

Development of Shower Chair for Increased User Independence

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MASTER THESIS

arjo

with people in mind



Development of Shower Chair for Increased User Independence

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Abstract

Maintaining independence when getting older is an important aspect in everyday life and to remain the quality of life. It can be difficult to accept the need of assistance, why sufficient aids can be useful to maintain and support the individual's independence in the daily life, especially in the private situation such as during a shower. A shower chair that is adapted to the user and the environment will give support and reduce the risks of falling and increase the user's independence.

This report investigates the important needs of the user group, important functions of a shower chair and how it should be developed to promote an ergonomic way of use. The project has been performed in collaboration with the medical device company Arjo in Malmö. Interviews, observations, prototyping and user tests has been performed in an iterative process to develop a shower chair for elderly with reduced mobility.

The most important identified user needs are that the chair should be stable, adjustable for each individual, comfortable and easy to use. It should offer stability and safety to the user. The functions of the chair make the chair easy to adjust and adapt to the user and the environment by offering adjustable and removable parts.

The conclusion is that there is no single function that is the most important. It is the combination of all functions that fulfil the needs and makes the chair ergonomic to use and increases the user's highly valued independence.

Keywords: Ergonomics, Shower chair, Prototyping, Elderly care, Medical equipment, Product development.

Sammanfattning

Att behålla självständigheten senare i livet är en viktig aspekt för många för att bibehålla sin livskvalité. Ett ökat behov av assistans kan vara svårt att acceptera. Välanpassade hjälpmedel är viktigt för att behålla och stötta en individs självständighet i vardagen, speciellt i de privata situationerna som under duschning och bad. En duschstol som är anpassad till användaren och omgivningen ger stöd, ökar självständigheten och minskar risken för fall.

I detta projekt utvecklas en duschstol för äldre människor som går med hjälp av käpp eller rollator. Arbetet har utförts i samarbete med det medicintekniska företaget Arjo i Malmö. Det har undersökts vilka behov som är viktiga hos användargruppen, vilka funktioner stolen bör ha samt hur den ska utformas för att främja ergonomisk användning. Intervjuer, observationer, prototyper och användartester har utförts i en iterativ process under utvecklingen.

De viktigaste identifierade behoven är att stolen måste vara stabil, att den ska kunna individanpassas, vara komfortabel samt enkel att använda. Den ska ge stabilitet och säkerhet till användaren. Funktionerna hos stolen gör det lätt att ändra och anpassa stolen till individen och omgivningen genom att erbjuda anpassningsbara och avtagbara delar.

Slutsatsen är att det inte finns en enstaka funktion som är den allra viktigaste. Det är kombinationen av alla funktioner som uppfyller behoven och gör stolen ergonomisk att använda och ökar användarens högt värderade självständighet.

Keywords: Ergonomi, Duschstol, Prototyp, Äldreomsorg, Medicinskt hjälpmedel, Produktutveckling.

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Lund, May 2019

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1 Introduction

1.1 About the company

Arjo is a global medical device company with products for both acute and long-term care. Nearly 6000 employees are working worldwide with headquarter in Malmö, Sweden. They provide solutions and devices for users with reduced mobility and age-related diseases, with the aim to improve the quality of life, and includes devices for patient handling, hygiene, disinfection, medical beds, therapeutic surfaces, venous thromboembolism prevention and diagnostics. The development is “always with people in mind” as the slogan states. (Arjo, 2019)

1.2 About this project

The aim of this project is to develop a concept for a new shower chair for mobile elderly that wants to remain independent, in collaboration with Arjo. It should enable the users to more safely and comfortably perform hygiene activities on their own. There is of interest for Arjo to develop this type of shower chair to expand their product portfolio. The other shower chairs in the product portfolio today are mainly directed to users with less mobility than the users to be considered in this project. Ergonomics is an important aspect.

The objectives of this project are to define the market and customer needs, perform a competitor research and create concepts solving the identified needs. This will result in different prototypes that should be evaluated. Finally, one will be visualised in a physical prototype that will be evaluated.

Considerations to have in mind during the process are the common age-related health problems such as reduced mobility, dementia and other physical and cognitive disabilities. The possibility to use already existing parts or solutions from Arjo’s product portfolio will be investigated. It should also be investigated if the chair could be used

for more than one purpose to add value to the customer. Environments where the shower chair should be used are in hospitals, elderly care facilities and in private homes.

1.2.1 Research questions

This project has three research questions to be investigated. These are:

- What are the most important needs to fulfil?
- What are the most important functions the chair must have?
- How should the chair be designed to promote an ergonomic way of use?

1.3 Target group

In this project, two personas from Arjo's mobility gallery are used to represent the primary target group of this shower chair. These two are Albert and Barbara, who both are elderly with different mobility and needs. Albert is independent in most situations, but he may use some support such as a cane when walking. Barbara is more dependent on support but can support herself to some degree. She can be in need of assistance and resident adaptation. Table 1.1 contains more information about the personas, taken from Arjo's mobility gallery. (Arjo, 2019) There are also secondary users that are to be considered in the target group such as caregivers, occupational therapists that prescribe medical aids. When referring to the target group later on in this report, it is the primary target group that are considered.

Table 1.1



<i>Name</i>	Albert	Barbara
<i>Characteristics</i>	<p>Ambulatory, but may use a walking stick for support</p> <p>Independent, can clean and dress himself</p> <p>Usually no risk of dynamic or static overload for staff</p> <p>Stimulation of functional mobility is very important</p>	<p>Can support herself to some degree and uses walking frame or similar</p> <p>Dependent on caregiver in some situations</p> <p>Usually no risk of dynamic overload for staff. A risk of static overload can occur if not using proper aids</p> <p>Stimulation of functional mobility is very important</p>

Note: From Arjo's Mobility gallery (2019). <https://www.arjo.com/int/insights/mobility-gallery/>

1.4 Introduction to the subject

1.4.1 Aim with pre-study

The aim of the pre-study is to get information and understanding of the target group, the users and their problems and needs. It should also give an understanding of the current working situations for caregivers and what environment the chair is expected to be used in. It is important to understand the user and how different environment affects the situation.

The gathering will lead to a knowledge of needs, how people are working, thinking and the user's demands (Bohgard, 2008). One way to achieve this knowledge is by investigation triangulation. Two methods used are observations and interviews, these complement each other. (Preece, et al., 2015)

Search engines used are Google Scholar, Scopus and Lund University Libraries' search engine LUB search.

1.4.2 Maintaining independence

Remained independence and participation is important for elderly people. Studies by Haak (2006) have shown that the meaning of independency change with age and physical condition. Independence is often connected to the physical aspect, where the possibility to take care of yourself is very important. To maintain this physical independence, adapting the home is a possible solution, together with extra equipment such as a shower chair. Later on, independence is often more correlated to the possibility of making your own decisions. This could be to decide when, how and where to do an activity (Haak, 2006). Additionally, the quality of life is linked to independence, and when in need of assistance, the personal connection to the person helping is important to remain a good quality of life. (Hellström, 2003)

Assisted bathing can sometimes result in a decline of the individual's well-being due to the loss of independence. Many elderlies suffer from musculoskeletal conditions and pain that affect their physical abilities, or a cognitive decline that results in different types of bathing disabilities. (Barrick, et al., 2006). A bathing disability is when an individual is unable to either wash or dry their body on their own. (Robinson & Kathleen, 2005). The need of assistance can be difficult to accept. A shower chair can therefore be of great importance to maintain and support independence in the daily life (Barrick, et al., 2006). The use of adequate aids adapted for the users' needs can

maintain the ability of independent showering and self-care and might slow down a continuous reduction of independence. All kinds of effort to maintain a person's independence and self-care should be encouraged, all to remain the highly valued ability of independence. (Docking, 2018)

1.4.3 Adapting the home

Aid equipment are often developed with the practical aspect, and not the visual appearance, in mind. It often has a clinical appearance that is negatively associated with a lack of independency. It can induce a negative feeling and be a reminder of lost mobility and independence, instead of being seen as a tool to improve the independence. It can result in that the decision to adapt the home is often made when a person already is struggling, instead of performing adaptations to act more preventing to lost mobility (Docking, 2018). If the stigma that is associated with this type of products can be reduced, they are more likely to be used (Hyde, & Lanspery, 2018).

1.4.4 Important physical and cognitive considerations for a shower chair

An important factor to consider when designing a shower chair is that it should be comfortable. Many elderly users suffer from pain during showers and the common shower chairs without padded seats does not ease the negative experience. Support for the feet is good to reduce the risk of reduced blood circulation and if a commode chair is used, it shall not make the user uncomfortable and create a feeling of sinking down in the opening. A padded seat and backrest increase the comfort, but it is also important that the material should not feel cold against the skin when wet. (Barrick, et al., 2006; Robinson, & Kathleen, 2005)

Persons with dementia often find bathing and showering as stressful and uncomfortable. They may resist to hygienic care and the response can be aggressiveness and screaming. Due to this discomfort many caregivers want to complete the task rapidly. A better approach is to be person-focused which would reduce the agitation (Robinson, & Kathleen, 2005). The behaviour is connected to unmet needs and a stressful environment for the person. This must be taken into consideration while designing, the product shall contribute to reduce a stressful environment by having easy functions and being comfortable (Barrick, et al., 2004). It is also important to consider the design to not look unfamiliar and definitely not intimidating. Shower and bathing situations can already be painful as it is, and the aid a shower chair offers should make this situation easier and more comfortable for both independent and assisted showers. (Barrick, et al., 2006)

1.4.5 Anthropometry and ergonomics

Anthropometric data is measurements and proportions of the human body and is used in a design process to create physically ergonomic products with good fit, adaptation and comfort for the user. (Gard, et al., 2009) It is important that the data represents the certain target group, for example elderly, in an as wide extent as possible. (MacCormick, & Sanders, 1993)

While designing a chair and its functions not only the anthropometry of its user is important, but also the environment it will be used in and the task to be done needs to be considered. The shower chair should be able to support the entire body weight rather than be a temporary stool. With a backrest the back muscle can relax. Further, a generally good feature is the possibility to change posture and individual adjustment (Corlett, & Wilson, 2005)

When seated in a chair with 90° angle of the backrest, it creates pressure on the discs in the spine. The disc pressure increases significantly compared to standing when using a chair without any back support at all. When sitting in a vertical position at 90° the pressure is still 40 % larger than standing, and this pressure increases to 90 % more than standing if sitting in a slightly forward leaning position. A backrest is therefore of big importance as well as its angle. The use of arm supports also plays a big role to reduce the pressure of the discs. A possibility to tilt the backrest backrest to 100° or 110°, from the horizontal plane, has a great impact for reduced disc pressure. The effect from the arm rests becomes less significant when the back rest is in a reclined position. (MacCormick, & Sanders, 1993)

The depth of a chair should be short enough for a small person to sit comfortably, it should also be wide enough for a large person. The American National Standards Institute, ANSI, recommends that a typical office chair used at workstations with computers should have a depth between 38 to 43 cm and a width of 45 cm. (MacCormick, & Sanders, 1993)

1.4.6 Risks for elderly in shower environment

The most common accidents reported among elderly are falling accidents, and the reported accidents are increasing (Schyllander, 2014). For people in the age 80 or more, nine out of ten accidents are due to falling. Also, it is shown that 80 % of these accidents leading to a hospital visit are happening during home and leisure conditions. Furthermore, 12 % of these accidents are happening in the bathroom.

There are both intrinsic risk factors such as cognitive impairment where Alzheimer dementia is an example but also extrinsic risk factors which refers to the environment (Rubenstein, et al., 2005). The environmental risk factors are one of the main factors contributing to injuries. In a bathroom tripping or loss of balance on the same level stands for 39% and slipping stands for 28 %. Other factors associated with falls are wet floor, changes in the floor surface and improper furniture. The most common injury that occurs due to this is fracture (Berglöf, et al., 2005; Rubenstein, et al., 2005). Besides, injuries increase the health care costs and decreases the quality of life. (Fisher, et al., 2003) However, these accidents can to some extent be prevented, by correct furniture and lights, for example carpets are easy to slip on, and chairs without armrests are risky. Moreover, aids need to be customised and have enough information about how to be used in order to be safe. In conclusion, the design of the shower chair should aim to reduce the risk of falling and thereby contribute to maintaining a good quality of life (Rubenstein, et al., 2005).

2 Method

Firstly, the methods used in this project are introduced. Secondly it is described how these methods are used in the process.

2.1 Introduction to methods

2.1.1 Interview

Interviews give subjective information about the interviewees' thoughts and opinions about a topic. In this project unstructured interviews are used, also called open interviews. This type is suitable when the interviewer has a vague idea about what information that is valuable, and it also allows the interviewer to be explorative. Further, this method gives the opportunity to follow up interesting topics, to get a deeper understanding and background to the interviewee's opinions. Usually three to six interviews are enough to get a good idea about the needs and problems. (Bohgard, 2008; Preece, et al., 2015)

2.1.2 Observations

With observations it is possible to achieve knowledge about the user experience in a real environment and situation. By being a passive observer, it is possible to see things that not even the user is aware of, and therefore can't communicate in an interview. Natural behaviour under real conditions can be studied, which is an advantage. However, the disadvantage are that the cause behind a behaviour can be hard to interpret (Bohgard, 2008).

2.1.3 Empathic modelling

Empathic modelling can be seen as a sort of brainstorming, where the whole body is used to find and understand user needs in a development process. It can be performed by developing or testing prototypes in the same location it is intended to be used, or by embody the intended user and act accordingly to create a simulation of how the product will be used. By entering and experiencing the actual environments where a product will be used, it can enrich the understanding of the user situations and promote imagination and new types of solutions. It is possible to get a better understanding of how the environment will affect and limit both the user and the product. Empathic modelling makes it possible to get to know the users and their daily routines. In difference to brainstorming, data about the environment where the product will be operated can be gathered, rather than only result in new ideas. It is a tool that can be used to develop products to improve the user experience. (Smith, 2008)

2.1.4 Function analysis

The aim with a function analysis is to find what functions a product must have, in order to fulfil the needs. The goal is not to find complete solutions to the needs or problems, rather to concretise the expectations of the product, what it is supposed to offer. Requirements are broken down into functions to be concretised. Also, it helps to show how these functions are connected. First, the main function and purpose of the product needs to be found. That is then divided into sub-functions, which are what defines the whole product. Without these sub-functions the product cannot be used for its purpose (Bohgard, 2008). Further, the sub-functions can be branched and concretised to under-functions. One way to visualise this is in a function tree (Eriksson & Rosén, 2013).

2.1.5 Hierarchical task analysis

The understanding of how a task will be conducted can be achieved by a hierarchical task analysis (HTA), which is a method used to structure events. The purpose is to get a structure for the stages a user goes through to reach a particular goal. To gather input data for this method, interviews and observations are performed with the users. Firstly, the overall goal with the task is identified. Secondly, this goal is divided into sub-goals. If any sub-goal is removed the task cannot be completed. Lastly, these sub-goals can be further divided until enough details are obtained. The lowest level is referred as operations. Information that can be provided in the operations are the goal of the operations and the possible actions. (Bohgard, 2008)

2.1.6 Brainwriting

Brainwriting is an individual idea generation method that is preferably used while having a good insight in the problem. About three to eight participants are a good amount of people. Each person writes 3 ideas on a paper for a given problem. A time is set, normally about 5 minutes, and ideas are written or sketched. The paper is then passed to the next person to the right and another 5 minutes starts. The next person having the paper can either come up with three new ideas inspired by the old ones or just make additions. When the papers have been at all participants the ideas can be discussed and reviewed and the best solution picked. (Bohgard, 2008; Michanek, 2007).

2.1.7 Prototyping

An early physical realisation of a product, that do not contain all features and parts of a construction, is called prototype. It enables users to test the product and help them to understand the concepts when put into something physical. The prototypes can be created with different levels of details and resolved finish. Throughout early tests a low-fidelity (lo-fi) prototype is common and are usually not more complicated than sketches. In the later phase of the process a high-fidelity (hi-fi) prototype is more common. A hi-fi prototype is an improvement of the lo-fi prototype. The final look and feel better represent the final product, also some basic functions can have been implemented. In these types of prototypes users can also give feedback on the aesthetic parts, interaction and usability. An example of high-fidelity prototypes are models presented in computer-aided design (CAD). (Martin & Hanington, 2012). In this thesis lo- and hi-fi prototypes are referred as prototypes, without distinguish between lo- and hi-fi.

2.1.8 User test

User testing is a method used to evaluate if a product fulfills the expectations and also makes it possible to observe how the product is used in a certain situation. Scenarios and tasks that the test person is presented to are created to reflect a real situation where the product can be used. This method helps developers to identify problems with the product and what should be improved to increase the usability. The more test persons, the more problems are identified and the same goes for the number of observers and evaluators. User tests makes it possible to find problems with the usability, and when used iteratively in a design process it makes it possible to develop a user-friendly product. (Martin & Hanington, 2012)

2.1.9 Questionnaires

To collect survey information, questionnaires together with interviews, are one of the primary tools. The construction of the questionnaire affects the response and analysis. To get a depth in the response, open-ended questions are to be preferred, whereas close-ended questions are easier to numerically analyse. Likert scale questions can be used to maintain neutrality. This by providing a five-point range from strongly disagree to strongly agree, which scales the responses along a continuum of choices. Then, the strength of the agreement or disagreement can be analysed. In this project both types of questions are used in the questionnaires together with a Likert scale. (Martin & Hanington, 2012)

2.2 Overview of the process

The project was carried out in an iterative process. A schematic image of the iterative process is shown in Figure 2.1. Only the main processes are shown to get an easy overview.

