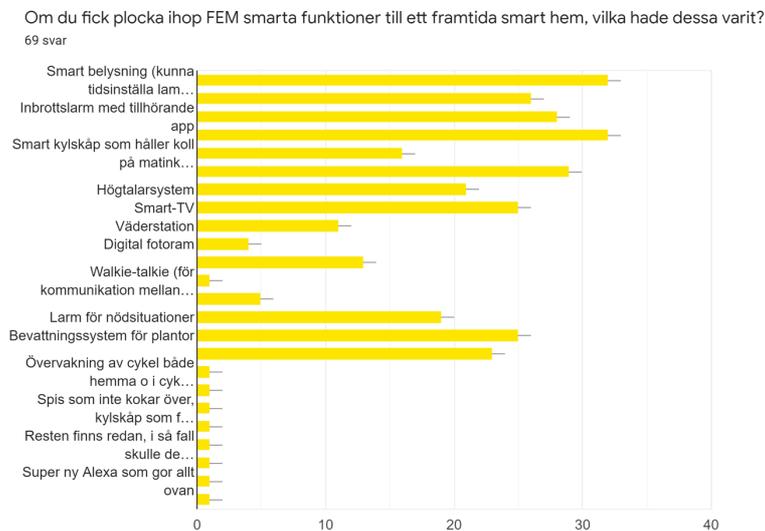


Figure B1 - Chart from questionnaire

Appendix D – Personas



Klara

"My friend suffered a stroke some time ago and since that I have started to question how I would get help if something happened to me."

- Home: Alone in a house with home care a few hours a day
- Family: Widow with two children and grandchildren

- Klara is very socially active and has a lot of friends she stays in contact with over the phone.
- She is happy to use her iPad and her favorite apps are Hemnet and Instagram.
- Klara needs help to make changes in her iPad and to pay her bills.
- She gets help from home care with cleaning and grocery shopping.
- She does not live very close to her children.
- She worries about how she could get help if anything happens to her.



Lars

"My son suggested senior living for us but we enjoy being independent."

- Home: A villa in a small, friendly neighborhood
- Family: Wife, two children and grandchildren

- Lars enjoys to be physically active but feels limited in mobility.
- He is a person that likes routines.
- He does not use a lot of technology but owns a smartphone that he can text from.
- His son helps with grocery shopping and gardening sometimes.
- Lars always has a lot going on with maintaining the house.
- He also has a lot of responsibility when it comes to his wife who has mild dementia.



Anders

"My mother has an alarm bracelet but she refuses to use it."

- Family: Parents in the same city, wife and children
- Work: At an office

- Anders likes visiting his parents and tries to help them with chores as often as he can.
- He visits them less and less due to other priorities at home and work.
- His children almost never want to join him to his parents.
- The kids once called it "like working for free" being at their grandparents house.
- It makes him sad that his mother becomes more and more limited with age.
- He knows that his father takes great care of his mother but would like for them to have some extra help.



Lillemor

"We have residents that remember their "home" as a place where they were always healthy, it makes them unhappy to be elsewhere."

- Family: Husband and two kids that have moved out
- Work: Retirement home and (mainly) home care in a small town

- Lillemor has worked within elder care for 30 years.
- She spends a lot of time in a car on the way to elders with home care.
- They use a specific work phone to connect to the different welfare technologies.
- She does not always trust the new systems and feel like systems are ineffective.
- She brings physical keys to care takers even when there are smart locks.
- The nightly visits are her least favorite part of the job.



Lena

"There is research that shows that being independent helps you live longer, but not everyone wants to live alone."

- Family: Husband
- Work: Caregiver at a privatized senior living

- Lena has spent a lot of time researching geriatrics.
- She has worked with home care, at a retirement home and now at a private senior living.
- Lena prefers working privatized where there is more time to spend with the elders.
- She finds there are too few places at retirement homes now so only the sickest get to live there.
- She always does her best to introduce technology to the people she cares for to help them with chores.
- Lena thinks a lot of technology they use now is developed to help sick people and not aging people.



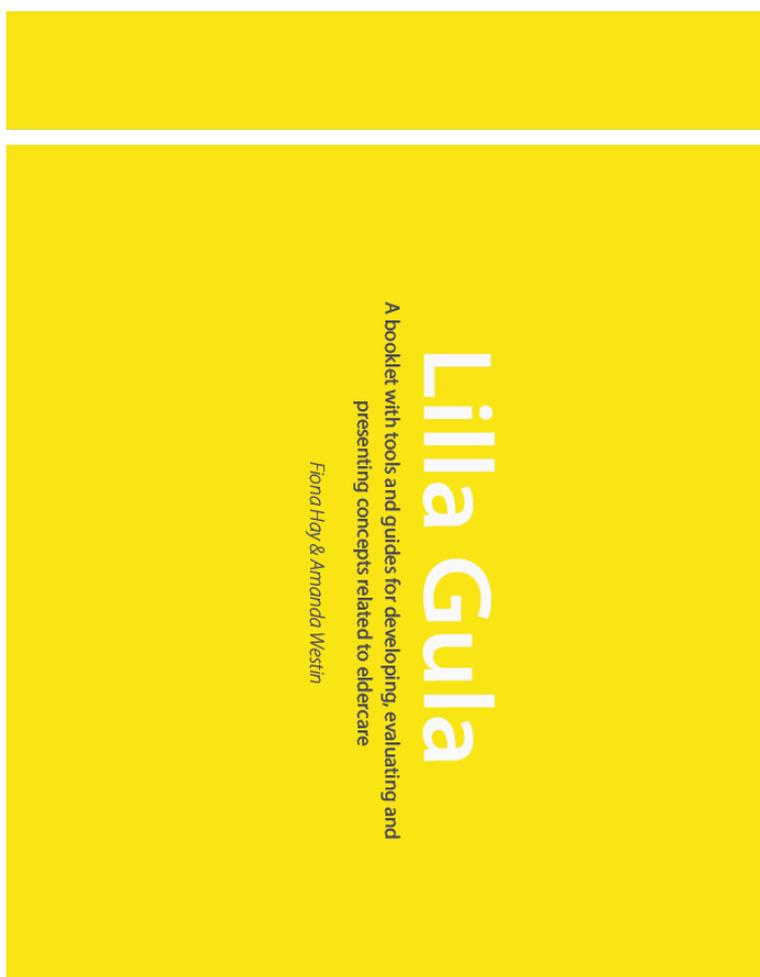
John

"We need to reconsider the way we use technology in elder care and use it to find and prevent issues instead of trying to solve ones that have already occurred."

- Family: Mother at a retirement home and a son
- Work: With eHealth in eldercare

- John thinks technology is important for everyone no matter the age.
- He works at a small municipality in Sweden.
- He is in charge of choosing assisting technology for their retirement homes.
- John thinks it is important to support companies and their inventions.
- He tries out a lot of the tech himself before applying it to the elder care.
- They use a lot of AAL-tech today but there are a lot of different systems to keep track of.

Appendix E - The Booklet: Lilla Gula



PREFACE

Imagine you are an investor and you're ready to build a new complex of apartments. To do this you start by searching for a suitable neighborhood for your building. Here you have to be clever because you don't want to invest in an area that has reached its fullest potential, this will be expensive and the return won't be profitable, you instead want to find a place where there is a future growth opportunity.

When you find that hidden gem you start envisioning what your new building will look like, you want it to be innovative and creative but most importantly you want to make the building attractive to the new residents. You're however only an investor with great vision and therefore need some help, so you hire two architects. They haven't graduated yet and are therefore not only very cheap, but they also provide a set of fresh eyes.

You explain your dream to the two young architects, and they start to give their view of the task. They don't want to see it as one building but like individual little homes. To make every apartment attractive they want to address the residents individually and make them feel like it is the perfect home for them. This is a great start you think and ask them to further develop the idea and create a mockup for the concept.