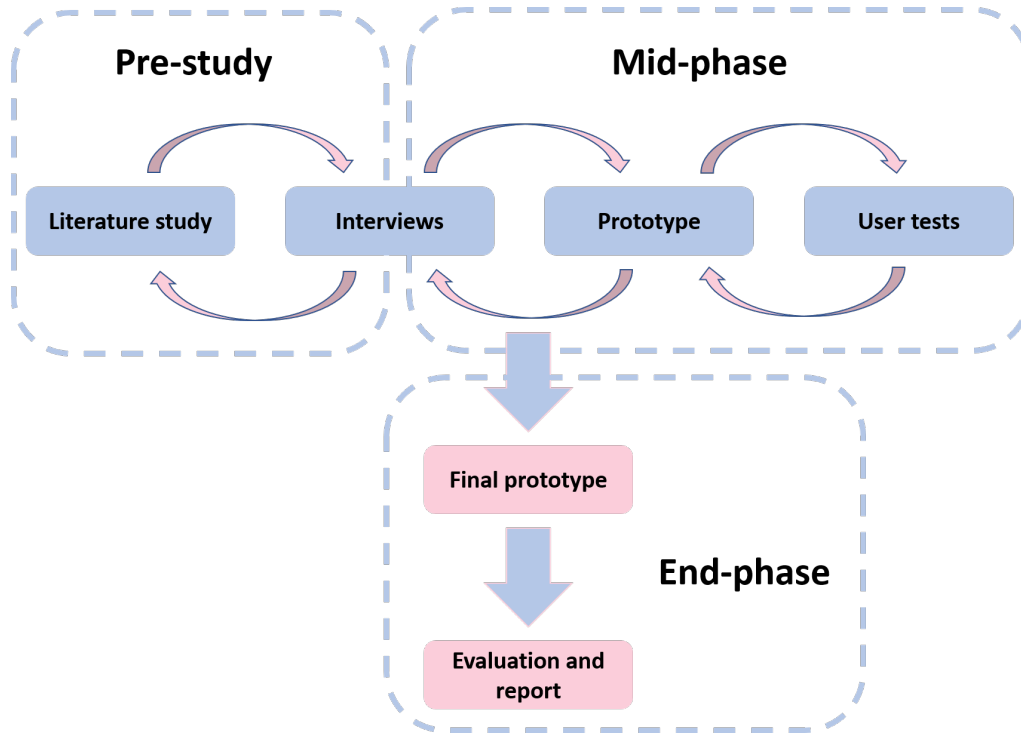


Figure 2.1 An overview of the iterative design process.

2.3 Pre-study

2.3.1 Anthropometric data

Anthropometric data used in the development process are data for British adults, aged 65-80 years (Pheasant & Haslegrave, Table 10.5, p. 248) and Swedish adults (Pheasant & Haslegrave, Table 10.7, p. 250). Anthropometric data for the hand was also used (Pheasant & Haslegrave, Table 6.1, p. 144). The dimensions of the chair have been developed to fit the 5th to 95th percentile of the users.

2.3.2 Market research

A study of Arjo's existing products was carried out to identify if some of the existing parts could be used in the development of this new shower chair. It was performed by testing and investigation the products and their environment of usage.

A study of existing shower chairs on the market was also performed to identify a gap and opening for this shower chair to differentiate itself from competitors and attract a wide range of users. It was performed by online research and observation of shower chairs used in care facilities.

2.3.3 Identification of customer needs

Due to the shower chair's wide range of user environments, interviews were performed with several persons with different background and professions.

2.3.3.1 Interviews at Arjo

Two open interviews with personnel at Arjo with good knowledge of the users and target group were conducted. The first was the 21st of January 2019 with Richard Nilsson, Head of New Solutions Research, with open questions about needs and common problems in the user group concerning showering. The other interview was the 23rd of January 2019 with Bodil Åkesson, Product Development Engineer, concerning guidelines when designing products for dementia care.

2.3.3.2 Interviews at elderly care, Trollsjögården in Eslöv

Open interviews with three elderly, one caregiver and the branch head were performed at an elderly care facility, Trollsjögården, in Eslöv the 25th of January 2019. The elderly had different mobility and need of assistance and therefore used different types of shower aids. One interviewee was very independent and used only a simple shower chair. Another interviewee had reduced eyesight and used a stool and had some assistance when showering. The third interviewee used a wheelchair and was assisted during showers and used a more complex toilet/shower chair. The first two were asked to show how they normally do while showering, and their demonstration was observed. Open questions were then asked to all three about what they think of their shower aids and if they experience any difficulties when they shower, for example with balance or difficulties to reach. The interviews were performed with help from an interview mind map as can be found in appendix A. The interview with the branch head was mainly focusing on dementia from the patient's point of view and the caregivers' perspectives.

2.3.3.3 Interview with personnel within home care, Tidaholm's municipality

A telephone interview with open questions was performed the 11th of February 2019 with a person with 2 years of experience from working with home care, and with experience of assisting during showering and bathing. Needs and often occurring problems in this situation was discussed.

Another telephone interview with open questions was performed the 12th of February 2019 with a person working within home care. This person had 7 years' experience and was used to different types of shower chairs, environments and situations when assisting during showering and hygiene activities. Often occurring problems for the care recipient and needs during the showering was discussed, both from the aspect of assisted and independent showering.

2.3.3.4 Interview with occupational therapists, Kungsparken Rehab, Malmö

An open interview was done by telephone with Therese Tordenheim, occupational therapist at Kungsparken Rehab, Malmö City, the 18th of February 2019. The interview questions followed the interview sheet found in appendix A.

2.3.3.5 Observations

Observations in the form of videos of real situations with assisted showers, baths, and usage of shower chairs has been performed. The personnel's thoughts about devices, why they were good and the problems with them were discussed in the videos.

2.3.4 Empathic modelling

Empathic modelling was used early in the process to learn what it feels like to shower with reduced mobility and less strength in the body to mimic the situations the target group may experience. Weights around the ankles weighing 2 kg, and on the wrists weighing 1 kg, were used to imitate less muscles in arms and legs. An overall was worn with sewed on braces over knees that hinder from movements and straps that forces the back in a curved position. That gives an insight in the difficulties a real user may encounter in the shower situation. In addition, hearing protection and glasses that reduce the sight were also worn during the empathic modelling. It was performed by showering with and without a shower chair and reflecting on difficulties in both situations.

2.3.5 Visit on a furniture company

A visit on a furniture company was done. Different chairs were investigated. Measurements were taken on the chairs, these were the sitting depth, sitting width, the sitting height, the size and height of the backrest as well as the distance from the seat and backrest if there was a gap. Also, different shapes of chairs were investigated and their comfort. The results could then be compared with standard measurements for chairs and anthropometry.

2.3.6 Function analysis and Hierarchical task analysis

A hierarchical task analysis was performed, and a clear structure of the overall goals was identified as well as the sub-goals. All steps performed while showering was discovered, from when a person is undressing to raising up from the shower chair at the end. This was structured in a hierarchical tree. Further, function analysis was performed and also structured in a hierarchical tree. Both basic and more detailed requirements for the goals were set. The function analysis was updated when the user needs became clearer during the project.

2.3.7 Specification of requirements

After analysing the result from all interviews and observations, a specification of requirements for the chair was created. Important functions and needs of the chair were listed and used in the continuation of developing prototypes and concept of the shower chair.

2.4 Mid-phase

From identified needs within the target group, early concepts on functions of the chair were created, tested and evaluated. Throughout the whole process, iterations on prototypes and evaluations were performed.

2.4.1 Prototyping

Prototypes were created early in the process in order to test concepts and evaluate these. Materials used were cardboard, 'Styrofoam', wood and later metal to produce quick and simple lo-fi prototypes of the whole chair and its functions.

Once a concept prototype was created, it was tested with a small amount of people. Feedback was gathered and improvements of the prototypes were made, to later be tested again on a larger group of people. After the user tests on the early concepts, it was decided what to continue develop. Further on a more detailed prototype was created.

During the prototyping process, three main chairs were built and showing different ways of solving problems and identified needs. After that, the final prototype was created. The first chair was used for early testing of the concept, see prototype A in Figure 3.5. It offered a rotating seat, different types of armrests and three sizes of the backrest. During the user tests, the functions of the chair were evaluated and also the dimensions of each part. Anthropometric data (Pheasant & Haslegrave, 2005: 248, 250) in combination with common guidelines (MacCormick, & Sanders, 1993) for designing chairs was used during the development to create ergonomic accurate dimensions, for example length of arm rest, seat depth and width etc. These dimensions were evaluated during the user tests.

The second chair was developed from the first chair, with focus on the lever for rotating the seat and the rotation mechanism. It was used in combination with the first chair to continue evaluate what way to operate the rotation worked the best, since the two chairs showed two different types of managing the rotation. After user tests and evaluation, a third chair was built.

The third chair was developed after evaluation of the earlier prototypes and included several improvements, see prototype B in Figure 3.5. The final dimensions and functions of the chair was presented in this prototype, except for the shape of the armrests, there were still several different shapes and sizes to be tested further. This chair was used in the user tests in Malmö, where especially different armrests were evaluated. Before the final user test, the chair was improved further and modified to the final prototype, see prototype C in Figure 3.5. Two new types of armrests were built according to feedback from the previous user tests and installed on the chair, one type on the left side and another on the right. These two were evaluated during the final user test.

2.4.2 Questionnaire for user test

Before the user tests, a questionnaire was made to be used during the tests. A first pilot test was performed, and the questionnaire was updated. A second pilot test was then performed. Some modifications were made, and the resulting questionnaire used in the user test can be found in Appendix C.

For the final user test, a new questionnaire was created and a pilot test was performed before the real user test. This questionnaire can be found in Appendix E.

2.4.3 Need puzzle and Function puzzle

On the same occasion as the user tests the respondents had the possibility to perform a 'need puzzle' and a 'function puzzle'. The aim of the puzzles was to further identify the most and least important needs and functions of the chair to complement the identified needs from the pre-study phase. For both puzzles, the respondents ranked the needs and functions separately. It was possible to choose between 14 needs and 10 functions that had been identified as relevant earlier in the pre-study, these can be seen in Appendix B. Further, the five most and less important needs and the three most and less important functions were ranked. Their choices were then discussed to understand why they chose as they did. These puzzles were performed iteratively during the development of the prototype. The result from all puzzles were analysed and the five resulting needs that occurred most frequently on the "top 5" ranking among all respondents were found. The same was done with the functions, showing the three most occurring functions of the chair on the "top 3" ranking among all respondents.

2.4.4 User tests and interviews at Vallås retirement home in Halmstad

Interviews and user tests were performed with two persons at Vallås retirement home in Halmstad the 19th of March 2019. One of them is working as a transfer instructor and background as an assistant nurse. The other person has a background as occupational therapists and now works as a seller with Arjo's products.

Both did the need puzzle, where one discussed the needs with the view of home care, and the other with the view of using the chair at a nursing home. 14 needs were ranked from most important to least important, see the proposed needs in appendix B.

The lever for rotation of the seat was tested on prototype A, see Figure 3.5, and also on the one referred as 'the second prototype' where the levers for unlocking the rotation worked opposite to prototype A. The preferable way of unlocking the rotation and the overall appearance of the chairs were discussed.

Three care assistants working at Vallås retirement home, Halmstad were interviewed with open interview questions, following the interview mind map seen in appendix A. Two interviews were performed since two of the interviewees were interviewed together. All three had a long background within elderly care and different type of chairs and often occurring problems in shower situations for elderly. The personnel are familiar with using Arjo's chair Carendo, and the advantages and disadvantages with that product and different user situations were discussed. For all of the interviews, images from 'Questionnaire 1 for user tests' (Appendix C) was shown and discussed, see the images from question 1 concerning backrest, question 5 concerning armrests and questions 1 about adjusting the height of the chair. The preferred size of the backrest, the shape of the armrests and different ways to adjust the height of the chair was discussed.

2.4.5 User tests at Kungsparken rehab in Malmö City

A workshop was performed with occupational therapists at Kungsparken Rehab in Malmö, the 28th of March. Prototype B, see Figure 3.5, was tested and is the resulting prototype from the user tests at Vallås retirement home in Halmstad. The functions and ergonomics of the shower chair were investigated. The users' reactions while testing the chair were observed together with verbal feedback that was noted. The shower chair was tested with eight different armrests made by cell plastic and three different sizes of the backrest, which can be seen in Figure 3.6 respectively in Figure 3.20.

The occupational therapists could then answer a questionnaire, related to the test, which is to be found in Appendix C. There were seven persons who answered the questionnaire. Due to the limit of time and the number of respondents, there were no time to go through the questionnaire together with each person. Instead the respondents could add additional comments to all questions in the questionnaire to clarify their answer if necessary.

In addition, the function puzzle and need puzzle were also conducted. Three submissions for the function puzzle were received and four answers for the need puzzle. A discussion was held after every puzzle together with the respondent to understand the choices better and the background to why some needs and functions were more important than other.

2.4.6 Prototype in SolidWorks

A prototype of the shower chair was made in SolidWorks. This prototype, compared to the built ones, looks more like the shower chair should look like. The correct measurements that have been decided were used in the construction. Also, the functions and shapes of the armrests, backrest, seat and legs were constructed more accurate as well as the seat rotating function. The prototype was made with colours taken from Arjo's colour gallery. The result could then be used for the last user tests to give a better common picture of how the chair actually should look like. The results of the constructed shower chair can be seen in Figure 3.14.

2.5 End-phase

2.5.1 Final user tests

To evaluate the third and final prototype of the shower chair, final user tests were performed individually with 10 persons with different expertise and knowledge about shower chairs and the target group. Four of the persons were women and 6 men, in the ages 25-55 years old. Three occupational therapists, five engineers and product developers and two product managers. The user test was not performed with any person from the target group due to the chair being a prototype and not safe enough.

Together with the final prototype of the shower chair, a foot support was tested separately. The foot support was not included in the shower chair since it would have been hard to create a convenient prototype with it. Also, because the foot support was created early in the concept phase where the rest of the features of the shower chair was not decided yet.

Each person was introduced to a specific situation where he/she were asked to take the role as a person from the target group. The description of the situation and the user test can be seen in appendix D. An overall used to mimic common age-related health problems, such as reduced mobility, were offered to the test persons. They could decide themselves whether or not to wear it, and it was used by three participants. An introduction to the shower chair and its functions, without telling or showing how the functions work, was given. The purpose and description of the user tests was also explained. The rendered images from SolidWorks of what the chair could look like with real design was shown to the participants.

The test started with that test person entered the chair and performed a normal shower routine, while thinking loud and telling everything that came to mind about the chair and the usage of it. A bottle of shampoo was placed in the basket at the side of the chair, see Figure 2.2. The chair was placed with the side to the shower regulation, why the user had to use the rotation to start the shower.



Figure 2.2 This image shows how the shower chair was placed during the final user test.

The usage of the chair was observed and complemented with a short discussion together with the test person at the end. After the test, a questionnaire was handed out to complement the observation and the short interview, see appendix E. Each respondent was asked to answer the questionnaire with the perspective of a person from the target group. The results from the questionnaire together with the observations and discussion could then be used to evaluate the shower chair.

The final questionnaire consisted of 33 questions about the chair divided into seven parts, excluding the questions about the respondent. Each question was a statement where the respondent was asked to rate from 1 to 5 if he/she agreed or not, where 1 was strongly disagree and 5 strongly agree. Three is seen as a neutral answer, while a 2 is disagree and 4 is translated as agreeing to the statement. A field for comments were given after every question, offering the respondent a chance to explain the answer further if needed. Each respondent answered the questionnaire anonymously and was always able to ask questions about the statements or the questionnaire.

3 Results

3.1 Pre-study

3.1.1 Identification of customer needs

From all interviews and observations in the pre-study phase, needs for the user during the hygiene activity were identified. These needs are summarized below.

3.1.1.1 Stability

One need is that the chair must be stable and that the user should feel safe during all times when using the chair, when entering, sitting in it and raising from it. The uneven floor in bathrooms is a problem when it comes to shower chairs and their stability. This was confirmed in all interviews. The stability of the chair is of special importance when used by patients with dementia according to the branch head at the elderly care at Trollsjögården (interview, January 25, 2019) and Bodil Åkesson, product developer at Arjo (interview, January 23, 2019).

3.1.1.2 Comfort

Another important factor and need is that the chair should be comfortable. Many shower chairs are made of a stiff and hard material that also feels cold when showering. These aspects were also confirmed and brought up during every interview. There is a need for a more comfortable chair to make the hygiene activities more pleasant, which is of great importance for all types of users. A comfortable chair is important in dementia care since it makes the care recipient feel more safe and secure in the often uncomfortable situation that a shower cause (Bodil Åkesson, interview, January 23, 2019).

3.1.1.3 Ability to reach and be more independent

From observations, empathic modelling and interviews it was clear that a need is to easier reach things in the shower, without having to get up from the chair. It would increase the user's independence and in case of assisted showering, make the care recipient more active and have more control over the situation. There is a need for care

recipients to be more independent (care recipient at Trollsjögården, personal communication, January 25, 2019). When the mobility decreases the chair should offer solutions for maintaining as much independence as possible for the target group.

A problem for many elderly is to reach and wash their feet. It was discussed with care recipients at Trollsjögården (interview, January 25, 2019), where some couldn't reach their feet at all, and some were more agile and could lift and rest their feet on the other knee. Not being able to reach the feet is one factor that decreases independence in hygiene activities.

3.1.1.4 Appearance

It's getting more important among the users that the chair has an appealing design. From interviews with home care personnel, occupational therapists and branch head at an elderly care, it is clear that it is an important need to consider. This is of special importance when it comes to dementia care, that the chair doesn't look intimidating. There is a need for a shower chair with a home-like design. (Bodil Åkesson, interview, January 23, 2019)

3.1.1.5 Customized adjustability

This chair should be used at home, at hospitals and in elderly care facilities, and the needs in these environments are slightly different. Therefore, there is a need for the chair to be customized to the right situation and to the individual user. A chair that is adjusted to the individual offers maximum support and a safer shower. From an occupational therapist's point of view (interview, February 18, 2019), the possibility to easily adapt the chair according to the varied needs of the user, is of great use. Both due to that the same chair can be used for a wide range of users with different mobility, but it's also useful if the same chair can be adapted if the user needs changes, instead of having to install a completely new chair into the user's home. In dementia care, the opportunity to have several options and possibility to adapt the chair after each individual and their specific needs, are of great use (Bodil Åkesson, interview, January 23, 2019).

3.1.2 Market research

There are many shower chairs on the market and the variations are enormous. There is everything from the easiest stools to complicated chairs. Functions that differ are whether there is a backrest or not, footrest, armrests, wheels, softness, a gap in the front of the seat, rotation of the seat and commode hole. Moreover, the size, the settings and complexity of these things also varies. Some of the products can be perceived as

stigmatising because of the design as a medical device that does not melt into the environment. Instead a homelike product is to be preferred (Socialstyrelsen, 2017).

Carino and Carendo are two shower chairs in Arjo's product portfolio. They both aim to help people with less mobility than the target group in this project. There is no simple shower chair for people walking with cane or walker. Therefore, there is of Arjo's interest to produce a shower chair for Albert and Barbara. (Arjo, 2019)

3.1.3 Function analysis

The result from the function analysis is shown in Figure 3.1 below. The main goal with the chair is to shower independently, with sub-functions presented in the pink boxes and branched out in under-functions.

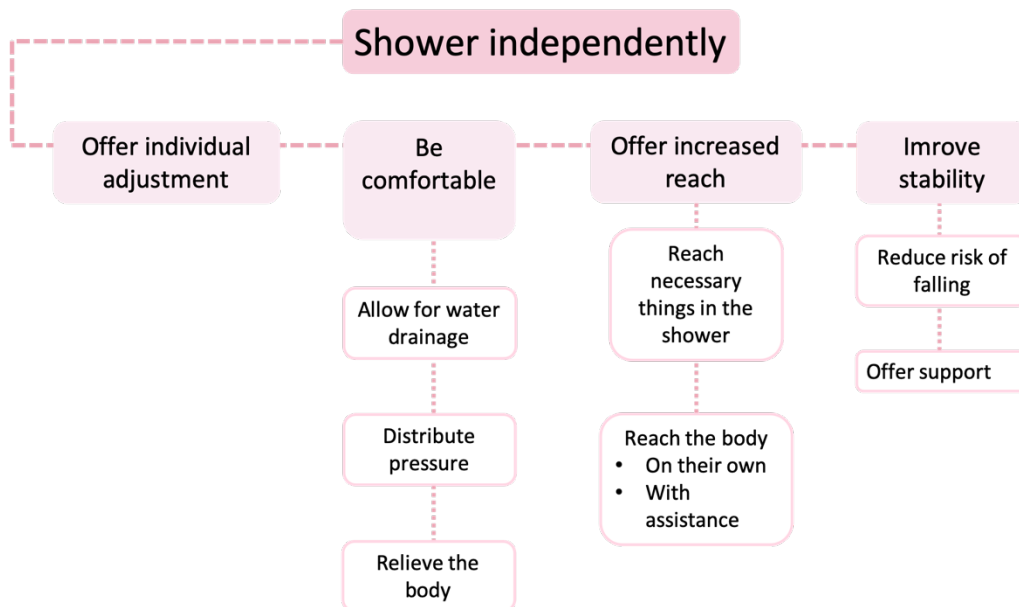


Figure 3.1 Tree diagram of the function analysis of the chair, with the goal to shower independently.

3.1.4 Hierarchical task analysis

The result from the hierarchical task analysis is shown in Figure 3.2 below. The task is to shower independently, and each step on how that could be performed by using the chair is branched out in sub-tasks.

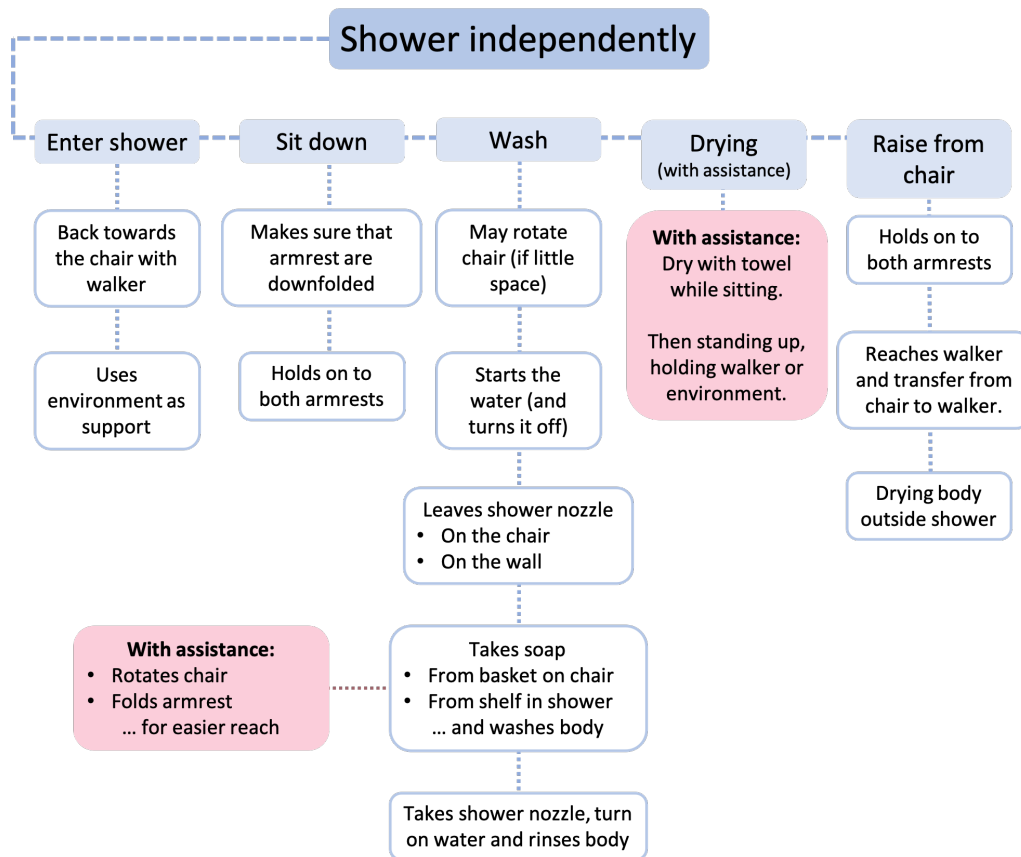


Figure 3.2 Tree diagram of the task analysis of the chair, with the goal to shower independently.

3.1.5 Specification of requirements

The resulting requirements of the chair is shown in Table 3.1 and is the summarized result from all interviews and observations in the pre-study phase.

Table 3.1:

<i>Function</i>	<i>Requirements, shall and should</i>
Armrest	Shall have armrests.
Removable armrest	Should be able to remove the armrests.
Adjustable armrest	Should be able to adjust the width between the two armrests.
Folding armrest	Should be able to fold the armrest up and down.
Rotation of seat	Shall be able to rotate the seat.
Active choice for rotation	Shall only rotate while the user actively chose to rotate. Shall stop to rotate whenever the user wants it to.
Backrest	Shall have a backrest.
Removable backrest	Should be able to remove the backrest.
Adjustable chair height	Shall be able to adjust the height.
Chair accessories - padding	Shall offer a soft padding for seat and backrest.
Chair accessories - storage of hygiene items	Should have a place for storing hygiene items.
Foot support	Optional to have foot support
Appearance - dementia friendly	Should be dementia friendly.
Wheel	Should not have wheels.
Commode chair	Shall not have a commode hole.
Hygiene	Shall be easy to clean.
Stability	Shall be stable.

3.2 Need puzzle and Function puzzle

The results from the need- and function puzzles used to confirm or deny the identified needs of the user group from the pre-study, and functions of the chair, is shown below in Figure 3.3 and Figure 3.4. The resulting graphs are a summary of all performed puzzles with respondents of different professions and background.

The most important needs according to the ‘need puzzle’ is that the chair should be stable, and it must be able to adjust the seat height. Folding armrests, high comfort and easier to reach things in the shower are the other needs that most respondents had on their top five list. The possibility to use the chair both as a chair and a stool, or the need for it to be multifunctional and be able to use over the toilet, or as a walking aid, was not seen as an important need by any of the respondents. See Figure 3.3.

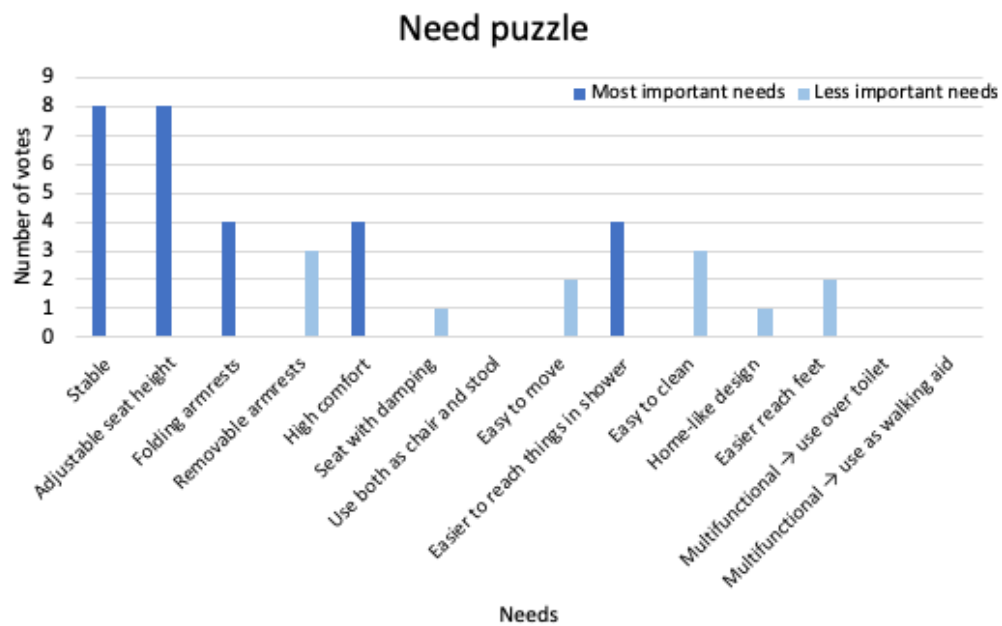


Figure 3.3 This is the result from the need puzzle. Showing which needs that is most important. The darker colour shows the 5 most important needs.

The result of the three most important functions of the chair according to the respondents is that the chair should have a removable backrest, removable and foldable armrests. A soft seat and possibility to rotate the seat occurred on the top three list one time each. A soft armrest, adjustable footrest, commode hole and possibility to easy adjust seat height did not appear on the top list at all, see Figure 3.4.

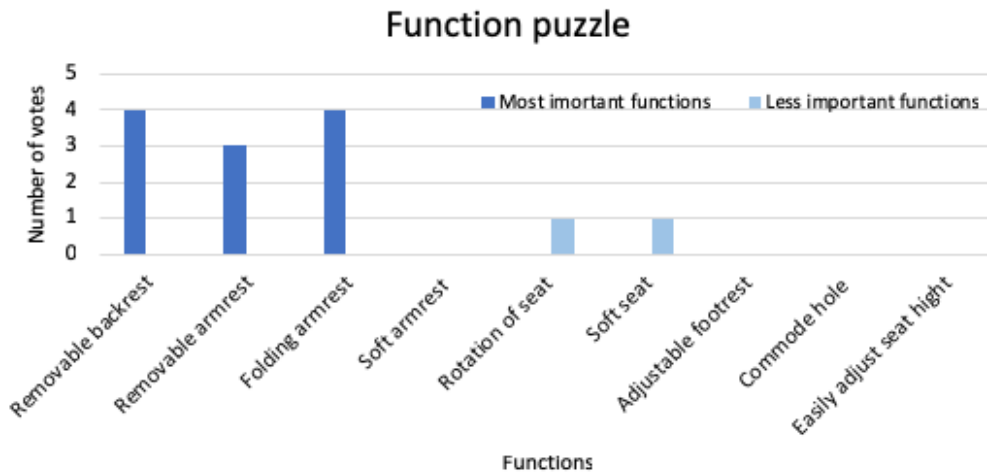


Figure 3.4 This is the result from the function puzzle, showing what functions that are most important. The darker colour shows the three most important functions.

3.3 Presentation of the chair and its functions

The main prototypes of the chair in different iterations are shown in Figure 3.5. Prototype A is the first prototype that was built of the entire chair. Prototype B was created after some iterations with the first prototype and is the first chair that has folding armrest. It also has several different armrests made out of cell plastic that can be put on to the metal armrests. Prototype C is the prototype used in the final user test, also referred as the final prototype. Finally, prototype D is the rendered prototype made in SolidWorks.



Figure 3.5 The main built prototypes in the project. A is the first one, B the second one. C is the prototype used in the final user tests together with the rendered prototype D.

3.3.1 Armrest

It was early identified from interviews with Bodil Åkesson (interview, January 23, 2019) and Richard Nilsson (interview, January 21, 2019) that the chair needs to be stable and give support both when sitting down and raising up. To be stable while raising up, the user should be able to have ‘nose over toes’. That means that the user should put their feet under the seat and leaning slightly forward, holding the armrests, and aligning nose and toes. Feedback from early user tests showed that this length was good. They were not too long to misadjust were the seat started and not too short to not give enough support according to the users.

The user tests at Kungsparken Rehab, Malmö city gave results in the preferable appearance, shape, grip and support of the armrests. A majority thought armrest G, as can be seen in Figure 3.6 and Figure 3.7, had the most appealing appearance, best grip and gave best support. The shape of armrest G, seen from an above view, has been inspired by the armrest of Arjo’s shower chair Carino (Arjo, 2019).

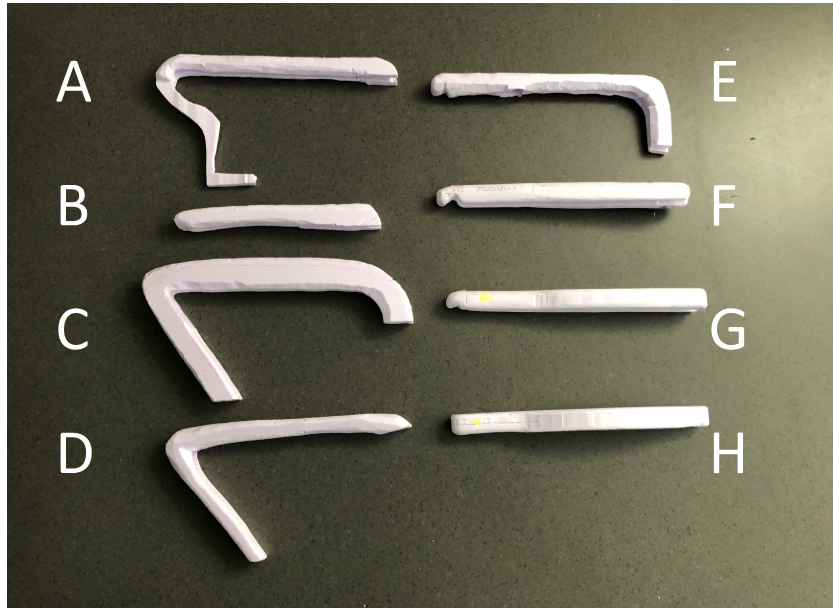


Figure 3.6 The armrests tested in the user test, seen from the side and the front of them pointing to the left.



Figure 3.7 The armrests tested in the user test, seen from above and the front of them pointing to the left.

Sketches with different shape and distances between the armrests were evaluated in the questionnaire, found in appendix C. Sketch A, which can be seen in the questionnaire, show the preferred placement and shape of the armrests. The respondents also thought that the distance between the armrests was enough. The user tests also showed that the armrests gave enough space for the user to reach different parts of the body. However, several participants commented that it could be a bit difficult to lather the thighs and feet due to the armrests' shape in the front, see the referred area marked with an arrow, Figure 3.8. The results from this user test resulted in the final prototype.



Figure 3.8 The arrow in the image points out the area of the armrest that was thought to be in the way while trying to lather the thighs and feet.

The armrests in the final prototype was a result of further development of armrest G in Figure 3.6 and 3.7. The left and right final armrests are very similar but has some small differences. Both armrests can be seen in Figure 3.9. Both has a rounded front, orange area, narrower in the middle and a wider part in the back. The left armrest is shaped so the front is pointing slightly upwards, while the right is pointing slightly downwards, see Figure 3.10.

The front of both armrests has a width of 60 mm, and a thickness of 30 mm, marked as orange in Figure 3.9. The diameter of a circular cross-section gripping area should be

30-50 diameter to be comfortable, and a circular cross-section is more comfortable than a cross-section with edges according to Pheasant & Haslegrave (2006: 148-150). The cross-section of the narrower gripping area of the armrests is rectangular with rounded edges, almost elliptical, see blue part in Figure 3.9. The narrower area is 50 mm wide and 30 mm thick. The left armrest is more rounded on the side facing up, and flatter on the side facing down, while the right armrest is the opposite. The dimensions are a result of anthropometric data (Pheasant & Haslegrave, 2005: 248, 250) for width and length of fingers and hands.