They start right away with researching on what is trending on the market right now. They look at other buildings in the area and also taking inspiration from more successful areas. They conduct interviews with relators to understand the needs of the future residents. Then they start creating the material for the final presentation. The result is a final concept for an initial building but they decided to also give you the developed tools, so that you can build another complex in the same neighborhood, maybe be the leading brand on the market.

The neighborhood you found future potential in was the eldercare and we acted as your architects. This is an area with great need of technology based solutions and therefore we set up needs, goals and requirements to make the final concept attractive and stand out on the market.

This booklet contains the tools needed to navigate the market and understand its actors. It also gives you an example of a final concept and how it can be integrated with the actors. This is done to show how we used this booklet to create a technology based solution.

The booklet *Lilla Gula* is a compilation of tools, produced during the master thesis titled *Technology based solutions as enablers for active and assisted living*. The tools are to be used in further development of welfare technology within eldercare. The goal of this book is to act as an aid in concept generation, concept selection and evaluation as well as provide inspiration for presentation of the final concept. It is a guide and a framework in the development process of new concepts.

Using this book should clarify the need, the users and give you a set goal for your development. Once you have developed a final concept, hopefully the tools also give you inspiration to create illustrative presentation material.

The book is divided into three segments: *The Need, Concept Generation and Solution*.

We hope you find this booklet useful, happy developing!

Fiona Hay & Amanda Westin

Together, these three chapters create a framework with necessary tools and inspiration for you to navigate in the area of eldercare:

THE NEED \ CONCEPT GENERATION \ SOLUTION

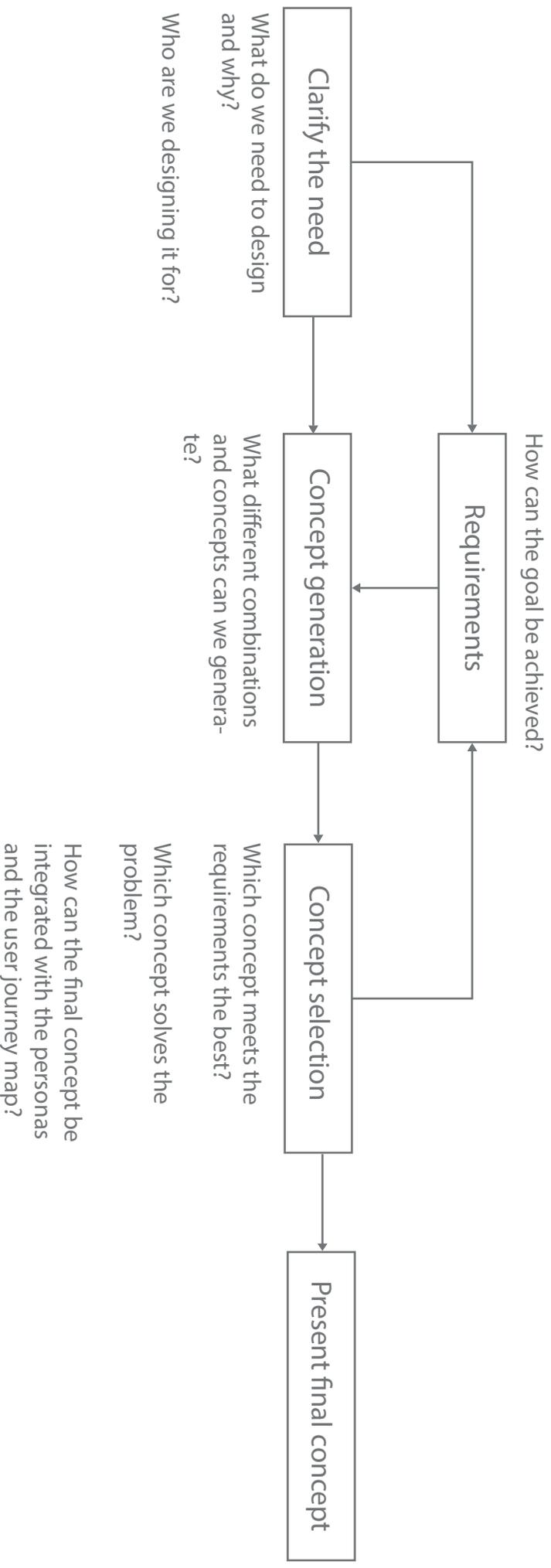
To clarify the need it is important to understand the target group. The outcome of this chapter is a framework of product requirements necessary to achieve the goal.

In this chapter you do all the work, through sketching brainstorming and discussions. The raw material for this is the product requirements, user journey map and personas, from the previous chapter. As an extra help we give you some scenarios that describe a possible narrative of problem along with examples of features to implement for the final concept.

The solution shows a final concept that is developed using the booklet. This is done to create value to the information given and to clarify the purpose. The solution chapter can be used as inspiration for presentation visuals.

CONCEPT DEVELOPMENT PROCESS

Below is an illustration of the intended process. To understand where in the process each tool is used the title of the step can be seen at the top right corner of the page.



THE NEED

The need clarifies the purpose of the process by answering the questions: *What do we need to design and why? As well as, For who are we designing?*

The outcome is a basis for concept generation through providing product requirements that outlines the final concept by answering the question:

How do we achieve the goal?

Establishing needs

Listed in the matrix are common problems of geriatric syndromes and undesirable feelings elders encounter due to primary aging. The problems are categorized and translated into a need that represents the least common denominator. The solution and goal to each need is listed in the final column and acts as a base for setting the requirements that creates a framework for the product concept.

Problem	Need	Goal
<ul style="list-style-type: none"> - Loss of integrity due to decreased level of control - Difficulty in performing every day chores - Increasing health problems - Limitations in physical activities and exercise - Poorer memory - Problems in getting the right aid inserted in time - Problems in communication with home care or health care - Feeling of being a burden - Problem with using modern technology 	<p>Physiological Needs</p> <p>Have control over a functioning life</p>	<p>A system that assists in everyday life and enables independency and self-determination</p>
<ul style="list-style-type: none"> - Increased risk of accidents - Not being able to let people know if you get hurt - Getting lost while outside - Worrying about break-ins - Needing nightly supervision - Does not trust the alarm bracelet 	<p>Safety needs</p> <p>Feel safe and secure</p>	<p>A system that enables a safe environment and feeling with focus on detection and prevention of accidents</p>
<ul style="list-style-type: none"> - Involuntarily loneliness - Does not have anyone around in a similar situation that relates - Depression - Decreased social activity due to distance and death amongst friends and family - Have no way of getting new friends - Lack of role or context 	<p>Social needs</p> <p>Have a sense of belonging, feel appreciated and needed</p>	<p>A system that promotes and enables social contact as well as gives a sense of belonging</p>

WELLBEING

Social Needs

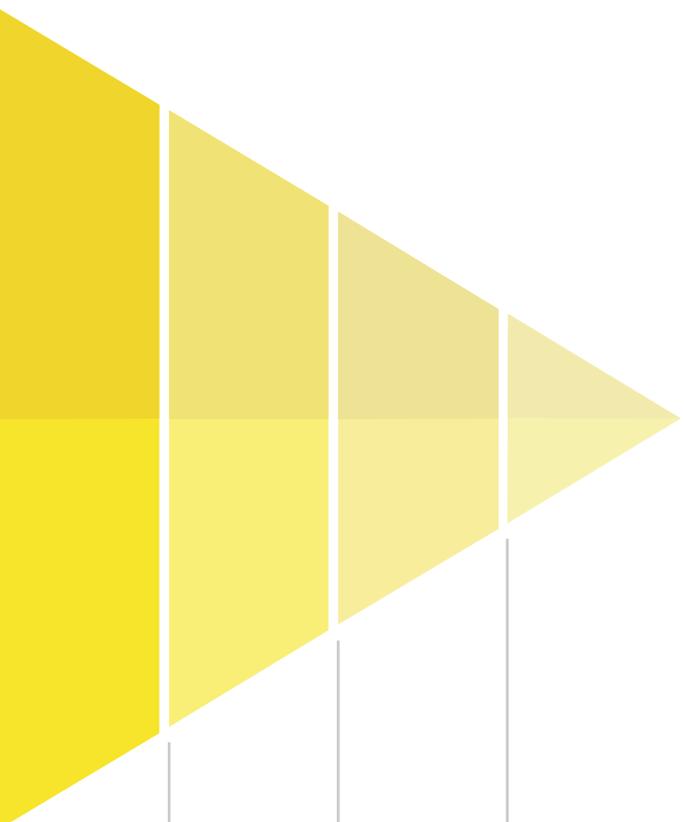
Have a sense of belonging, feel appreciated and needed

Safety Needs

Feel safe and secure

Physiological Needs

Have control over a functioning life



The Goal Pyramid

The pyramid of needs above illustrates how the long-term goal, at the top, consists of several smaller goals that have to be achieved in order to reach well-being for the older person. It is a beacon to keep in mind throughout the development process. The needs are expressed and categorized based on different problems identified. They are further explained on the next page.

Requirements

Product requirements have a central role throughout the development process. They are the outcome of chapter one, the input in chapter two and evaluated against in chapter three. The set of requirements are a translation of the needs established earlier and aims to explain what the product features should accomplish in order to achieve the long-term goal. It is an important building block for steering the concept generation in the right direction and is used again to evaluate and select a final concept.

The product...

GENERAL

- Will be an interactive system
- Will be modular
- Can be transported when moving
- Will be alterable
- Will work with other products
- Will fit in a home environment
- Will enable independence

FEASABILITY

- Will have high usability
- Will be easy to install
- Will be reliable
- Will be user-friendly for health workers
- Will be fun to use

TECHNICAL

- Will be voice activated
- Will be internet connected
- Will be battery driven
- Will have two-way communication
- Will cover the area of a living space
- Can analyze data
- Will collect data
- Will have cameras
- Will have radar
- Will have sensors

SOCIAL

- Will encourage social contact
- Will connect people
- Can contact relatives and friends
- Can create communities

SAFETY

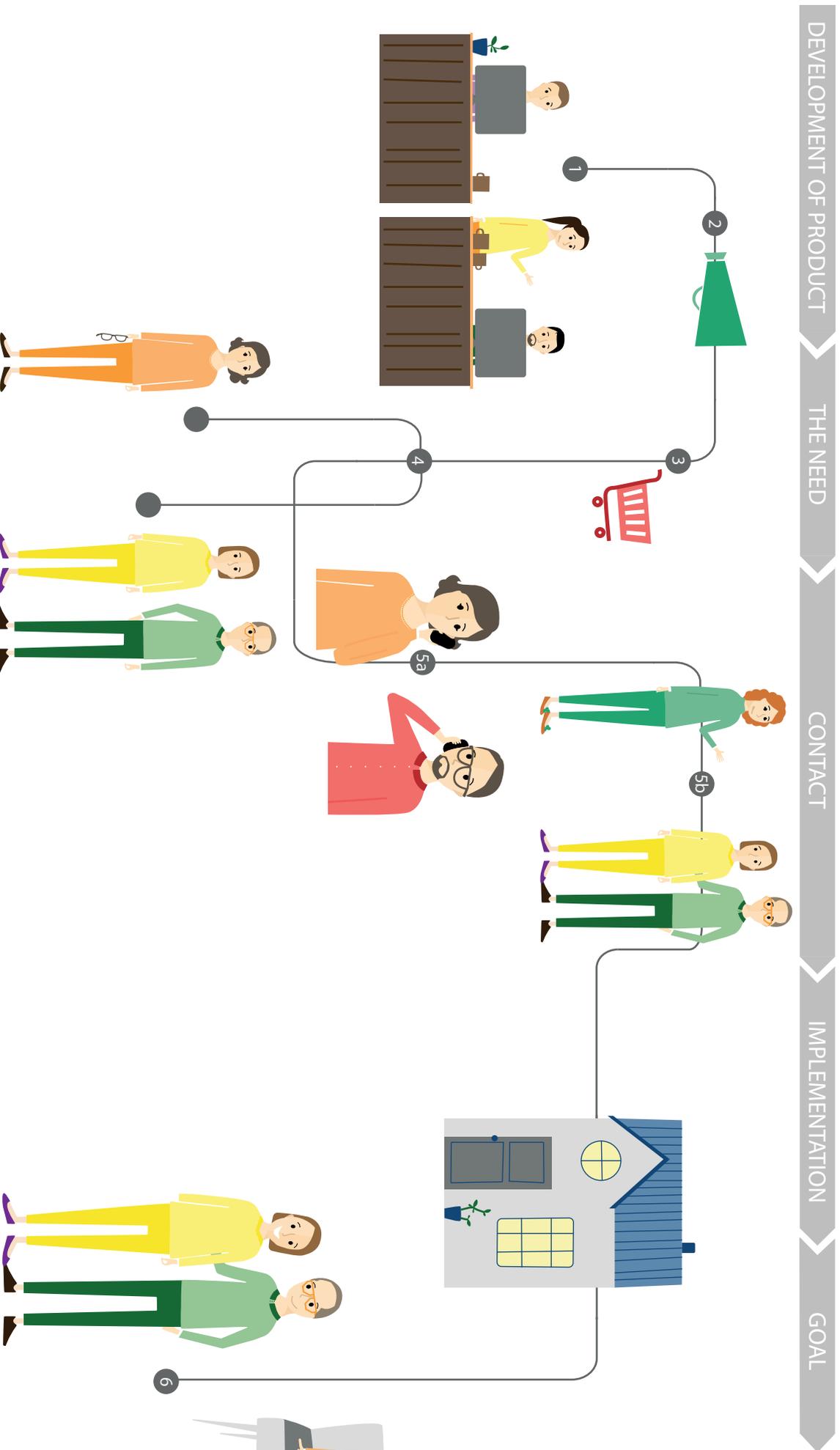
- Will try to prevent accidents
- Will detect accidents
- Will assist in case of accidents
- Can connect to alarm central
- Can track people inside their home
- Will keep track of journals
- Will have a security system integrated

PHYSIOLOGICAL

- Will measure vitalities
- Will enable physical activation
- Will enable cognitive activation
- Will assist with remembering tasks
- Will assist with medication
- Can provide information about the user
- Will have a calendar function
- Can adjust environment in home
- Can make purchases and orders

User journey map

The illustration below highlights the touchpoints and phases of the product journey from development of a final concept to implementation and use. The purpose of the journey map is to understand how the actors cross paths with both each other and the concept itself. The journey map aims to give an overview of the sequence of events that lead to the long-term goal. It can be used as presentation visuals, to explain the journey to a new listener. The touchpoints are explained on the next page.



PHASES AND TOUCHPOINTS

Development of product

- 1 The team uses the tools to develop a final concept of a smart system for eldercare.

The team sees a need for creating a smart system that is innovative and extensive within safety and security. With the tools they feel it is easy to quickly understand the market and the end-user as well as get an overall picture of the problem definition.

- 2 The company markets the product through explaining the benefits of a system that increases well-being specifically for elders.

By enabling independence and self-determination for the older persons as well as working preventive and assistive, the system will not only contribute to a healthier older population but also make it more cost effective as well as relieve the caregivers.

The Need

- 3 Municipalities need a solution for solving more complex health issues and to relieve the caregivers in their work. They buy a set of products which are provided if needed for the older person contacting the municipalities.

A private senior living facility is in need of creating smart apartment solutions. They are looking for a complete system that can be integrated in every apartment and create a mutual platform for the caregivers and caretakers to communicate with ease.

- 4 The older person is starting to be concerned over his/her living situation since he/she is experiencing geriatric syndromes. Limitations in mobility make everyday life harder and there is a need for more assistance but the elder doesn't want to burden relatives or friends and therefore there is an increased risk of accidents.