The widest part in the rear of the armrest is flat, 70 mm wide, see green area in Figure 3.9. The dimensions are a result from anthropometric data: hand length, palm length, handbreadth and elbow width, (Pheasant & Haslegrave, 2006: 144, 248, 250) and measurements from Arjo's chair Carino (Arjo, 2019).



Figure 3.9 The two armrests used in the final user test, with the right armrest at the top and left at the bottom. The width and length are seen from an above view and the thickness is going into the paper. The front of the armrest is marked as orange and 60 mm wide. The narrower gripping part is marked with blue, 50 mm wide, and the wider supporting area is marked with green colour, 70 mm wide.



Figure 3.10 The handle of the left picture, the left armrest, is slightly angle upwards and the handle on the right picture, right armrest, is slightly angled downwards.

It is shown in the specification of requirements in Table 3.1 that the chair shall have removable armrests. They should also be able to fold up and down and it should be possible to adjust the width between them. To fulfil the required needs of folding and removable armrests, the joint used for Alentis armrest, one of Arjo's hygiene lifts, see Figure 3.11, could be used with some modifications. One of the modifications is to make it possible to adjust the width between the armrests. This modification was made in SolidWorks and can be seen in Figure 3.12. The slot was moved to the armrest, instead of on the attachment point of the body of the chair. Also, further development of the slot was added in order to make it possible to adjust the width between the armrests. This adjustment can only be changed when the armrest is up folded.



Figure 3.11 The figure to the left show Alenti. The upper right image show the point of attachment for the armrest in detail. Its position on Alenti is marked with a red box. The lower right image shows the armrest when removed from the chair, and what the locking mechanism looks like. Image of Alenti (Arjos, 2019)



Figure 3.12 The image shows how the armrest is fastened to the chair. There are two slots on the armrest to be able to adjust the width between them.

The point of rotation for the armrest is placed close to the middle of the seat, see Figure 3.13. The armrests are almost aligned with the backrest when up folded. In the front of the armrest the handles have a blue colour to separate from the rest of the chair.



Figure 3.13 The image shows the shower chair and its rotation point for the armrest.

3.3.2 Seat

The depth and width of the chair is a result from anthropometric data (Pheasant, & Haslegrave, 2006: 248, 250; MacCormick, & Sanders, 1993). The shape of the seat can be seen in Figure 3.14. It has soft edges and curvatures that follow the shape of the body. In the front of the seat, there shall be a soft curvature and the seat shall be angled backwards 5°. (MacCormick, & Sanders, 1993)



Figure 3.14 The image shows the shower chair and the curvatures and shape of the seat.

There are shower chairs on the market with an opening in front of the seat. Occupational therapists at Trollsjögården, Vallås retirement home and Kungsparken Rehab stated that users who cannot sit straight, are stiff or small, easily get one leg in the opening. That is an unpleasant feeling and according to the occupational therapists, it makes more harm than good.

From interviews at Trollsjögården (interview, January 25, 2019), Vallås retirement home (interview, March 19, 2019), and from caregivers within home care (interview, February 12, 2019) it is seen that the softness of the seat is of great importance. This shower chair will have a seat made out of plastic, but with a possibility to use extra padding.

The chair should have a removable seat that is easy to clean. Arjo's chair Carino have removable seats and this chair could use the same construction. In Figure 3.15 it is seen how the seat is fixed to the body of the chair. The same mechanism as used in Carino could be used to allow for flipping up and down the seat, see Figure 3.16.

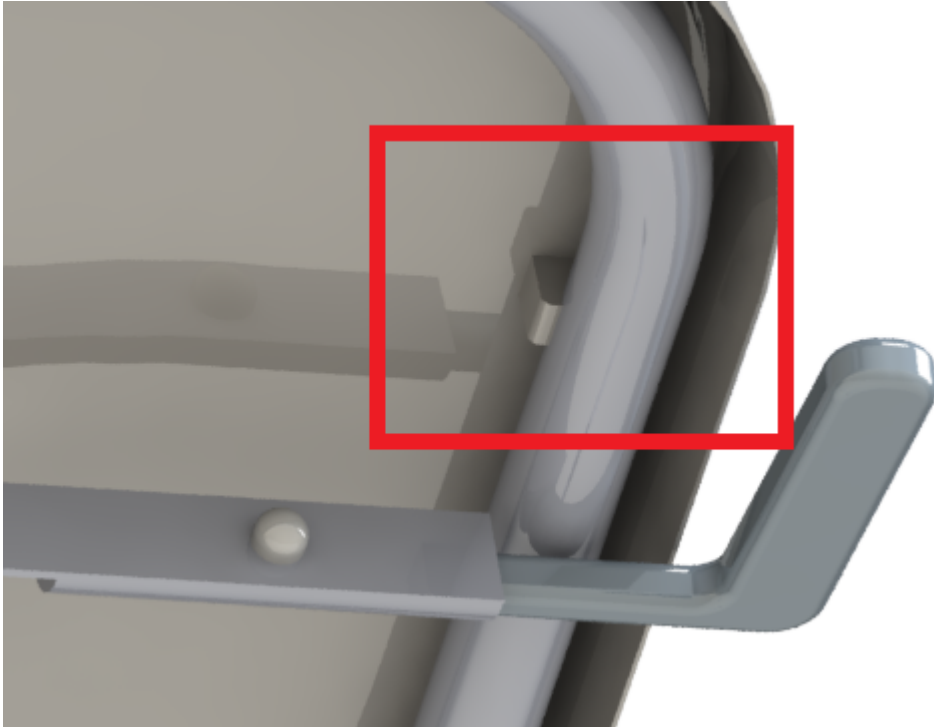


Figure 3.15 The image show how the seat can be fixed to the body of the chair.

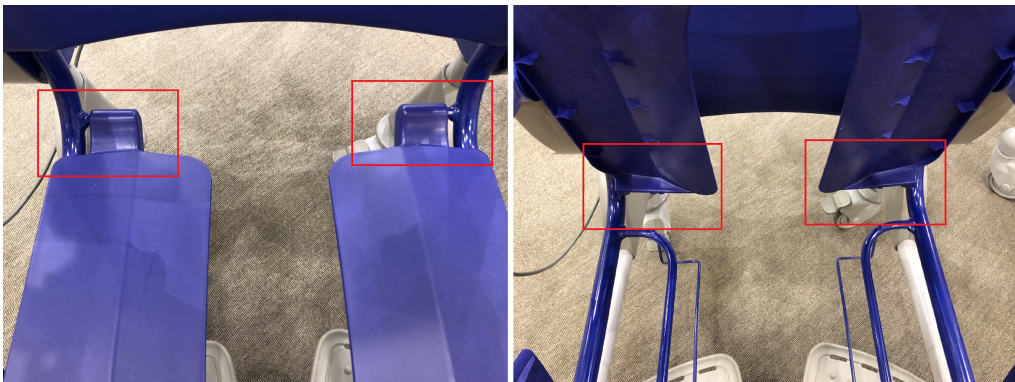


Figure 3.16 The images show how the seat is fixed to the body of the chair and how the seat is fixed so that the seat can be flipped up without being completely removed.

3.3.3 Rotation of seat

An identified need was to easier reach things in the shower and have better accessibility. Showers often have a limited space and when using a walker, it can be difficult to access the shower chair. By rotating the seat to a position where it's easier to access and enter the chair, the accessibility increases. The seat is possible to rotate 360° and stop at any angle.

An early prototype of the chair and the function for rotating the seat is shown in Figure 3.17 below. When pressing one or two of the green levers downwards, it is possible to rotate the seat. The rotation stops directly when letting go off the levers and the chair locks itself.



Figure 3.17 Early prototype of chair and function for rotating the seat by pressing levers (green) downwards.

From early user tests with the first prototype, it was seen that the users tried to pull the levers upwards rather than pushing them downwards, it felt more intuitive to them. In the later prototype, the rotation is unlocked by pulling the levers upwards, see Figure 3.18.



Figure 3.18 Prototype of the chair where the levers (gray) are pulled upwards.

It is important that the levers are visible and easy to reach in order to understand and remember that the seat is possible to rotate (Pheasant & Haslegrave, 2006: 168). They are placed at the sides, close to the front of the seat, in the field of vision. There are two levers on the chair, even though it is possible to use only one. There is also the option to remove one of the levers and only use one, if that would be preferred.

From the user test with occupational therapists at Kungsparken rehab (March 28, 2019), all respondents answered that they prefer to pull the levers upwards to unlock the rotation, instead of pushing downwards (see question 3 in Appendix C). From the same user test, all respondents stated that it was easy to understand how to unlock the rotation and that the placement of the levers was good. All respondents preferred to have two levers, one on each side of the chair, or one lever that was easy to switch side on. No changes with the seat rotation and the levers were made for the final user test.

The resulting renderings of the chair show what the lever could look like, with a slight tilt downwards. This can be seen in Figure 3.19 below. In order to make the lever more visible, it has a blue colour to separate it from the surroundings. Colour is important, especially considering users with dementia, as stated by Bodil Åkesson (interview, January 23, 2019). High contrast makes it easier for these users to separate things from the environment, a statement that is backed up with emphasis in all interviews.



Figure 3.19 Image of the rotation levers and their placement at the rendered prototype.

3.3.4 Backrest

The angle and the size of the backrest is a result from identified anthropometric data, chair designing guidelines (Pheasant & M, Haslegrave, 2006: 248, 250; MacCormick, & Sanders, 1993) and user tests. The angle of the backrest is 100° from the horizontal plane, which is a common angle to for a chair (MacCormick, & Sanders, 1993). Firstly, three different sizes of the backrest were built and evaluated in the user tests at Vallås retirement home and at Kungsparken Rehab. The backrests can be seen in Figure 3.20. Backrest C, the biggest one, was comfortable, but compared to the other two, the size made it harder to reach the back. The preferable backrest was backrest A and B, the small and medium size. They both got the same number of votes in the user test. They gave the users more space to reach the back, both for the person sitting in the chair, but also if assistance is used. The resulting backrest for the final prototype had the size in between A and B, see Figure 3.21.



Figure 3.20 Three different backrests with different sizes, A is the smallest one and C is the biggest.



Figure 3.21 The backrest in the final prototype.

An identified need is that the shower chair should be able to be used in shower environments with little space since bathrooms are often small in an average home. The backrest is removable, and its mechanism can be seen in Figure 3.22. No user tests were performed to test this function since it was not implemented on the final prototype, only shown on the rendered images. The cross-section makes it possible to only connect it in one way under the seat.

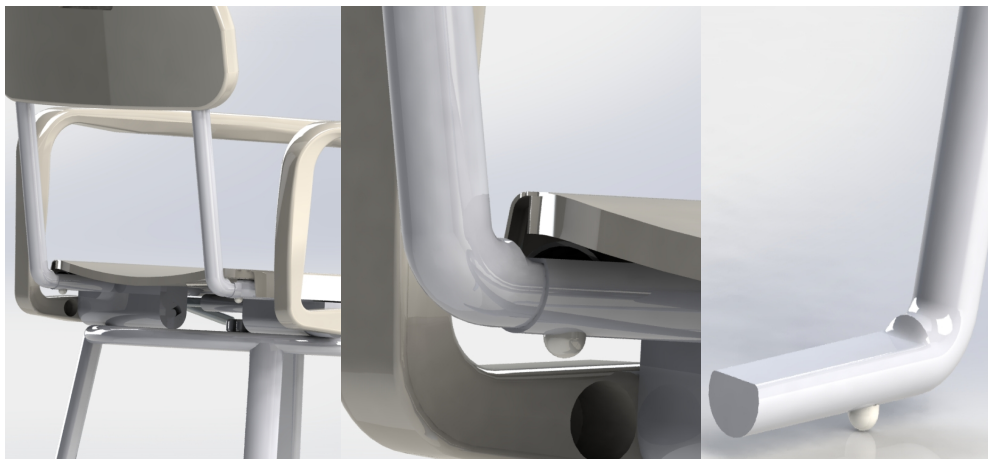


Figure 3.22 The images show the shape for the fixation of the backrest.

On the back of the backrest there is a handle, see Figure 3.23. The size of this handle is 100 mm wide and the 5th percentile of the width of the hand for women are 69 mm and the 95th percentile for males are 95 mm (Pheasant & Haslegrave, 2006: 144).



Figure 3.23 The image shows the back of the backrest with its handle.

3.3.5 Adjustable chair height

An important need is to customize the chair to each individual user. Ability to adjust the height of the chair is one of the most critical aspects that has to be included in the chair, according to the results in the function and need puzzles.

The height of the chair is adjusted by altering the length of the telescopic legs, see Figure 3.24. It is a common way of altering and adjusting height on shower chairs according to the interviewed occupational therapists' and caregivers. The material of the legs and body of the chair should be in a stainless metal, for example aluminium.

In the questionnaire that was handed out during the user test with the occupational therapists at Kungsparken in Malmö, different examples on how to adjust the chair height was shown (see Appendix C). According to them, no tools should have to be used due to loose parts such as screws easy get lost. The majority preferred the telescopic leg with holes and a button used for adjusting the height, see Figure 3.24. This option was also the favourite when interviewing caregivers at the elderly care Vallås (interview, March 19, 2019).

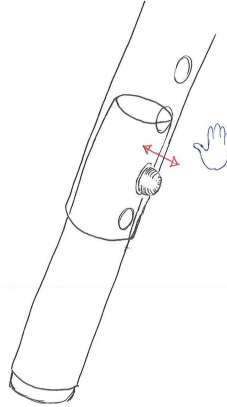


Figure 3.24 Sketch of the preferred type of function for adjusting chair height.

The feet should be constructed so that they can adapt for the tilting floor. In the rendered prototype, a ball joint is used where the feet can rotate and change angle, see Figure 3.25.

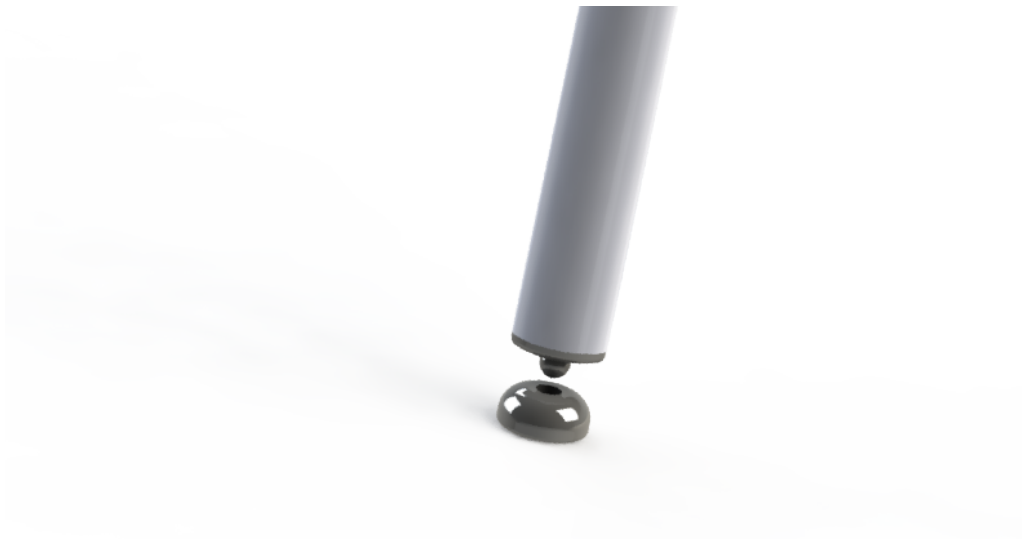


Figure 3.25 The figure shows how the feet are fastened to the legs with a ball joint. The joint enables the chair to adjust to the tilting floor.

The cross-section of the legs was developed to only move in one direction and not rotate. Each leg can only fit one way when assembling the chair. This cross-section is seen in Figure 3.26 below. A hole for water drainage is at the bottom of each leg to prevent water from filling up the legs.



Figure 3.26 Cross-section of the chair legs.

3.3.6 Chair accessories

3.3.6.1 Shampoo and soap basket

It has been identified that the users sometimes would like to have somewhere to put soap and shampoo to easier reach it. The need for this is dependent on what the shower looks like. The identified need resulted in a small basket that can be put on the side of the chair, follows the rotation and that is able to move and remove if wanted, see Figure 3.27. It should be possible for the user to choose whether to have this accessory or not.

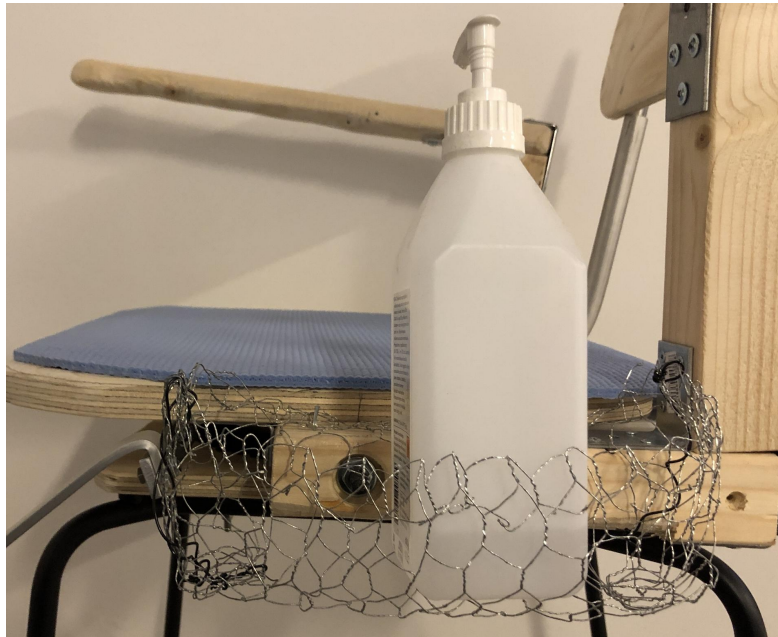


Figure 3.27 The image shows the basket to put for example shampoo and soap in. The basket is positioned so it follows the rotation of the seat.