The older person is feeling more and more depressed over limitations in everyday life but still want to live independently. When losing more control over life and being in need of assistance the elder is concerned this will lead to a loss of integrity.

A relative is concerned about the older person's safety and not being able to help out as much as needed.

Contact

- 5a The older person contact the municipality and gets a smart system implemented in his/her apartment.

- 5b They start to look at different housing opportunities and get in touch with a private senior living facility. They visit the site and the caregiver shows the housing as well as explains the selling point of moving into a smart home.

Long-term goal

- 6 After the system is implemented in the older person's apartment he/she has better contact with caregivers and feels more secure. Everyday life is easier and the elder still feels independent and in control at home. In the long-term it creates an increased level of well-being for the older person.

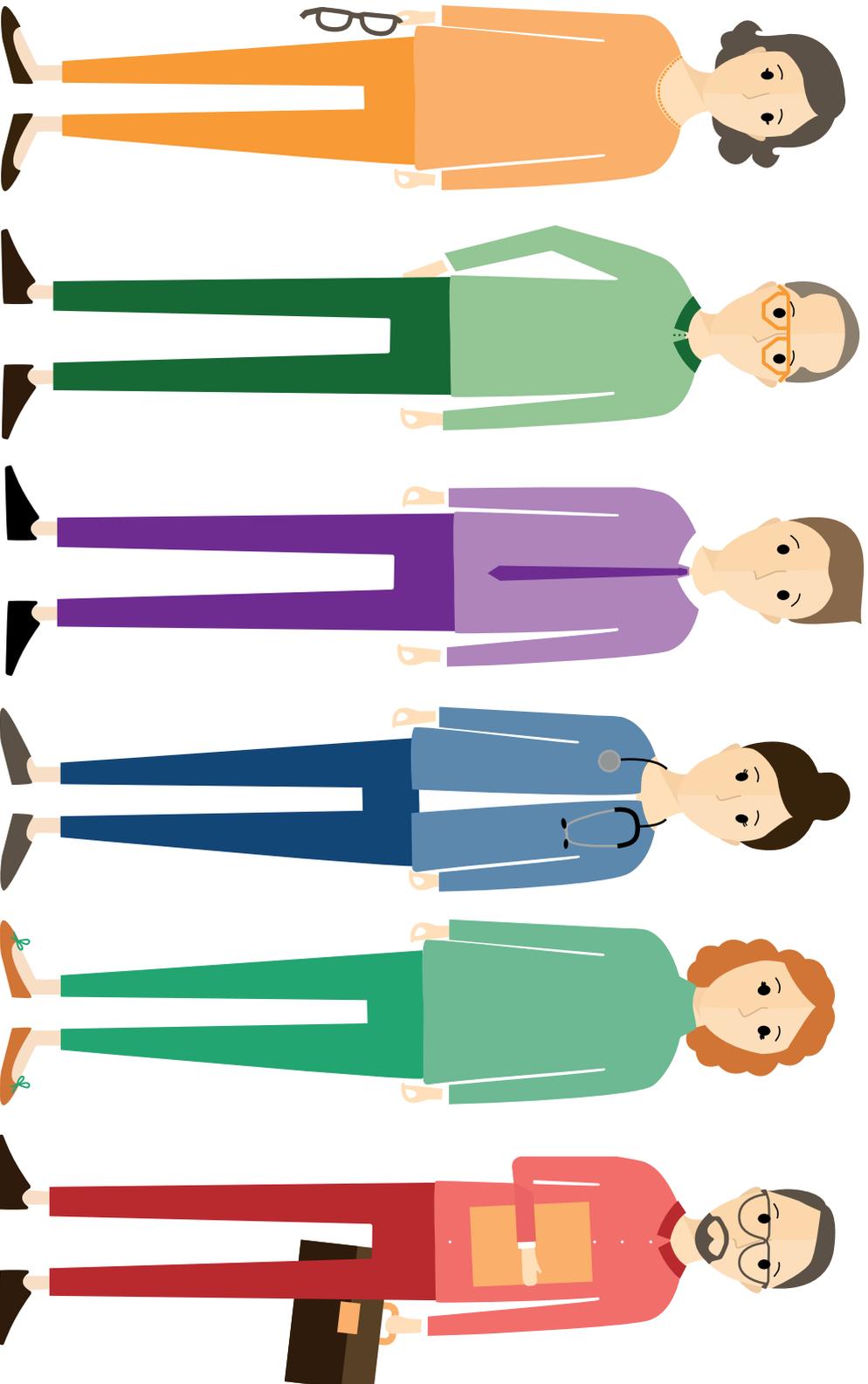
Caregiver has good contact with caretakers and does not feel stressed during visits.

CONCEPT GENERATION

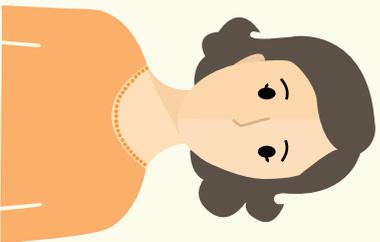
During the concept generation three important building blocks are presented, based on the insights from the previous chapter. Product requirements represent the outline of the final concept. They will steer the development in the right direction to achieve the goal. Scenarios of the problem are presented as a summary of why and for who you are designing. At last a list of possible features are presented as a guide and inspiration for brainstorming new concepts.

Personas

These personas aim to describe the actors that will benefit from the final concept and therefore play an important role in the development. They are based on information from real users and describe behaviors relevant to the design inquiries. They are to be used for a deeper understanding and as a basis for concept generation. The personas can also be used as presentation material as an illustrative way to explain the users or actors for a new listener.



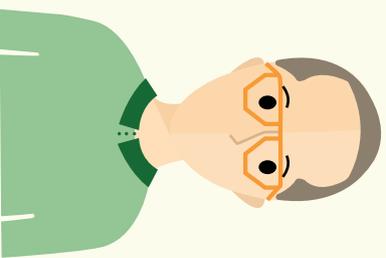
“My friend suffered a stroke some time ago and since that I have started to question how I would get help if something happened to me.”



KLARA

- Home: Alone in a house with home care a few hours a day
- Family: Widow with two children and grandchildren
- Klara is very socially active and has a lot of friends she stays in contact with over the phone.
- She is happy to use her iPad and her favorite apps are Hemnet and Instagram.
- Klara needs help to make changes in her iPad and to pay her bills.
- She gets help from home care with cleaning and grocery shopping.
- She does not live very close to her children.
- She worries about how she could get help if anything happens to her.

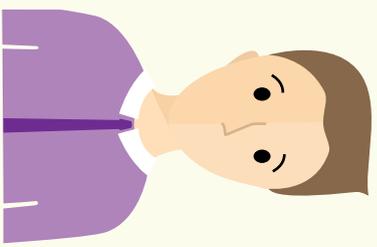
“My son suggested senior living for us but we enjoy being independent.”



LARS

- Home: A villa in a small, friendly neighborhood
- Family: Wife named Hilda, two children and grandchildren
- Lars enjoys being physically active but feels limited in mobility.
- He is a person that likes routines.
- He does not use a lot of technology but owns a smartphone that he can text from.
- His son helps with grocery shopping and gardening sometimes.
- Lars always has a lot going on with maintaining the house.
- He also has a lot of responsibility when it comes to his wife who has mild dementia.

"My mother has an alarm bracelet but she refuses to use it."

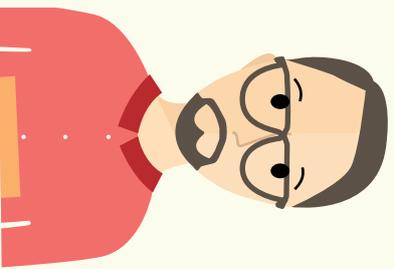


ANDERS

Family: Parents in the same city, wife and children
Work: At an office

- Anders likes visiting his parents and tries to help them with chores as often as he can.
- He visits them less and less due to other priorities at home and work.
- His children almost never want to join him to visit his parents.
- The kids once called it "like working for free" being at their grandparents house.
- It makes him sad that his mother becomes more and more limited with age.
- He knows that his father takes great care of his mother but would like for them to have some extra help.

"We need to reconsider the way we use technology in elder care and use it to find and prevent issues instead of trying to solve ones that have already occurred."

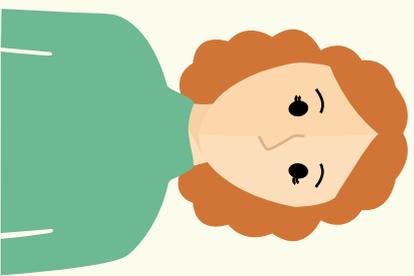


JOHN

Family: Mother at a retirement home and a son
Work: With eHealth in eldercare

- John thinks technology is important for everyone no matter the age.
- He works at a small municipality in Sweden.
- He is in charge of choosing assisting technology for their retirement homes.
- John thinks it is important to support companies and their inventions.
- He tries out a lot of the tech himself before applying it to the elder care.
- They use a lot of AAL-tech today but there are a lot of different systems to keep track of.

“There is research that shows that being independent helps you live longer, but not everyone wants to live alone.”

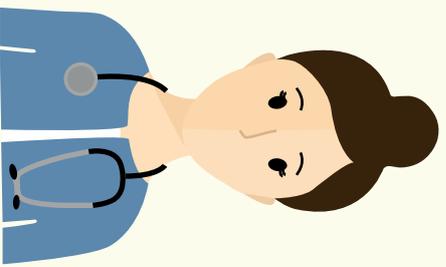


LENA

Family: Husband
Work: Caregiver at a privatized senior living

- Lena has spent a lot of time researching geriatrics.
- She has worked with home care, at a retirement home and now at a private senior living.
- Lena prefers working privatized where there is more time to spend with the elderly.
- She finds there are too few places at retirement homes now so only the sickest get to live there.
- She always does her best to introduce technology to the people she cares for to help them with chores.
- Lena thinks a lot of technology they use now is developed to help sick people and not ageing people.

“We have residents that remember their “home” as a place where they were always healthy, it makes them unhappy to be elsewhere.”



LILLEMOR

Family: Husband and two kids that have moved out
Work: Retirement home and (mainly) home care in a small town

- Lillemor has worked within eldercare for 30 years.
- She spends a lot of time in a car on the way to elders with home care.
- They use a specific work phone to connect to the different welfare technologies.
- She does not always trust the new systems and feel like systems are ineffective.
- She brings physical keys to care takers even when there are smart locks.
- The nightly visits are her least favorite part of the job.

Scenarios

The scenarios describe the personas' feelings and frustrations in a narrative. They aim to guide the concept development and give examples of real life situations that need a new solution. The scenarios facilitates the concept generation but can also be a basis for creating a new set of scenarios describing the feelings and actions of the final concept.

SCENARIO 1: Klaras day to day life living with home care

It is Wednesday morning, Klara is drinking tea and looking at instagram on her phone. She likes to look at the posts from her family and to be able to engage in what they are doing since they all live far away. She doesn't get to see them except for on holidays, with some exceptions of her daughter visiting once in a while, she is the one living the closest. It gets lonely sometimes not having them closely and living on her own but she also wants them to live their life. They call and text her as well as send photos but it has been a long time since they saw each other.

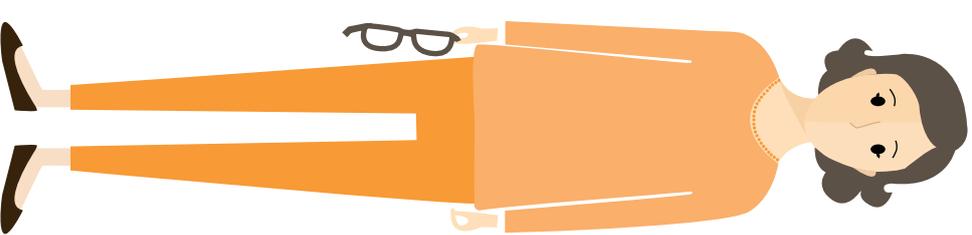
There is a knock on the door and Klara gets confused at first, but then she realises that it is the home care, of course! She had forgotten that they helped her with the cleaning on Wednesday mornings. She opens the door and is happy to meet the staff, even though she is a little ashamed because she is still in her morning robe, but it is always nice with some company. They make small conversation and then the home care staff gets to the cleaning. Klara gets changed and then continues with her instagram. When the carer is done with the cleaning Klara offers her a cup of coffee but she kindly turns it down because she has to rush off to the next house, she tells her wednesdays are stressful but next time she will stay for a cup!

She decides to take a walk even though she doesn't like doing it alone in case something happens or she gets lost but she wants some fresh air and the weather outside is sunny. If anything was to happen, she does have her phone so that she can contact someone. Sometimes the home care accompanies her on the walk but they are not coming again until tomorrow.

She decides to take a walk even though she doesn't like doing it alone in case something happens or she gets lost but she wants some fresh air and the weather outside is sunny. If anything was to happen, she does have her phone so that she can contact someone. Sometimes the home care accompanies her on the walk but they are not coming again until tomorrow.

Klara gets help from the home care, with things like grocery shopping, cleaning and exercise but mostly she just really enjoys the social interaction with the staff. Klara thinks the home care works fine, they are always friendly and helpful. The only thing she doesn't like is that she has to decide her food for a whole week at once. Every Friday morning someone will sit down with her and they make a list of groceries for the upcoming week and then on Monday she gets the groceries delivered. Today she is not in the mood to eat any of the food she has the ingredients for, so when she comes back from her walk she decides to skip lunch and just drink some more tea.

Klara has been thinking of moving to a senior living, not that it is necessary right now, but because she feels a little unsafe on her own and also it would be nice with some social interaction with people her own age. At the same time she loves her house and all the memories it brings her and she is not ready to leave it right now.



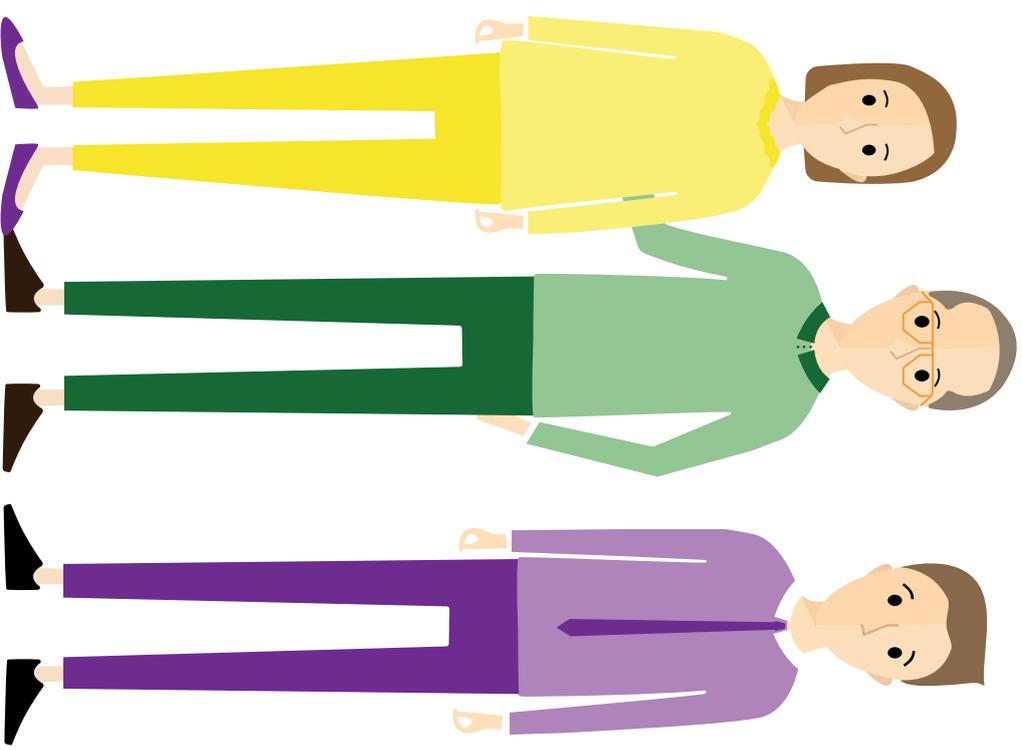
SENARIO 2: Lars and Hilda's day to day life living on their own

Lars lives with his wife Hilda, in a one floor house. Every morning they wake up around 9 am, drink coffee together and solve crosswords, followed by watching the local news. It is their routine and has been for a long time. After breakfast Lars takes a walk, he had a surgery for disc herniation some years ago and it is important for him to stay active, however he is limited in mobility and walking is the only thing he has found working. His wife doesn't join him even though they do almost everything together. Hilda is even more limited in mobility. Lars doesn't like leaving Hilda at home because she sometimes experiences vertigo and he is afraid she will fall and hurt herself, and not be able to contact him.