3.3.6.2 Padding

Plastic can be perceived as a cold material and it can feel hard and uncomfortable to sit on (care recipient, interview, Trollsjögården, January 24, 2019). The shower chair will have an optional padding that can be added to the seat. Depending on a person's condition, the need for a soft padding variate.

3.3.7 Foot support

It is often problematic to reach the shins and feet according to the interviewed occupational therapists and caregivers. This need resulted in different prototypes trying to solve that problem. The prototype considered as the best one, was used in the final user test. The solution can be seen in Figure 3.28. The foot support has the shape of a cylinder and should be able to adjust in length and angle. The foot support should be optional, and it can either be used to support the foot or the leg. In Figure 3.29 it can be seen how the foot support can be used.



Figure 3.28 The foot support used in the final user test.



Figure 3.29 The pictures show how the foot support can be used, with either the foot on or the calf.

3.3.8 Wheel

With the target group in mind, there is no need for the shower chair to have wheels according to several interviewees (care assistance, interview, February 12, 2019; care assistance, interview, January 25, 2019; occupational therapist, personal communication, 19 March 2019). The chair should be standing in the sower at all times and not be moved. Sometimes it might be used by the basin, since some people likes to sit down e.g. while brushing their teeth.

3.3.9 Commode chair

A commode chair is used over the toilet. As seen in the result from the need and function puzzle, there is no need for this shower chair to be multifunctional and be used as a commode chair. According to several interviews, the target group is not in a need for a commode chair (care assistance, interview, February 12, 2019; care assistance, interview, January 25, 2019).

3.3.10 Final prototype and rendering

The resulting final prototype used in the final user test, and the rendered images of the chair, is shown in the Figure 3.30, 3.31 and 3.32. The dimensions of the chair can be seen in Figure 3.33.

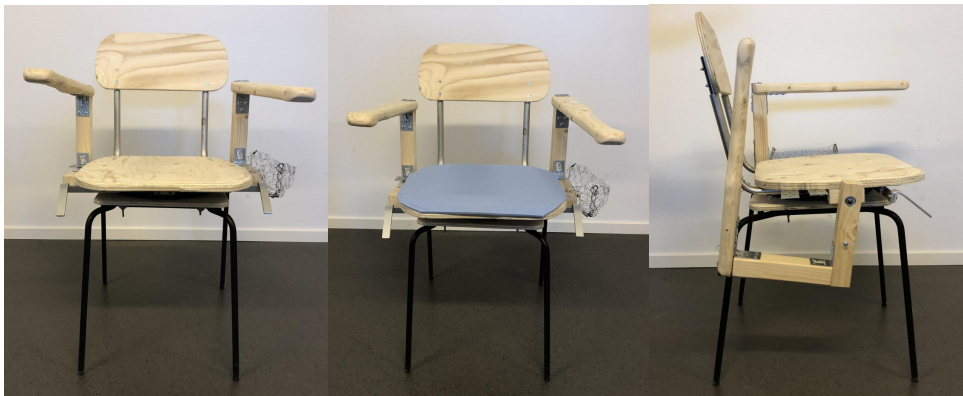


Figure 3.30 Shows the final prototype used during the final user test. The left and middle image show the chair with a basket at one side and with and without a soft padding on the seat. The right image shows the chair with the armrest up folded.



Figure 3.31 Rendered image of the chair used for the final user tests.



Figure 3.32 Rendered image of the chair used for the final user tests.

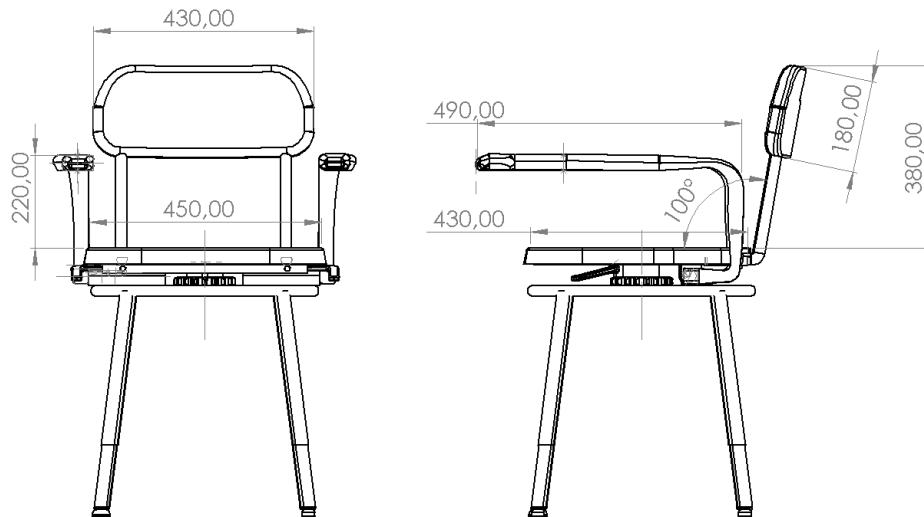


Figure 3.33 Drawing of the final prototype with its dimensions.

3.4 Final user test

The final user test summarized how well the chair and its functions reach the identified needs, and the result from this is shown in the paragraphs below. The placement of the chair and the environment where the tests were performed can be seen in Figure 2.2.

3.4.1 General

When asked about the overall opinion about the chair, all were positive and stated that if they were a person in the target group, they would like to use the chair regularly, see Figure 3.34. For these questions concerning the general opinion of the chair, the opinion about the foot support was also considered, even though it was not incorporated to the chair during the test.

Seven respondents agreed on that the chair was easy to use and two agreed fully to the statement. One respondent, 10%, was neutral to the statement. This can be seen in Figure 3.35 below. No respondent agreed to the statement that the chair was difficult to use, see Figure 3.36.

General comments about the chair were that it felt safe, user friendly and easy to use. It gives satisfying support and looks like a chair, which is positive. The foot support must be easy to manoeuvre if it should be used, and some users thought it was a little difficult to at first understand how to make the chair rotate. Once the levers were found, it wasn't a problem. Overall, most thought it was easy to enter and egress the chair.

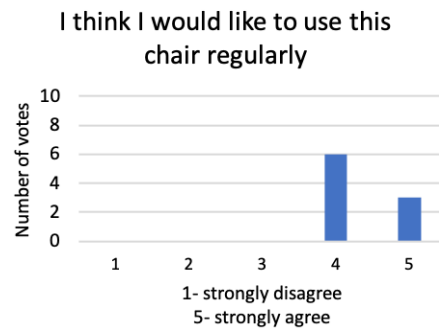


Figure 3.34 The result from the final user test whether the respondents would like to use the chair or not.

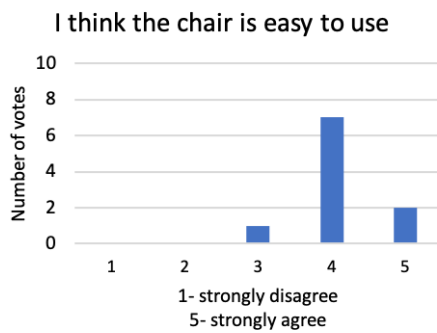


Figure 3.35 The result to if the respondents thinks it is easy to use the chair.

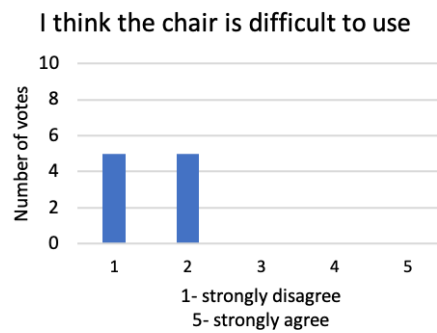


Figure 3.36 The result to if the respondents thinks it is difficult to use the chair

3.4.2 Armrest

General comments about the armrests were that the length of them are good, it makes it easy to raise from the chair and to sit down. The length of them also makes the movement from a walker to the chair safer, it is easy to reach and grip the armrests and hold on to them during the movement.

Some respondents preferred a combination of the left and right armrest, but as seen in Figure 3.37, the result is that the front and gripping area of the left armrest was preferred according to most respondents, see Figure 3.37. The referred parts of the armrests, “front area” and “gripping area”, can be seen in Figure 3.9 in orange respectively green.

Comments about the left armrest were that the gripping area followed the curvature of the palm well, and it was comfortable. Some thought it gave better grip than the right gripping area, while some had the opposite opinion. Overall, both armrests offered good stability and a comfortable grip. The variations between the two are small, but the left appealed to more users.

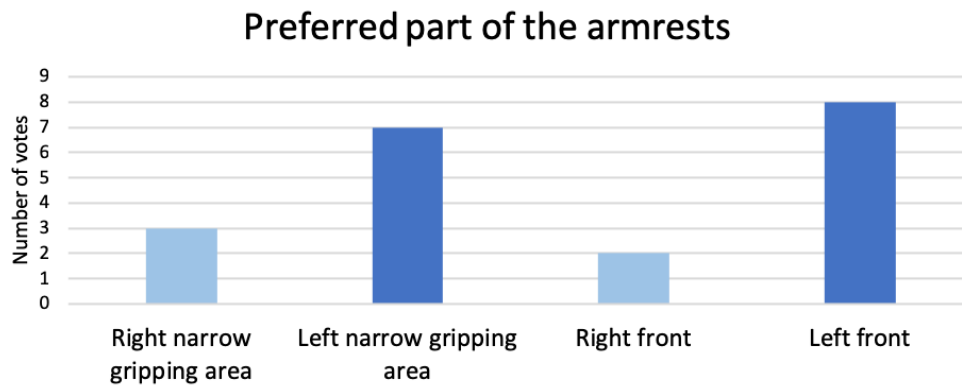


Figure 3.37 The result of what armrest, and what part of the armrest that was preferred.

All respondents agreed that the armrests gave enough support, see Figure 3.38. They also gave enough space for showering since seven persons answered that they fully agree to the statement, see Figure 3.39. Even though the majority thought that the armrests did not hinder them in any moment of the showering, three people agreed to some extent that they limited to some extent, see Figure 3.40. Comments about this was

that the armrests made it more difficult to rotate the chair, that it was difficult to reach the levers. Another comment was that it could be difficult to wash the thighs if the armrests were not upfolded.

The observation and discussion during the user test showed that it was difficult to fold down the armrests when in upfolded position, especially for a person with reduced mobility. It is also difficult to see and find the armrests when up folded.

Other comments were that it is good that the armrest can be folded in order to make room for moving or reaching different parts of the body, or during assistance. The fact that the armrest does not go much further back than the backrest was also positive, it saves space. The shape of the armrests, that they give room for moving the legs sideways was also commented positively on and it was appreciated that the armrest does not need to be unlocked in order to be up folded.

The majority also thought that it was good to be able to alter between two widths between the armrests, see Figure 3.41. Though, this function is not implemented in the final prototype. When asked if it is enough to have only one distance between the armrests, and not being able to alter it, 40 % thought that it wasn't enough, while 30 % thought it was, see Figure 3.42. Comments were that this type of adjustment is great for the occupational therapists that prescribes aids, it is easy to modify the chair after each individual. If the armrests are too far away it can feel unsafe for the user, and too close makes it difficult to move. Another comment was that it is good to be able to adjust the distance since people can vary a lot in shoulder width, while another comment was that it is not needed since people do not vary that much. An additional comment was that if a person needs to move the armrests further out, then maybe it would be better to have another version of the chair that can tolerate a higher safe working load.

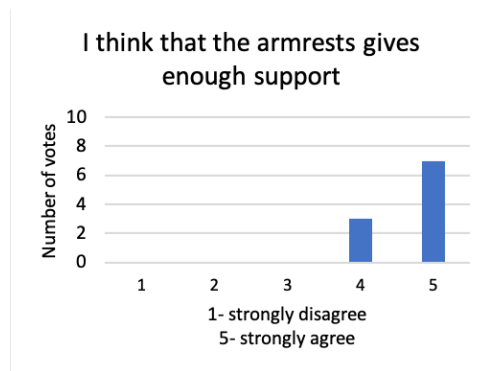


Figure 3.38 The result to if the respondents thinks that the armrests gives enough support.

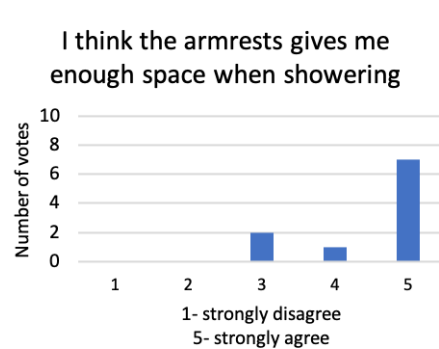


Figure 3.39 The result to if the respondents thinks that the armrests gives enough space when showering.

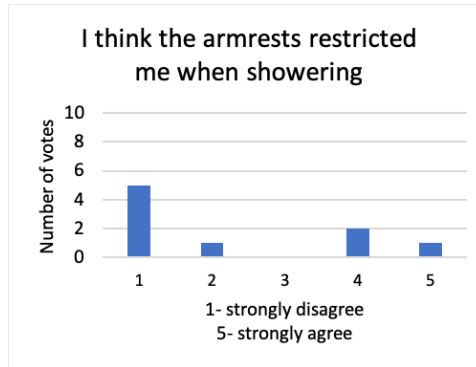


Figure 3.40 The result to if the users feel limited or restricted by the armrests when showering.

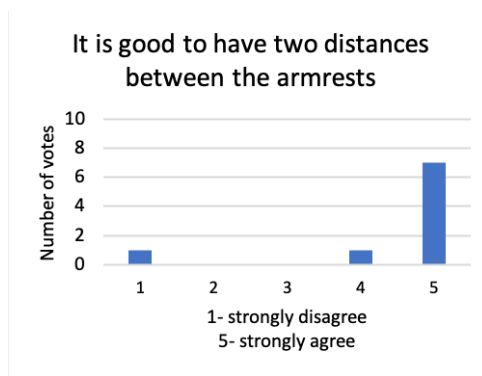


Figure 3.41 The result to if the respondents thinks it is good to have the possibility to change distance between the armrests.

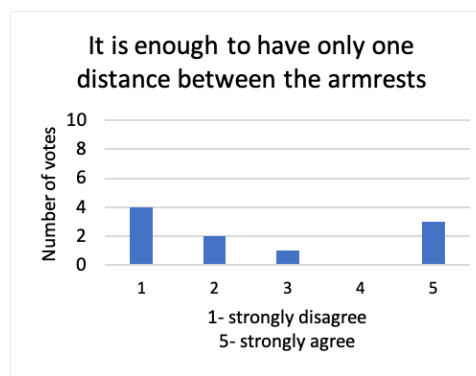


Figure 3.42 The result to if the respondents thinks it is enough to only have a fixed distance between the armrests.

During the user test, some users wanted the height of the armrest to be higher versus lower when sitting in the chair and resting their arms. The height of them was however not commented on in the situation when sitting down or raising from the chair.

3.4.3 Rotation of seat

Of the respondents, two persons agreed, and five persons fully agreed that it was easy to understand how to rotate the seat of the chair. Nine out of 10 respondents did not

think it was unnecessary complicated to rotate the seat. It was observed that all participants instinctively pulled the lever upwards. At first sight, some thought they had the use the lever on both sides to make the seat rotate but they easily discovered that only one hand was needed. There were comments about the colour of the handle for the lever, that it is good it has another colour than the rest of the chair. Further, it was suggested that it could be good to add an arrow on the levers to show that they should be pulled upwards. One mentioned it would be better if the levers were bigger.

It varied how easy the participants thought it was to reach the levers. When asked if it was easy to see and grab the levers, seven persons agreed, see Figure 3.43. When asked if it was unnecessary hard to reach the lever three persons agreed and one person fully agreed. Five persons disagreed or fully disagreed to the statement, and did not think it was difficult, see Figure 3.44.

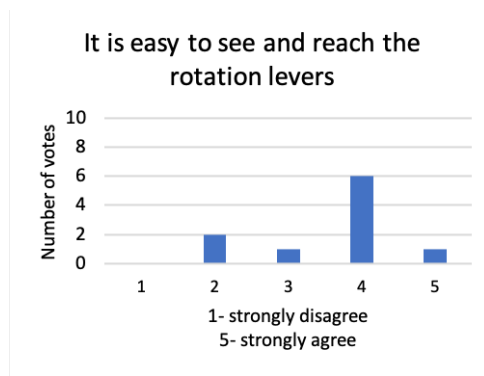


Figure 3.43 The result of how easy the respondents think it is to see and reach the levers.