During the walk Lars remembers he has to take his vitamins along with his painkillers for the back and also remind Hilda about her medicine. Hilda is experiencing mild dementia and therefore Lars has to act as her memory.

Lars takes care of all the chores, grocery shopping and cooking at home. Hilda enjoys baking every once in a while but it is getting harder for her to stand for longer periods of time.

Their son Anders lives close by with his family and helps out the best he can, they don't always ask for help, though, they don't want to burden their son and that worries him. He has tried to suggest they should move in to a senior living, they don't have an attachment to the community and there aren't a lot of people their age to socialize with. They feel, however, like it is giving up some of their privacy and they also want to be independent. Lars says as long as he can take care of both of them there is no need for a third party to get involved.



Features

As a final help in the concept generation, the product requirements are concretized into a list of features. This list is based on existing products as well as products within a future of five years. We recommend using the necessary features as a basis in all the concepts generated, then you can combine it with additional features or come up with your own for creating different concepts.

Physiological	Safety	Social
ENVIRONMENTAL	PREVENT INJURIES	VIRTUAL CALLS
Timer	Gather data	Promote virtual calls
Lighting	Detect unusual behavior	To friends/family
Temperature	ASSIST IN ACCIDENTS	To caregivers
Music	Fall detection	BULLETIN BOARD
Weather info	Motion detection	Help out/get help in community
HEALTH	Positioning	Help out/get help in community
Communication with caregiver	SECURITY	Promote interaction with community
Reminders (e.g medication)	Digital lock	Posting of events
Vital values	Burgular alarm	SOCIAL COMPANYY
Journal keeping	Fire alarm	AI assistant
PHYSICAL ACTIVATION	NIGHT SUPERVISION	Virtual pets
Games (physical and cognitiv)	Camera	Online games
Exercisise help		
SHOPPING		
Grocery		
Medicine		
Other		

NF = necessary feature

AF = additional feature

SOLUTION

This chapter explains a final concept selected using the booklet. It creates a smart home solution through a system including a central hub and a chosen number of radars. The final concept is chosen through evaluating the concepts against the goals and the list of product requirements. The final concept is presented by describing the product in a set of scenarios as well as with other visuals for describing placement and actions of the system. This chapter can be used as inspiration in how to present and explain your final concept.

Scenarios

The scenarios are based on the previous ones describing the problem this is an example of how a narrative can be used for creating a deeper understanding of the final concept.

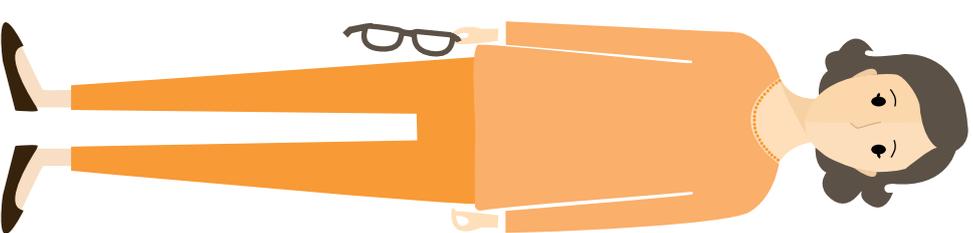
SENARIO 1: Klaras day to day life living with Axel

It is Wednesday morning, Klara is drinking tea and looking at instagram on her phone. She likes to look at the posts from her family and to be able to engage in what they are doing since they all live far away. She doesn't get to see them except for on holidays, with some exceptions of her daughter visiting once in a while, she is the one living the closest. Today, however, since it is Wednesday they always eat dinner together, virtually. Klara uses her photo frame Axel to make face calls to her family a couple times a week, usually they just speak at random times but they always meet up on Wednesdays to eat at the same time. The premise is that they cook the same thing to increase the feeling of being together at the dinner table again. Both her son and daughter join in with their families on Wednesdays.

While scrolling on instagram she gets a notification on her photo frame, she walks over to see what the Axel wants. She forgot to bring her glasses so she taps the button "read out loud": "Hi Klara, I am on my way to help you with the cleaning. I will be there in 30 min, accept the notification so I know you got it / Lillemor." She had forgotten about that, but it is always nice with a bit of company, so she accepts the notification. Klara finishes her tea and then gets dressed just in time for when there is a knock on the door. They make small conversation before Lillemor gets on with the cleaning. After she is done they sit down and drink a cup of coffee together. They discuss if Klara is in need of any help the rest of the week since she is entitled to a few more hours of home care. Klara says that a refill of the fridge on friday would be nice and Lillemor makes a notification on her work phone to contact Klara on friday morning for an eventual grocery shopping.

Klara asks if Lillemor has time for a walk since the weather is sunny. Lillemor is supposed to visit Simon who lives close by and says that she can contact him and see if he wants to join their walk since they usually take walks together and Simon is not able to take walks on his own because he gets lost, but enjoys them when the weather is nice.

They all go for a stroll in the neighbourhood and when Klara gets back she starts making herself some lunch. While she is waiting for the chicken in the oven she sits down and watches the Axel. He is showing pictures that are over 20 years old and that she almost forgot about, but they are from a trip she took with a friend to Mallorca. She decides she wants to call this friend and taps the photo on the screen. Axel asks her: "Would you like to call Berit?" Klara presses yes and a call starts. Berit is eight years older than Klara and now lives in a senior living home not too far away. Berit is alert and feeling well today and asks if Klara wants to visit. "Yes, why not! I will call for transportation service and then I will see you in a while." They hang up and Klara uses the Axel to send a request for transportation service to Berit's senior living.



SCENARIO 2: Lars and Hilda visits

Axel Park

Lars and Hilda have started to look at other possible housing situations after some discussions with their son Anders. They have together found a place called Axel Park that is close to their neighbourhood and therefore still close to Anders. It is a senior living home that provides staff around the clock, common areas and a private accommodation. Lars and Hilda are headed into a meeting with Lena, who is a caregiver working at Axel park, to find out more.

Lena meets them at an apartment that she thinks is suitable for the couple. She explains how their system works and is meticulous about pointing out that they are all about independence and value integrity, the purpose is to assist everyday life and create a welcoming community.

All apartments are equipped with the same smart system that will ensure a safe environment, enable social contact and give assistance without jeopardizing integrity. The system is called Axel and consists of a central hub, that doubles as a digital photo frame,

which is complemented with two radars. One radar is in the bedroom and one in the kitchen and living area. She shows them to Hilda and Lars who comment on them looking nice and almost invisible, "kind of like a fire alarm", Hilda says. Lena answers with "And they work like one too! They have sensors that can smell smoke and will immediately alarm the staff!"