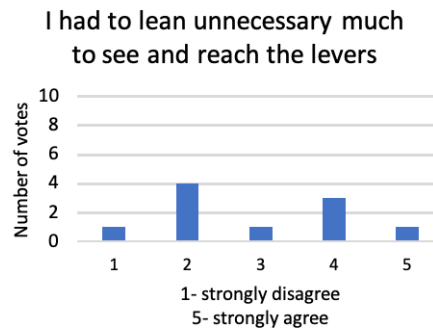


Figure 3.44 The result of what the respondents think of reaching the levers

3.4.4 Backrest

During the final user tests the participants stated that the angle of the backrest felt comfortable for them while sitting straight up. If the sitting person was round-shouldered, they commented that the edges of the flat backrest did not feel comfortable. However, the prototype of the shower chair created in SolidWorks do not have these sharp edges.

There were different thoughts about the fixation of the backrest. The respondents were asked if they thought it looked easy to attach or remove the backrest from the chair, six

respondents agreed or fully agreed while three persons were neutral and one disagreed, see Figure 3.45. Moreover, five out of ten did not think it looked unnecessary complicated, see Figure 3.46. Comments in the questionnaire mentioned that there are already existing products on the market with this function. The caregivers think it is easy to use but commented that it can feel a bit uncomfortable due to the risk of pinching the fingers. However, they mentioned that it is good to be able to remove the backrest, not only for the user but also when transporting the chair to the user by the occupational therapists.

Four persons, 40 %, fully agreed and two persons, 20 %, agreed to that the cross section of the backrests' point of attachment (see Figure 3.22) would guide them to put the backrest in the correct position. Though, 20 % fully disagreed to the statement and did not think that the cross-section would help them and 20% were neutral, see Figure 3.47.

One comment was that the orientation of the backrest is obvious anyway so the cross section should not matter.

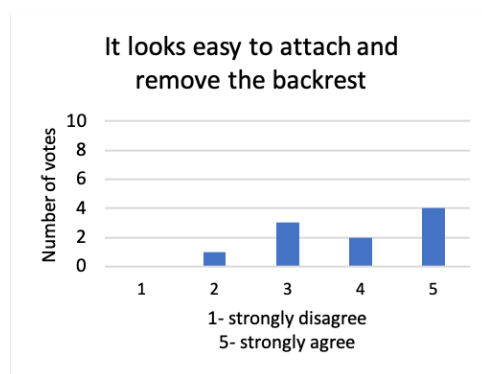


Figure 3.45 The result of if the respondents thinks it looks easy to remove and attach the backrest.

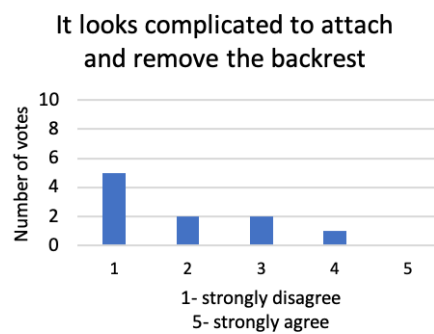


Figure 3.46 The result to if the respondents thinks it looks complicated to remove the backrest.

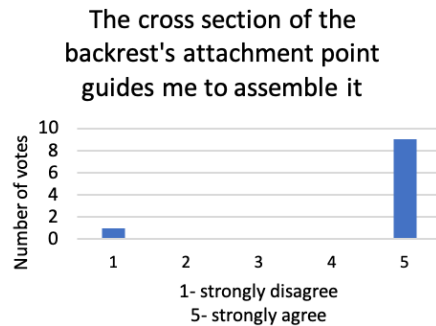


Figure 3.47 The result to if the respondents thinks that the shape of the backrest's attachment points will act as guidance when attaching the backrest.

3.4.5 Adjustable chair height

A suggestion to allow for finer adjustment of the chair height of one of the chair legs was proposed during the earlier user test at Kungsparken in Malmö. It could make the chair be more stable and have four legs in contact with the floor. This solution was presented in a question in the final questionnaire and the result can be seen in Figure 3.48. Every respondent except for one thought that it was good to be able to adjust the height of one leg. A comment to why that feature is not useful was that if the chair is adjusted, and then slightly moved, all four legs will not be in contact with the floor and the chair will be unstable again.

9 out of 10 respondents answered that the cross-section of the legs would make it easier to adjust the height and to assemble the chair, see Figure 3.49. Comments were that it is a known technique, but that the holes allow for dirt to enter the inside of the legs.

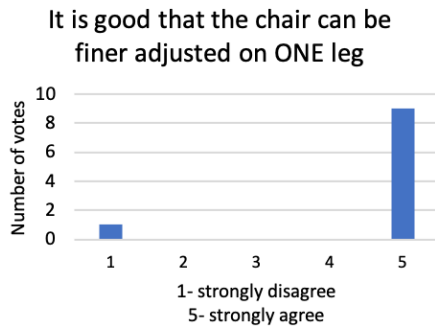


Figure 3.48 The result to if the respondents thinks it is good to adjust the height with better precision on one leg.

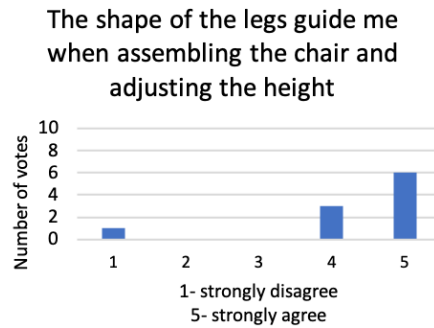


Figure 3.49 The result to if the respondents thinks the cross-section of the legs will act as guidance when assembling the chair and adjusting the height.

3.4.6 Chair accessories

3.4.6.1 Shampoo and soap basket

8 out of 10 respondents were positive to have a basket to put the soap and shampoo in, see Figure 3.50. Eight persons disagreed on that the basket was in the way in any part of the showering, see Figure 3.51. Some thought it was hard to see and reach the basket because the armrest was in the way. Comments from the user test and observation was that it would be preferable if the basket was movable and could be put on the armrest to reach it easier or hang it somewhere else in the shower.

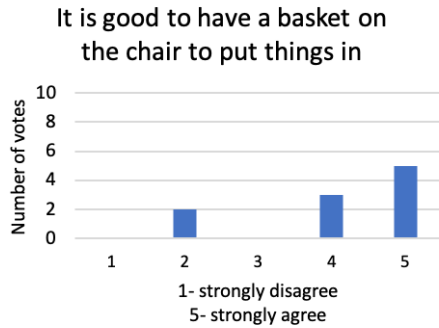


Figure 3.50 The result to if the respondents would like to have somewhere to place things on the chair.

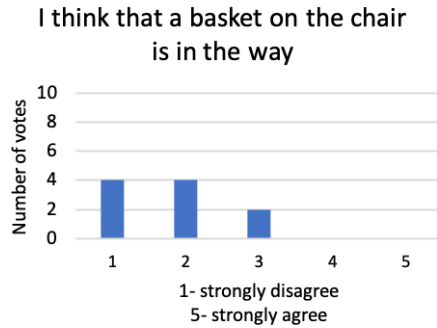


Figure 3.51 The result to if the respondents thinks that the basket is in the way when showering.

3.4.6.2 Padding

As stated earlier, the seat should be padded. Seven respondents fully agreed on that there should be a possibility to choose a soft padding for the seat or the backrest, see Figure 3.52. The result for if the seat itself should be soft, and not need extra padding, was more varied, see Figure 3.53.

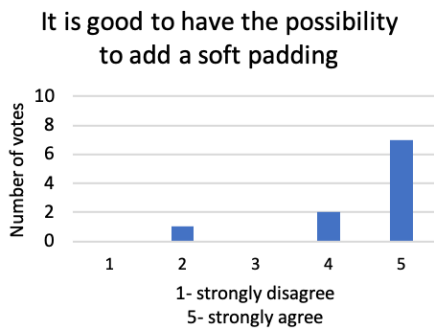


Figure 3.52 The result to if the respondents would like the chair to have an additional optional soft padding.

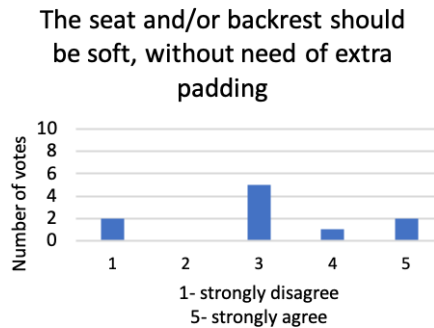


Figure 3.53 The result to if the respondents thinks the seat or backrest would be soft without the need of extra padding.

3.4.7 Foot support

The respondents were asked if they thought the foot support would help the target group to easier clean their feet. More than half, 60%, disagreed to the statement that the foot support would help the user group. Out of these, one person strongly disagreed, see Figure 3.54. They were also asked if they thought it would be hard for the target group to use this solution, where half of the respondents were neutral to the statement, 40 % agreed that it would be difficult for them to use and 10 % fully agreed that it would be difficult, see Figure 3.55. No respondent thought it would be easy for the target user to use this kind of support. However, all of them thought a foot support could be helpful for the caregivers, but some comments stated that there might be other solutions that are better.

The occupational therapists mentioned during the user test the problematics about that the user needs to bend the hip more than 90° to put their foot or shin on the support, see Figure 3.29. Another comment was that the foot support can increase the risk of falling since the user might forget to remove them before standing up or might try stand on them while raising up.

Another comment by the occupational therapists was that if the person sitting in the chair is capable to put their feet in the positions the support requires, they are not likely to need the support. In addition, one of the mechanical engineers mentioned the problematics of the mechanics of this solution. It is hard to construct a foot support that easily can be adjusted in length and angle and easy to manoeuvre.

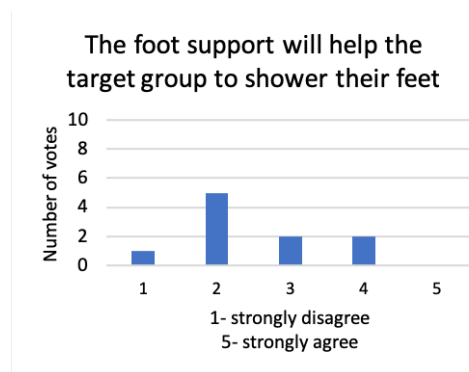


Figure 3.54 The result to if the respondents thinks that the foot support would be useful for the target users.

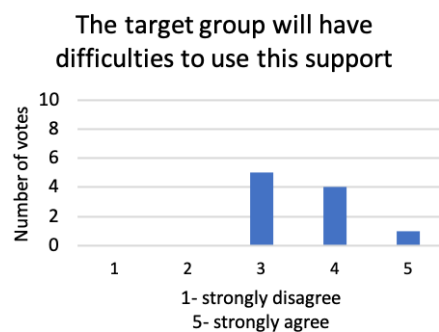


Figure 3.55 The result to if the respondents thinks that the intended users will have difficulties using this support.

4 Discussion

4.1 Evaluation of the process and used methods

This project has been performed with emphasis on keeping the development close to the target group and working iteratively with improvements of the prototypes. The needs of the target group have been evaluated in all steps of the process through interviews and user tests. The early use of user tests and prototypes complemented the interviews well to identify needs and solutions. Using new test persons with different background in every iteration of the prototype made it possible to confirm that the identified needs were perceived correctly, and if the proposed solutions fulfilled these. This feedback was highly valued and used to improve the prototype. It also made it possible to estimate what needs were more important than others, if the same problems and needs were presented several times from different persons. This iterative process with improved prototypes and close contact to the target group was important when developing a chair that fulfils the user needs.

What could have been performed differently to improve the result of the user tests further is to perform these with a larger number of people. An addition to this would also be to test the prototypes with primary users. Secondary users were used in this process due to safety issues with the prototypes. No interviews and tests with the target group at hospitals, which was the third proposed environment of usage for this chair, was performed. The needs differ slightly in different environments, why this would have been useful. Limited time is the reason why this was not performed. The questionnaires used for evaluation could have been developed further to be more concise and therefore easier for the respondents to complete. However, the triangulation of the methods used in this process fulfilled the purpose and offered sufficient information and data about the target group, needs and the prototypes.

4.2 Comparison with other chairs on the market

As stated in the result, there are a numerous amount of shower chairs on the market with different appearance and functions, from the simplest stool to advanced chairs for assisted showers. This chair should be used by a single user, but also allow for assisted shower in those cases it is needed. Therefore, it cannot be too advanced.

One of the main advantages of this chair when compared to similar chairs on the market is the way the rotation function works. Focus has been on developing a chair that the user can feel safe using. As soon as the user lets go of the lever for rotation, the chair locks itself, which is different to how many other investigated chairs work. The chairs investigated in the market research often allow the seat of the chair to rotate even though the user has released the lever. The chair will then rotate until it reaches a locking position, which often is at only four places in a full turn, every 90 degrees. This can be unsafe and dangerous for the user since it is difficult to know whether or not the rotation is locked. If the chair rotates without intention from the user when entering or raising the chair, the risk of falling is increased. The rotation function of the chair in this project will never rotate unless the user is holding the lever and actively wants to rotate to ensure stability and safety. The levers of this chair are also placed in the field of vision, at the front of the seat to make it easy for the user to see and use them. Many other chairs on the market have levers for rotation that are placed further back, or under the seat, which makes them less accessible. In many cases, the rotation is manoeuvred by pressing the levers downwards, or pulling a pin outward. The rotation of this chair is manoeuvred by pulling the levers upwards, which was preferred by all users after performing a user test. To summarize, the rotation of this chair is safer and easier to use than many other chairs on the market.

Another main advantage and difference with this chair compared to other similar chairs on the market are the armrests. Usually on this type of shower chair, the armrests are short and low. According to interviewed personnel within homecare, the armrests does not offer the stability and support that the users need when sitting down and raising from the chair. The shape of them is also different compared to many other on the market. Focus has been on developing ergonomic armrests that offer support and are comfortable to hold and grip, while many other chairs have thin armrests with a circular cross-section. The length also differs a lot, and this chair stands out on the market by offering long armrests that the user easily can reach and hold on to, to feel safe. With the target group in mind and the goal to increase their independence, and the increasing importance of dementia friendly products, long and stable armrests are important.

4.3 Identified needs and functions

The identified needs were evaluated throughout the whole development process by using interviews and user tests, and also by using the need- and function puzzles.

Some words are used both in the need- and function puzzle, for example ‘folding armrest’ and ‘removable armrest’. In one case it was seen as a specific need and in the other case it was seen as a solution or function to that specific need. Earlier in the process, the needs were treated more generally, while in the puzzles, the needs were more specified since the solutions needed to be evaluated and the participants’ thoughts and opinions about them could be discussed.

The result from the need puzzle shows that the two most important needs are that the chair is stable and that the seat height is adjustable. To be able to adjust the height, there must be a function providing that. However, none of the respondents considered that as one of the most important functions of the chair in the function puzzle. Likewise, none thought that it was an important need that the chair could also be used a stool. But in the function puzzle, the top three functions are that the chair should be able to remove armrests and backrest, i.e. be transformed to a stool. Another thing that affects the result of the puzzles are that some people only did the need puzzle and some only the function puzzle. That might be one reason to why it is hard to find a correlation between the most important needs and functions. From the interviews it is known that the more individual adjustments the better, and removable backrest and armrest increase the possibility to adjust to the current circumstances. The puzzles could be used to confirm these needs in combination with the information from the pre-study.

In the need puzzle folding armrests were considered as top five needs and in the function puzzle as a top three function, hence it is important that the chair has this function to fulfil the need. The needs ‘folding armrest’, ‘high comfort’ and ‘easy to reach’ are seen as equally important according to the respondents. Those are the same needs as identified in the pre-study phase. However, these needs got about the same votes as many other needs in the puzzle. The respondents’ opinions varied and therefore it would be good to further investigate these needs to be able to draw conclusions about it. Though, in combination with the interviews performed in the pre-study phase, it is seen that those needs are indeed important.

On the contrary, none voted for ‘multifunctional, use over toilet’, and ‘multifunctional, use as walking aid’ as important needs. It was not something that was seen as a need in the pre-study phase either. The target group is pretty mobile and independent. They may need help with certain things, but they do not need to be pushed around in the chair, i.e. no wheels are needed. They simply need a stable chair that they can sit on when they

shower. The result from the puzzles, together with the interviews, confirms that it is unnecessary for the chair to be multifunctional in that sense.

Generally, the statistics from the puzzles would have been more accurate if there were more participants, hence better conclusions could have been drawn, and the identified needs from the pre-study phase could be evaluated further. Though, the needs were also evaluated by handing out questionnaires and shorter interviews throughout the user tests. One possible reason to why it is so varying answers for the puzzles is because all the participating occupational therapists have different background and experiences, which make them likely to have different opinions. Another possible reason is because of the different circumstances while performing the puzzles. Some had seen and tried one of the prototypes before doing the puzzle, some had not, which can have affected them. Further, the instructions and presence of help during the performance of the puzzle was not the same for everyone. It would have been good to let all participate under the same circumstances.

The identified needs from the pre-study phase could be confirmed and evaluated with the help of interviews, user tests, questionnaires and the need and function puzzle. It is important that the chair is stable, comfortable, increases the ability to reach things, that it has a nice home-like appearance that is not intimidating and that it is adjustable. And the most important of them all - that it increases the user's independence.

4.4 The resulting functions of the chair

4.4.1 Armrest

Many different types and shapes of armrests have been investigated during the development process. The final user test showed a positive result to the final armrests, and the result showed that the left of the two was preferred. Therefore, the left armrest is the one that should be used to be developed further in the next iteration. A specific part of the armrest that could be developed further is the gripping area in the front. It follows the palm nicely, and is comfortable, but it could be made even better and offer more grip. The width of the armrest gives room for resting the arm on it, which is why the rear of it is wider than the front.

The armrest on this shower chair are longer than on most chairs (MacCormick, & Sanders, 1993). The egress from the chair is an unstable movement, and the long armrests that go further out from the seat enables the user to have contact with the chair during the entire movement, which was tested and confirmed during the user tests. On

the contrary, the armrest cannot be too long. In that case, the person might misadjust the position of the front edge of the seat (J.M. Holden *et al*, 1988). However, positive feedback was given on the length of the armrests in the user tests, both while sitting down and rising from the chair. Though, it has to be considered that the armrests were not stable enough in any of the prototypes to completely carry a person's weight. This means that the result cannot guarantee that the same feedback would have been given if the armrests in the prototype would have been able to support the entire body weight in the test.

The possibility to fold up and down the armrest, as well as move them sideways, was appreciated by the users in the final user test. Further, the fact that the armrests do not have to be unlocked to be upfolded is good, the simpler to use, the better. Reducing the number of levers and additional functions, makes the chair easier it is to use. Since the goal with this shower chair is to improve the users' independence, it is important that it is easy to use and reduce the cognitive load. However, the armrests' joints did not have the same stability as expected in the final product. It is expected that the chair should have armrests that are not wobbly, and still not too hard to move. They should be able to be folded back without falling down. When discussing this during the user tests, it was appreciated.

Once the armrest is upfolded, it was difficult for the users to reach it and fold it down again since it is positioned behind them. The users will not always be agile enough to reach, therefore a solution could be to offer some kind of strap or handle at the middle of the armrest, on the underside. An earlier prototype, prototype B, with metal armrests, see Figure 3.8, had armrests that when folded back, the lower ends of it formed a handle that could be gripped due to that part of the armrest not being folded as far back. That shape of the armrest was not implemented in the later prototype due to the need of having more space for the legs was stronger. A solution to use a soft handle on the underside of the armrests that protrude, and is visible for the user, without having to turn the torso, could be useful. It does not demand as much physical effort as without. Though, it has to be soft to not be in the way, for example when moving the leg sideways, it must give space and fold away. This is a solution as can be further investigated in the next step of the development.

Adjusting the armrests sideways should only be performed by an occupational therapist or caregiver, the users themselves should not make this adjustment. The joint of the armrests must be stable, and the solution that is used on Arjo's product Alenti has some resistance when folding up and down and could be used on this chair. That is also an easy way of removing and attaching the armrests, since it is a slot that the armrest is attached to and rotates in. However, this folding mechanics have only been tested on Arjo's product Alenti, so the conclusion that this type of joint would be good to use on

this shower chair are drawn from tests performed on Alenti. The proposition of how the mechanism for adjusting the armrests sideways does not exist on Alenti and has not been tested on the developed shower chair, only implemented in the prototype in SolidWorks. The solution might enable the user to move the armrests sideways by mistake, for example when folding them up and by mistake push those outwards. This solution therefore has to be investigated further to make sure it easy for an occupational therapist to adjust and at the same time minimize the risk that the user changes something by mistake. As a next step, a prototype of this feature should be built and tested before any conclusions can be drawn.

The possibility to move the armrest sideways is a function that most users liked, but during the user test it was discussed whether there actually was a need for it. It might be better to produce an additional version of the chair that is wider in itself, for larger people and with a higher safe working load. Though, on the other hand it is still a need to move the armrests closer to the user when seated if there is a smaller person.

The armrests in the final prototype did not use much space behind the chair in an upfolded position, thanks to the point of rotation. This is good since it usually is a lack of space in the shower according to all interviewed occupational therapists. However, the problematic is that they take space from the outer sides of the seat. This space could otherwise be good to use for extra accessories like the basket for soap and shampoo.

The ability to adjust the height of the armrests has been discussed throughout the development process. Some users in the user test wanted another height of the armrests when seated, but the height was never commented on, or a problem, when rising or seating. The possibility to adjust the chair and customize it to the user is important, but when it comes to altering the height of the armrest, the importance of them being stable is greater according to needs shown in the result. From user tests and interviews with occupational therapists, there didn't seem like adjusting the height of the armrest was that important, since there is a possibility to alter the chair height. As long as they are not too low or too high to give support for sitting and rising, the stability of them is more important.

4.4.2 Seat

The chair should feel safe to use, and by letting the seat be angled 5° backwards, the user is less likely to slip off the seat (caregiver, interview, Vallås retirement home, March 19, 2019). However, an angle backwards also makes the user sit down in a lower position which consequently makes it harder to raise up. Since raising up can be a

problem for the target group the angle backward must not be too big. The angle also make is possible for water to drain.

The curvature of the seat for the final prototype is flat, the real seat should have a slight curvature. This made it impossible to investigate whether the curvature of the seat and the angle of 5° backwards would feel comfortable. The real curvature is not shown in the physical prototypes, only in the rendered version. The idea of the soft curvatures in the front of the seat is to minimise high pressure points on the hamstrings and hence be more comfortable and ergonomic.

This shower chair should not have an opening in the front of the seat that many other shower chairs have. The intention of this feature is to make it easier to reach and shower the inside of the thighs, but according to interviewed occupational therapists and caregivers, the hole often makes more harm than good. It is easy for the users to get stuck with their leg, and since one of the most important needs are that the chair should be comfortable, that feature should not be implemented.

The seat is removable to make it easier to clean under it, for example easier to clean the rotation mechanism and keep the chair hygienic. This enable the person to not bend down, or sit on the floor, while cleaning that area or to have to flip the chair upside down (caregiver, interview, Vallås retirement home, March 19, 2019). This should increase the possibility to work in a more ergonomic position. Further the seat is fixed into the body of the chair in the rear, so that the seat can be flipped up from the front towards the backrest without being completely removed. This will hopefully make it easy to put the seat back on the correct position. To be sure about this, the construction has to be built physically and then investigated. The possibility to remove the seat was not discussed during the final user test. But since the same function is used at Carino, one opportunity to evaluate this function could be to ask users of Carino what they think about the solution.

4.4.3 Rotation of seat

By having a possibility to rotate the seat, it increases the users' independence since they can more easily reach things in the shower without having to raise up, bend or be in an uncomfortable position. It is also useful for the caregiver in the case of an assisted shower, since it makes it easier to reach and help. Movement from and to the chair also gets safer, since it is possible to rotate the chair to the direction with more space to make the transfer easier.

It is possible to rotate the chair 360° and stop at any angle. Whenever the user lets go of the lever, the chair locks itself, to make the usage safe. The chair should only rotate when the user intends to and never by mistake, to be stable and safe. It should not be possible to forget whether the rotation is active or not. However, the way this chair works means that the user might stop the rotation in a position where one of the legs of the chair is in the way. It could potentially increase the risk of falling or tripping. Another solution could be to only lock the rotation in the “safe” angles, i.e. four places in one turn. Though, that reduces the options of the rotation.

The shape of the levers could be developed further to signalize that they should be pulled upwards and signalize what they should be used for. A larger lever that better allow the user to lift it with all fingers could be good, so it lies better in the hand. Even though no user in the user tests tried to unlock the chair by pressing the levers downwards, it could be good to include a symbol that show the direction upwards. The colour of the levers should also have more contrast towards the rest of the chair than what it is in the rendered photos, to make them more visible and easier to see. The slight tilt downwards of the levers made it more intuitive for the user to pull them upwards to unlock the rotation.

Since strength decreases by age, it is important that there isn't a lot of force needed to unlock the rotation. The grip strength decreases on an average about 30% when going from 20-30 to 70-80 years according to Pheasant and Haslegrave (2006: 149). A lever used with a pushing action can be handled in many different ways, for example with the palm or the fingers, and is easy to manoeuvre without using much force (Pheasant & Haslegrave, 2006:154). It was discussed whether to push the levers downwards or pull them upwards, and even though less force is needed to push them downwards, all users intuitively tried to pull them upwards. Therefore, the decision was made to operate the rotation by pulling the levers upwards.

The function of removing one lever or moving one lever to another side could not be tested with the prototype, but the possibility to do that on the final product was appreciated. When one hand was used for rotating the seat, it was easy for almost every user to reach the lever. The problem appeared when two hands were used, one on each lever, since the user then had to lean forward and either access them inside or outside of the armrests. For a longer person that was not a problem, but for a shorter that was an uncomfortable position. Since it works perfectly fine to rotate the chair with only one handle, having two on the prototype was misleading for the users. Some thought that both handles had to be used. Therefore, it could be good to only attach one lever when installing the chair, to reduce the confusion, but that it is possible to move it from one side to another. By offering two levers, one on each side, it is easier for caregivers to rotate the chair during assisted showers, as well as easier for the users themselves to be

more flexible and use the most preferred hand in different situations. Due to different hand dominance between individuals, it is preferred to have a lever on each side, or the possibility to switch side of one lever (Pheasant & Haslegrave, 2006: 145).

Overall, the possibility to rotate the chair is an appreciated function that allow the user to be more independent and the ability to adapt and customize the chair is valuable.

4.4.4 Backrest

It is identified that the backrest should be removable. In homes there are often a lack of space in the shower and if the backrest is removed the shower chair take less space. Some people do not really need a backrest, or the wall can be used as a backrest instead, according to occupational therapists (interview, April 16, 2019). For this reason, this feature can be considered as important and something the chair shall have. It increases the adjustability, which is an important need found during the pre-study.

The results from the questionnaire in the final user tests showed that there were different opinions about shape of the cross section of the fixation to the body area of the backrest. There were both people who fully disagreed and fully agreed that the shape of the cross section guided the person to put the backrest in the correct position. The backrest fastened with help of a hole and a button and a majority were positive or neutral to the the feature. It is hard to know if something is easy to do or not while only seeing an image of a function. To really understand if the shape and fixation is good it would be good to physically try it. In addition, it would be good to be able to compare with another chair that has a removable backrest to see if this one is better or worse.

On the final user tests some participants stated that the backrest, both the size and the angle, felt good while sitting in a straight position. When sitting in a round-shouldered position the sharp edges of the flat backrest felt uncomfortable. The sharp edges create small pressure points and hence higher pressure on a small area of the back. This is probably the reason to why it felt uncomfortable. The rendered prototype from SolidWorks has a rounder curvature that should better distribute the pressure and therefore be more comfortable and ergonomic to use. The chosen curvature is a result from investigations of designing guidelines of chairs (MacCormick, & Sanders, 1993) and from trying different chairs. A flat backrest does not follow the shape of the back, but if the curvature is too big it will not fit larger people. A small curvature follows the back and enclose the person sitting in the chair and should be comfortable. This is strengthened by the fact that many chairs have this feature.

The handle on the back of the backrest was added to make it easier to grip the chair while lifting it. There are no results from any user tests or feedback to this design since the physical prototype did not have this grip, and there was no question about this in the questionnaire used at the final user tests.

4.4.5 Adjustable chair height

There are several possible ways to adjust the height of a chair. What is of great importance is that it should be easy to adjust, without being possible to change height by mistake. Since the height should only be adjusted once, and that is performed by an occupational therapist, their opinions were important in the decision. Using a telescopic function on the legs to adjust the height is a common and simple feature used on many shower chairs. It doesn't take up additional space on the chair and can be altered without needing extra tools. Another positive aspect of this way of adjusting the chair height is that it is easy to assemble/disassemble the chair. By removing the legs, the chair takes less space and can fit the opening of a small shower cubicle. The possibility to remove the legs is a useful feature in those cases, where there is little space. It can then be assembled inside the cubicle.

A telescopic function of the legs causes the surfaces of the legs slide against each other and the material has to be durable to withstand tearing. Aluminium is a light material that is stainless and is used in many shower chairs of this type. It could be a good choice, as long as it is hard and weight bearing enough to not make the chair feel wobbly. Stainless steel would make the chair feel more stable and robust, but it is a lot heavier and more expensive.

The decision to use a button and holes on the legs to alter the height was taken after interviewing several occupational therapists. They are used to that mechanism, and they stated that it is easy to use and does not require any tools, which is important. Though, it is important that this mechanism is constructed so that there is not a gap where the sliding surfaces meet. Otherwise, the chair could feel unstable or wobbly. The stability must be prioritised. Screwing the two parts of the leg together could seem more stable, but loose parts such as a screw easily get lost, and it takes more time to assemble than the proposed solution. It should be quick and easy and demanding little physical and cognitive effort to assemble and use the chair. The majority of the occupational therapists preferred using the solution with a button and holes.

Since stability is one of the most important needs of the target group, and bathroom floors are uneven and sloping, the chair has to be able to adjust for the tilt. This need is emphasized in all interviews and user tests. The feet of the chair can compensate the tilt

to some extent, since they allow the chair to have all feet in contact with the floor due to them being able to rotate around a ball joint. But that might not be enough when the slope of the floor is too steep. It was discussed whether or not one of the legs should have a possibility for finer adjustment of the height to compensate for the tilt. The presented solution was to screw one leg to adjust the height, but an easier and more stable solution could be to reduce the distance between the existing holes in the legs and just raise or lower one leg to get the same effect. It makes the chair easier to assemble and easier to clean since additional features are removed. Though, as shown in the result, it was stated that if the chair is moved slightly, the effect of adjusting one leg to alter for the tilt is removed since not all four legs will be in contact with the floor. In order for this finer adjustment to work, the chair has to be set in one place. By having a smaller distance between the ordinary holes, it gives the user the option to have different heights on one or several legs, without having to add extra features on the chair.

The cross-section of the legs hinders the legs from rotating when adjusting the height and forces the button to always align the holes. It makes it easier to adjust the height compared to a round cross-section. The asymmetrical cross-section makes it easy to see how the legs should be assembled, they can only fit one way, and therefore it is not possible to assemble it incorrectly.

Hygiene is an important aspect, and where the holes in the legs cause some problems. They allow water and dirt to enter the legs and once it is there, it can be difficult to remove. The legs are hollow and can be disassembled to be cleaned properly, and a hole at the bottom of the legs allow for water drainage.

4.4.6 Chair accessories

4.4.6.1 Shampoo and soap basket

It can be difficult to reach the shampoo and soap when sitting in a shower chair. It is a need to more easily access these things in order to be more independent. If these things are within reach, the users do not have to raise from the chair to reach. The floor is wet slippery, why the user should not have to stand up more than definitely necessary to reduce the risks of falling. (Berglöf, et al., 2005; Rubenstein, et al., 2005)

The results from the final user tests show that 80 % were positive to have a basket and also thought it was not in the way. However, the basket was fixed onto the armrest, see Figure 3.27. This position is not possible if the armrest should be able to fold up and down. The position of it needs to be further investigated. Also, there were suggestions about the basket to be able to put on more than one place on the chair and also to be

able to hang it somewhere in the environment. These features need to be built, tested and preferably in different shower environments.

4.4.6.2 Padding

The final user test showed that 90 % were positive to have an extra soft padding that can be added to the seat. A soft seat will make the chair more comfortable and distribute the pressure better compared to a hard seat which are important aspects to make the chair more dementia friendly (Bodil Åkesson, interview, January 23, 2019). Though, the results also showed that some respondents thought that the seat itself should be soft, instead of using optional padding. Soft materials tend to easier get a scratch or break and a scratch can lead to unwanted growth of bacteria. If a removable padding is used instead of having a seat that is soft in itself, the padding can easily be exchanged if it gets a scratch or breaks. It is an easy solution compared to having to change the entire seat. (Emma Johansson, personal communication, March 20, 2019)

Due to different needs of the users, it should be possible to choose between paddings with different softness. Another important aspect is that people using shower chairs dislike the chair if it feels cold. Hence, the padding should not be cold and easy to warm up with water to achieve the best positive experience for the user as possible. Offering a comfortable chair is important and one of the most important needs of the user group.

4.4.7 Foot support

A majority thought the foot support would be difficult to use and not useful for the target group. The occupational therapists mentioned the problematics with bending the hip more than 90° if the user has performed a hip replacement, which is common in the target group. This solution demands the user to be quite agile, and if they manage to use this foot support, they probably would be able to reach their feet anyways. Further, a foot support can be a safety issue, they can be easy to trip on if not removed while not using it. Also, as the result stated, a good construction for this feature can be difficult to create. All this resulted in the conclusion to not have a foot support.

Even though this solution is not useful for the user of the chair, it could be helpful for an assistant during assisted showers since the caregiver does not have to bend as much to reach. However, it was discussed whether it would be enough using a small stool to put the feet on instead, which probably would be easier. Another suggestion for the user to easier reach the feet on their own is to have a long brush to easier wash the feet.

There is a need to easier reach the shins and feet, but this kind of foot support on the chair is not the solution.

4.4.8 Wheel

A conclusion was drawn already in the result after performing interviews that there is no need for the chair to have wheels. The conclusion is based on information gathered in the pre-study, where none of the interviewees saw the need for using wheels on this type of shower chair, with this target group. The targeted user group are mobile enough to walk on their own, and therefore there is no need for them to be pushed around in their shower chair. As seen in the need- and function puzzle, none of the respondents saw the need for the chair to be multifunctional, which otherwise could have been one purpose to use wheels. However, the needs in hospitals has not been investigated, and there may be some differences in that result, if the chair should often be moved from one room or place to another.

Further, there is a need for the shower chair to be stable. Using wheels can affect the stability and safety, for example if the user forgets to lock the wheels when sitting down or raising from the chair. As stated in the result, some users likes to use their shower chair by the basin, but moving it between the shower and the basin by wheel has not been found to be a big enough need, greater than the need for stability. Since the users are quite mobile, they do not often move their shower chairs between different rooms, why wheels are unnecessary. This is a conclusion based on the needs in homes and retirement homes in Sweden, different countries might have other needs.