Depending on the level of smoke the radar will react in three stages. The first stage is just a soft alarm, as we all know the fire alarm can go

off when we burn the chicken a little in the oven and that's not really an emergency, it will communicate with you and you can easily dismiss it if it wasn't an emergency. The second stage will make more sound and also give instructions to evacuate the apartment and where to go. The third one does the same but with a very loud siren, this is programmed to wake you up during the night in case of an emergency. At all three stages the staff gets a notification so that we can assist and in the worst case start an evacuation for the building."

"We change the settings of Axel to make him assist you individually and tend to your specific routine", Lena continues explaining. "For example if you have medication, we set notifications so you never forget, and when you press "accept" we can be assured you have taken them. "

If you are in need of assistance from the staff you can either just call us through Axel and we can have a face to face talk or you can send a specific request through a message. For example if you need help to shower you can send a notification with the time and activity to us and you will get a notification back when we have accepted. If we for some reason have our hands full we will propose another time that you can accept. After that you will get a reminder 30 minutes before the activity and if for some reason you don't want to go through with the activity you can let us know then. This works the same for any type of activity from physiotherapy to getting assisted walks or help with groceries. Lars doesn't look at ease and says "We are not in need of a lot of assistance, this seems like a lot of technology." Lena assures Lars that, "You have to think of this as a smart home, if you are not in need it will not help, but if you are in need it will help, there are a lot of "invisible" features."

Lena explains how the smart system provides a safe environment. There is a radar that positions you in the apartment but only through showing you as a cloud of red dots, so we can't see what you are doing. If the radar was to detect a fall, it would alarm us or anyone you want, maybe your son if you are more comfortable with that, either through a text message or a phone call or both. We will then contact you to see if everything is okay or if you need help.

There is also a feature that collects data about your routines and patterns. This might seem like surveillance but we don't take part in the data until we get a notification about a deviation. This can for example be that the radar knows your average time of standing and moving is. If that changes significantly and you are moving significantly less than usual then maybe something can be improved. So we discuss it together, maybe send for a doctor to check on your values or we just increase the amount of physiotherapy. Maybe you from nowhere start sleepwalking, then we can keep an extra track of you during the night so there aren't any accidents. There are alternatives to night supervision, the most common is only using a radar. We can also install a camera that is turned off unless we detect an unusual behavior or if we would detect you fell out of bed, then we can turn the camera on and have a look of what is really going on, since the radar only displays you as a bunch of dots. The camera can also work if there was to be a break in, if the radar detects a movement pattern similar to a break in then it can turn on and record if necessary and we can hand it to the police. But the staff here also get an alarm about the incident.

I know it sounds like a lot but you won't even notice the smart system, it is just there for your safety. Through Axel's dashboard on your photo frame, you can also see your own information about vital values and journals if you want. It is a form of self-tracking and this feature is added because we want our residences to be a part of their own health care and well-being.

Lars and Hilda left Axel Park with some brochures and an offer for the apartment that they were to think about for the week to come. Since Hilda had felt a little like a burden to Lars because she couldn't help out as much around the house she thought this would be a nice opportunity for them while Lars seemed to be the harder one to convince, she thought. Lars however got the impression they really valued their residence independence and that they would age well there. The benefits of living close to Anders without needing his help and in a safe environment were weighing heavy, maybe they would get some new friends as well, since many of their older friends had passed away or moved to another city.

They moved together to Axel Park that same year and now thrive in the community.

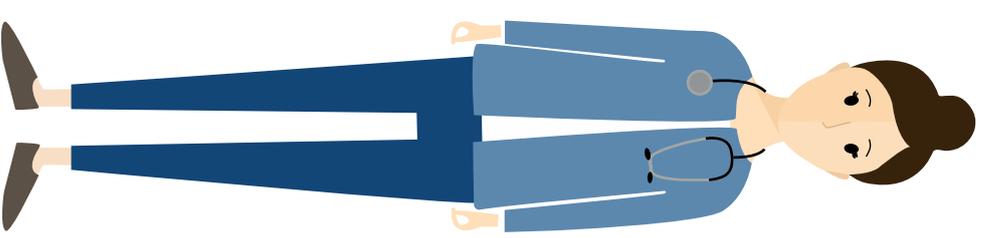
SENARIO 3: Lillemor's day to day work as a caregiver

It is Tuesday morning and Lillemor started her shift at the home care. She opens her laptop and logs in to the home care portal. This is a cloud service where all information is collected from the caretakers and viewed by the caregivers. There she can see that all her five patients slept through the night except for Klara who went to the bathroom three times, this is however normal for Klara and nothing she will have to make note of. However the system has flagged Simon, a caretaker, and she can see it is because the shifting in his pulse is slightly unusual during the night. She sends a request for an EKG and an appointment with a doctor at the local health center and then makes a note of this in the system.

After the update, her morning check in with the caretakers starts. Some caretakers want and are in need of a call every morning while others she only checks in with once or twice a week. Klara is one of the caretakers that she calls only on Tuesdays and she is first on the list. She answers and they have a webcam meeting about what Klara's plan is for the day, how she is feeling this morning and if she is going to have any visitors. Klara answers that her daughter is coming over with lunch and she is going to help her with the garden. Since Klara is independent in many areas Lillemor asks if she needs any help from hemtjänsten today and when she thinks she needs help with the grocery shopping. Klara explains that her daughter is visiting and that she is picking up some groceries on her way, she will help her with the garden during the day and then they will have dinner together. Since her daughter is visiting who lives a little further away, Lillemor knows Klara will have company for almost the whole day. Her daughter will help out with anything urgent and the system will alarm if there is an accident.

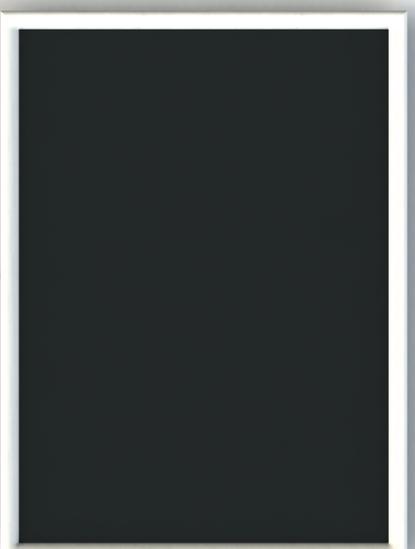
Lillemor moves on to calling her next caretaker, Simon. Simon lives in the same neighborhood as Klara but is in need of much more assistance. Simon answers and tells her he is feeling fine and that he would like help with a shower today, preferably during the afternoon because he is going for a virtual cycling tour with a friend at 2 p.m. Lillemor tells him that it is fine she will stop by then, and makes a note in the system that will remind Simon and herself 30 minutes before her arrival. Lillemor can also see that he has played a cognitive game during the morning. The system doesn't tell you which one just notifies her that an activity has been performed, but this is good because Simon has mild dementia. She makes some conversation about what game he played and then they hang up and she moves on to make the next call. She doesn't bring up the request for an EKG, since she is visiting him later the same day it is better to discuss the matters in person.

After making her last call, her phone notifies her of an accident. The system has detected a fall in Klara's apartment and Lillemor calls her to check in, however there is no pickup so the system automatically connects a video call to the caretakers screen. Klara cannot be seen since her Axel is put faced away from the kitchen but she responds from across the room and she is fine. She had slipped in the kitchen but the fall hadn't hurt her, but she wanted to sit still for a while and therefore didn't want to get up and answer right away. Lillemor asked if she wanted her to check in on her in person but Klara told her that her daughter was just a few minutes away anyway so it was fine.



The Hub

The selected concept makes out a smart home system. The hub represents the center of the system and is the device interacting with the elderly. The hub acts as a photo frame when not in use and is designed to not interfere with the interior of the living space. It can be mounted on the wall and have a more permanent position or placed on a stand and therefore be more mobile.