4.4.9 Commode chair

The advantage of having a commode hole is that the chair would be more multifunctional. Though, the need and function puzzle show that none of the respondents thought that there was a need for a multifunctional chair.

The same discussion follows as for whether or not the chair should have wheels. The target group are mobile and after interviewing several caregivers, occupational therapists and users, there is no definite need for the chair to be used as a commode chair. The advantages are that it could be easier for the users to lather the body since there are less seat area blocking. But at the same time, the disadvantages are that it can easily be uncomfortable to sit on a chair with a hole in the seat. A small variation in body size may cause a huge discomfort. Since comfort is of great importance in this project, a commode hole will not be used. It has not been found as a need for the target group and the intended usage.

The decision to not use a commode hole is backed up by the importance of adapt the chair to users with dementia. A hole in the seat can look scary and intimidating and look

unfamiliar to a person with dementia, which is the complete opposite of how the chair should be perceived. (Bodil Åkesson, interview, January 23, 2019)

However, the need might be different in other parts of the world than Sweden. Hence, this need can be further investigated for other countries.

4.4.10 Dementia adaptation

The colours of the chair become more important as vision and cognitive ability decreases. For users with dementia, it is of extra importance to make the chair and its different parts more visible by using colours with high contrast. The grey colour of the chair was chosen to be discreet and fit into a user's home, without dragging attention to it. The blue accent colour of the gripping areas of the armrests and rotation levers increases the visibility and makes it easier for the user to find them. The blue colour is used to signalize that the user should interact with these parts. However, the contrast could be increased to make the visibility even better and improve the cognitive ergonomics.

According to the performed interviews with users, occupational therapists and caregivers, a home-like design of medical aids gets increasingly important. The fact that the chair looks like a chair and has discrete colours is good, but in the care of dementia patients, the colours do not have to be as discreet. In fact, it could be useful to use more vivid and bright colours to make the chair contrast better towards its environment (Bodil Åkesson, interview, 23 January 2019). The chair does not look intimidating, it looks like an ordinary chair, which is important in dementia care.

Since this chair should be used in both home environment, hospitals and at elderly care facilities, it could be a possibility to offer the same chair with two different colours. One more discrete colour-scheme, like the rendered images, to be used in home environment, and another colour-scheme to be used where the need for higher contrast between the chair and its environment is more important, such in dementia care. This could for example be done by adding colour to the seat and backrest. That makes the chair more inviting and contrasting to the often light background in a shower. A contrasting colour on the armrests and the levers should also be used.

4.5 Contribution of knowledge

This thesis has contributed to a better knowledge about the customer and user needs of the target group for Arjo. Also, how the shower chair can be developed to fulfill these needs. For the academi and for the target group, the elderly, it has contributed to a knowledge about how the elderly with this solution can remain their independence in the context of shower.

The next step in this project would be to do further iterations in the development of the chair to get more detailed functions. Moreover, see if the needs in an hospital environment are different compared to homes and at retirement home.

5 Conclusion

The aim with the project was to develop a concept for a new shower chair for mobile elderly that wants to remain independent, in collaboration with Arjo. It should enable the users to more safely and comfortably perform hygiene activities on their own. The aim of the project has been fulfilled by answering which the most important needs for the target group and functions for the chair are. Also, by suggesting how the chair should be designed to promote an ergonomic use.

The most important needs that must be fulfilled are that the chair should be stable, comfortable and possible to adjust for each individual. By providing solutions for these needs, the user can be more independent and safer during their shower.

The most important functions provided as solutions to these needs are that the chair offer possibilities to be adjusted after each individual user, but also adjust to the environment it is used in, for example by having adjustable and removable parts. By offering a possibility to rotate the chair, it enables the user to be more active and independent during the showers and makes the transfers safer. It also improves the ergonomic aspect for the caregiver during an assisted shower. Since comfort is highly valued, a soft padding should be optional to use on the chair.

To promote an ergonomic way of use, the dimensions of the chair was developed with anthropometric data in mind. This in combination with the adjustability of the chair, it offers an ergonomic way of use for both the user and caregiver during assistance.

In conclusion, there is no single function that is the most important. It is the combination of all functions, that fulfil the needs and makes the chair ergonomic to use and increases the user's highly valued independence.

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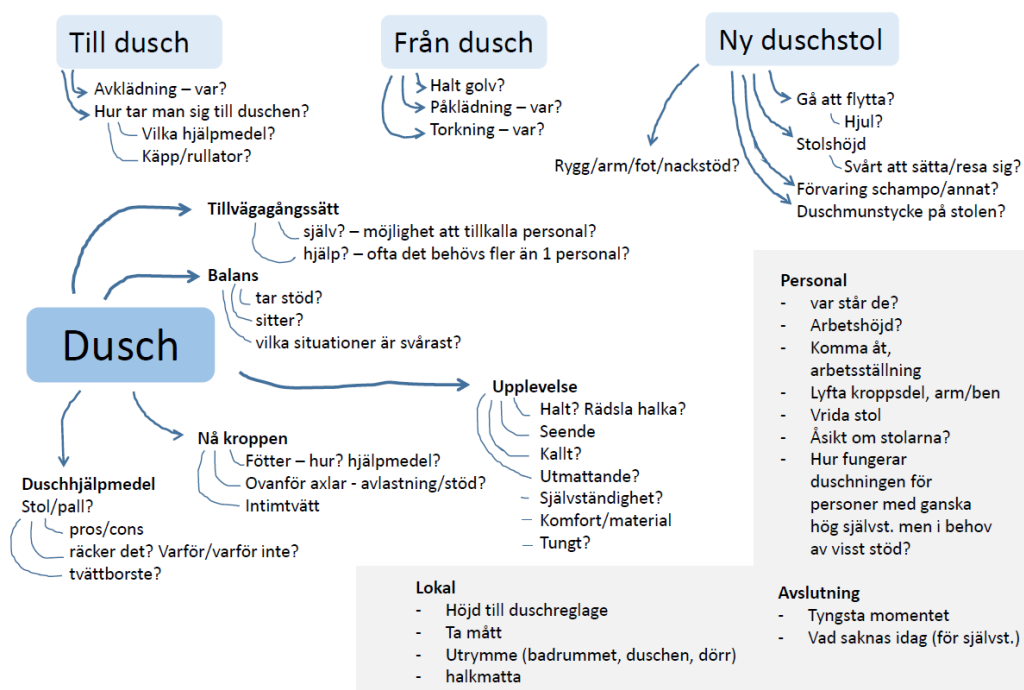
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Appendix A - Interview mind map



Appendix B - Need and Function puzzle

1. Vilka behov anser du är viktigast att stolen uppfyller?
 - Ta de rosa lapparna.
 - Välj ut de 5 behov du anser är viktigast samt 5 behov du anser är minst viktigast.
 - Ranka dessa behov genom att lägga dem på de numrerade papperna.
 - Plats 1 är det viktigaste behovet och plats 14 är minst viktig.
 - Visa resultatet.

Ord som användes till pusslet:

Stabil	Lättare att nå saker i duschen
Individanpassa sitshöjd	Lätt att rengöra
Uppfällbara armstöd	Hemma-lik design
Avtagbara armstöd	Se ut som en möbel inte ett hjälpmedel
Hög komfort	Lättare att nå fötterna
Stötdämpande sits	Multifunktionell → använda vid toalettbesök
Möjlighet att använda både som stol och pall	Multifunktionell → kunna använda stol som gåhjälpmedel
Enkel att förflytta mellan olika platser	

2. Vilka funktioner anser du är viktigast att stolen har?

- Ta de gula lapparna.
- Välj ut de 3 funktioner du anser är viktigast samt 3 funktioner du anser är minst viktigast.
- Ranka dessa funktioner genom att lägga dem på de numrerade papperna.
 - Plats 1 är det viktigaste behovet och plats 10 är minst viktig.
- Visa resultatet.

Ord som användes till pusslet:

Avtagbart ryggstöd	Mjuk sits
Avtagbara armstöd	Höj/sänkbart fotstöd
Uppfällbara armstöd	Mjukt ryggstöd
Möjlighet att enkelt höja/sänka stol inför varje användning	Kommodhåll
Rotera sits	Mjuka armstöd

Appendix C - Questionnaire 1 for user tests

Duschstol för ökad självständighet

Hej!

Vi heter Malin Lindström och Cornelia Sjöberg och studerar civilingenjör i medicin och teknik på Lunds Tekniska Högskola. Under våren gör vi vårt examensarbete på Arjo i Malmö där vi utvecklar en duschstol för ökad självständighet. För att kunna utveckla en duschstol som är så användarvänlig som möjligt och som uppfyller rätt behov behöver vi din hjälp!

Svaren från denna enkät kommer användas för utveckling av prototyperna och sammanfattas anonymt i vår rapport.

Malin Lindström: malin.lindstrom@arjo.com

Cornelia Sjöberg: cornelia.sjoberg@arjo.com

Målgrupp och syfte med duschstolen

Stolen vänder sig till personer som rör sig med hjälp av käpp eller rullator. Dessa användare kan behöva sitta ned när de duschar för att de inte orkar stå upp eller för att de inte har balansen till det.

Syftet med stolen är att öka självständigheten och minska behovet av assistans hos dessa användare. Vid behov av assistans ska stolen underlätta för både vårdtagare och vårdgivare. Stolen bör fungera i flera olika miljöer; hem, äldreboenden och sjukhus.

Behov- och funktionspussel

1. Vilka behov anser du är viktigast att stolen uppfyller?

- Ta de rosa lapparna.
- Välj ut de 5 behov du anser är viktigast samt 5 behov du anser är minst viktigast.
- Ranka dessa behov genom att lägga dem framför dig.
 - Plats 1 är det viktigaste behovet och plats 14 är minst viktig.
- Visa resultatet.

2. Vilka funktioner anser du är viktigast att stolen har?

- Ta de gula lapparna.
- Välj ut de 3 funktioner du anser är viktigast samt 3 funktioner du anser är minst viktigast.
- Ranka dessa funktioner genom att lägga ut dem framför dig.
 - Plats 1 är det viktigaste behovet och plats 10 är minst viktig.
- Visa resultatet.

Användartest av prototyp

Vi vill att du utforskar stolen och dess funktioner och gärna högt berättar dina tankar och reflektioner, positiva som negativa. Tänk att du är i en normal dusch-situation och ska använda denna nya duschstol för första gången.

Frågor om stolsprototypen

Om respondenten

1. Vad är ditt kön?

- kvinna
- man
- annat alternativ

2. Vad är din ålder?

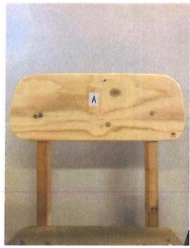
..... år

3. Vad är ditt yrke?

.....

Om ryggstöd

1. Ringa in det ryggstöd du föredrar med avseende på komfort och utrymme för att nå ryggen.



a)



b)



c)

Kommentar:

.....

.....

Om spärren för att vrida stolen

Ringa in det/de alternativ du tycker stämmer bäst överens med påståendet.

1. Jag tycker att spärrarna för vridfunktionen på stolen är...

- a) lätta att förstå hur de fungerar
- b) svåra att förstå hur de fungerar
- c) lätta att se/hitta
- d) svåra att se/hitta

Kommentar:
.....
.....

3. Hur föredrar du att använda spärrarna för vridfunktionen?

- a) jag föredrar att trycka dem neråt
- b) jag hade föredragit att dra dem uppåt
- c) jag hade föredragit att dra dem framåt/bakåt
- d) eget förslag:

Kommentar:
.....
.....

4. Jag tycker att placeringen av spärrarna för vridfunktionen är...

- a) bra placerad
- b) för långt fram
- c) för långt bak
- d) för långt bort från kroppen
- e) för nära kroppen
- f) för högt upp
- g) för långt ner

Kommentar:
.....
.....

5. Föredrar du en eller två spärrar på sidorna av stolen för att använda vridfunktionen?

- a) två spärrar, en på var sida
- b) en spärr på vänster sida
- c) en spärr på höger sida
- d) Annat:

Kommentar:
.....
.....

Om armstöd

Ringa in det påstående som stämmer överens med din upplevelse av armstöden av frigolit/cellplast.

1. Jag tycker att armstöden är placerade ... för att ge mig tillräckligt stöd.

- a) med lagom avstånd mellan varandra
- b) med för litet avstånd mellan varandra
- c) med för stort avstånd mellan varandra
- d) lagom högt
- e) för högt
- f) för lågt

Kommentar:
.....
.....

2. Jag tycker att armstödens placering och form ger tillräckligt utrymme att nå kroppen/benen/röra överkroppen/armar.

- a. ja
- b. nej

Kommentar:
.....
.....

Testa de olika armstödsformerna (lila prototyper, markerade A-H). Ringa in den som stämmer bäst överens med frågorna.

3. Vilket armstöd tycker du var mest greppvänligt?

A B C D E F G H

4. Vilket armstöd tycker du har finast form?

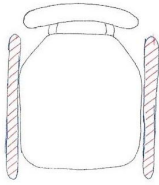
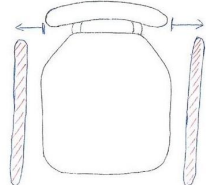
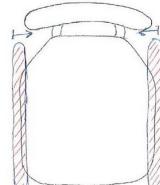
A B C D E F G H

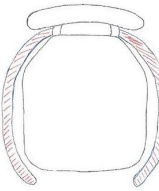
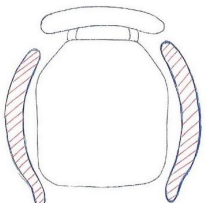
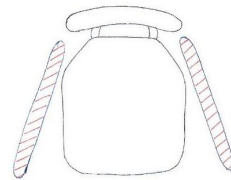
5. Vilket armstöd gav bäst stöd?

A B C D E F G H

Nedan visas exempel på olika placeringar och former på armstöd. Ringa in dem du föredrar (valfritt antal) och kommentera gärna varför.

- Annan idé på form/placering? Rita ut det på den tomma stolsitsen längst ned!

		
<p>Bild A) Armstöd placerade som på prototypen</p>	<p>Bild B) Armstöd placerade längre ut från sitsen jämfört med prototypen</p>	<p>Bild C) Armstöd placerade närmare sitsen jämför med prototypen</p>

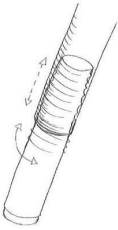
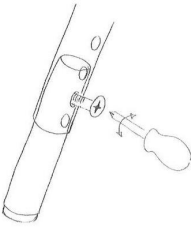
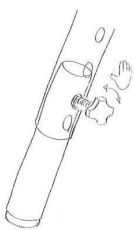
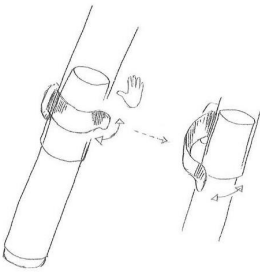
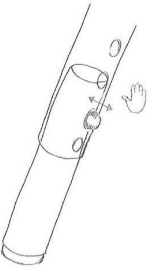
		
<p>Bild D) Armstöd som är rundade. (Ger större utrymme för kroppen)</p>	<p>Bild E) Armstöd som är rundade men rakare fram (Jämfört med bild D så blir greppet annorlunda)</p>	<p>Bild F) Utsvängda armstöd för att ge större utrymme för kroppen.</p>


<p>Fyll gärna i dina egna förslag på armstödens form/placering!</p>

Om att justera stolshöjd

Nedan visas exempel på justering av stolsbenen för att ställa in stolens höjd.

1. Ringa in det exempel du föredrar att använda för att reglera stolens höjd, kommentera gärna varför.

		
<p>A) Gängor, skruva benet för att ändra höjd steglöst.</p>	<p>B) Använd skruvmejsel för att ändra höjd</p>	<p>C) Skruv i form av en ratt, vrid skruven med handen</p>
		
<p>D Spänne som spänner åt runt benet och ändrar höjd steglöst.</p>	<p>E) Ändra höjd genom att trycka in pigg med handen (som på kryckor).</p>	

Kommentar:

.....

.....

.....

Appendix D - Situation in the final user test

Beskrivning av användartest: STOL

Situation

Du är pensionär och har fått lite krämpor den senaste tiden. Din kropp är inte lika smidig som den varit och du har börjat använda rollator eftersom du behöver mer stöd.

Det gäller även i duschen, där du känner dig otrygg i den hala miljön. Därför har du fått en duschstol och ska nu använda den för första gången.

Gå fram till duschstolen och sätt dig ner. Vrid sitsen för att nå duschmunstycket. Ta duschmunstycket och låtsas att du duschar. Tvätta hela kroppen, använd tvål och glöm inte att tvåla in håret och fötterna. Utforska duschstolens funktioner. Res dig när du är klar.

Tänk gärna högt under hela scenariot! Alla tankar är värdefulla för oss!

Beskrivning av användartest: BENSTÖD

Situation

Du är pensionär och har känt att du fått fler krämpor senaste tiden. Din kropp är inte lika smidig som den varit och du har börjat använda rollator eftersom du behöver lite mer stöd. Du har precis fått en duschstol och ska använda den för första gången.

Din duschstol har ett stöd för benet/foten och det är den funktionen du ska testa nu. Sätt dig bekvämt på plattan som har ett stöd monterat på sig. Testa hur det är att använda stödet när du ska tvåla in benen och fötterna.

Tänk gärna högt under hela scenariot! Alla tankar är värdefulla för oss!

Appendix E - Final questionnaire user tests

Hej!

Vi heter Malin Lindström och Cornelia