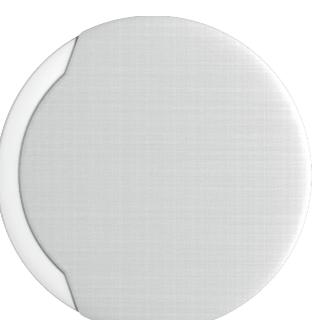
Hardware

Camera
Microphone
Touchscreen
Speaker

Technical specifications

Two way communication
Battery time 8 hours
Charges through power outlet
Wifi connected
Voice recognition
Receives data from radars
Voice activated

Feature	Action by hub	Reaction	Benefits
Tracking Health <ul style="list-style-type: none"> - Movement (from radar) - Vital values (from radar) - Medicine intake - Info for caretaker 	Store information in care system Store information in care system Store information in care system Display on screen	- - - See statistics	Gives health insight and enables to self tracking Helps to keep track of medication intake
Notifications <ul style="list-style-type: none"> - Reminders medication - Reminders visits - Sending requests to caregiver - Automatic video call after fall 	Display on screen Display on screen Display request form on screen Display on screen	Accept or postpone Accept or postpone Fill out form - send or cancel Hang up	Helps to not forget medicine Gives the elder more control Assists with communication Will make sure the elder is ok
Social Interaction <ul style="list-style-type: none"> - Contact list/ favorites list - Contact with caregiver - Incoming calls - Show photographs when not in use 	Display on screen (buttons) Display on screen (buttons) Display on screen (buttons) Display on screen	Choose person - call or text or videocall Call or text Accept or decline Possibility to contact people in photos by tapping	Enables communication and promotes social interaction Assists with and enables communication Assists with communication and gives elders control Assists with and enables communication Promotes social interaction



The Radar

The radar is a complement to the hub and will facilitate in collecting data along with detecting accidents, fires and break-ins. It has a microphone as well as a speaker and therefore creates a two way communication. The radar is mounted on the wall or in the ceiling and is connected to a power outlet. The radar covers an area of 25 sqm and can only travel through thin walls.

Hardware

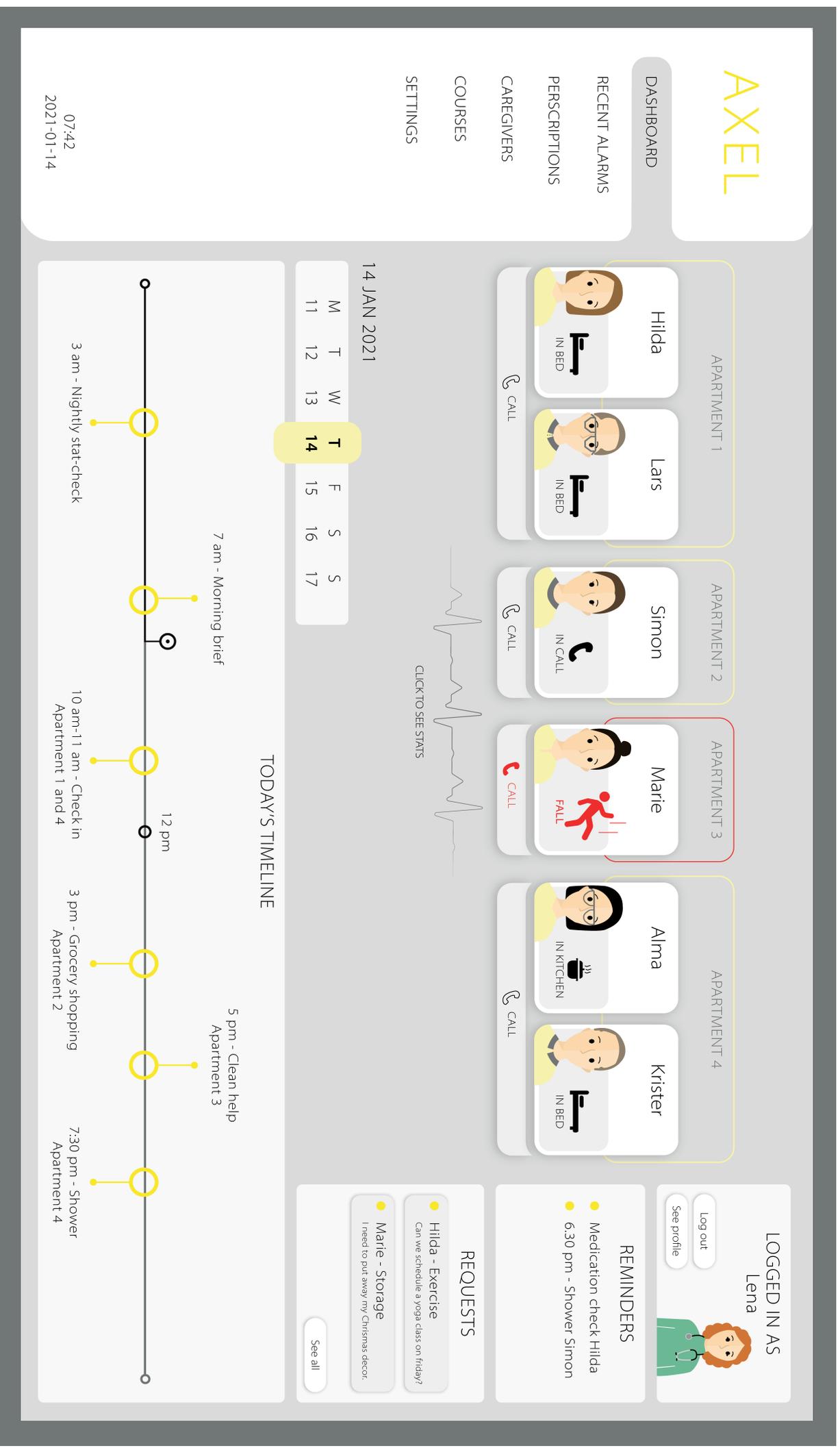
Technical specifications

Anonymizing radar	Coverage 25 sqm
Microphone	Two way communication
Positioning sensor	Plugs into power outlet
"Smell" sensor	Wifi connected
Smoke detector	Sends data to hub
	Stores data in cloud

Feature	Trigger	Primary Action - private house/senior living	Primary Action - senior living
Gather Data			
- Vital Values	If irregular values are detected	Send notification to chosen person	Send info to care system
- Movement mapping	If unusual behavior	Send notification to chosen person	Send notification to care system
- People counting	If new people appear	Store information in care system	Send notification to care system
- Positioning	If elder is in wrong apartment	-	Send notification to care system
	When caregivers are in the apartment	Store information in care system	
Safety			
- Fall detection	If fall occurs	Call to chosen person	Call caregiver + send notification to care system
- Positioning	If fall occurs	Call to chosen person	Call caregiver + send notification to care system
	If no movement within [Set time] is made	Send notification to chosen person	Send notification to care system
Security			
- Fire alarm	If smoke is detected	Start siren and give instructions + call to chosen person	Start siren and give instructions + send info to care system
	If sound from a different alarm is detected	Start siren and give instructions + call to chosen person	
- Digital nose	If gas is detected	Notify people in house + send info to chosen person	Send info to care system + notify care taker
- Burgular alarm	If break-ins are detected	Call to chosen person	Send info to care system + notify care taker

Interface for caregivers

This interface is made to illustrate how the caregiver would interact with the system. It is made to fit a computer screen.



Interface for user

This interface is made to illustrate what the hub could look like for the older person. It shows how to interact with certain features of the system.





The radar and hub stores information to a cloud and works independently of each other.

During the night the radar can detect if you fall out of your bed and also collect data about your vital values as well as your sleeping patterns.



The radar covers 25 sqm and can see through walls with the exception of concrete.

The older person can pick up the photo frame and call friends or family for a video conversation. While the elder is holding the frame it measures the vital values and keeps statistics to detect unusual values.

The Hub has a central position in the apartment and shows photographs when not in use. This reminds the older person of people to socialize with and makes a nice interior detail.

The radar knows which room the older person is located in and if he/she slips in the shower it will detect this and alarm concerned.

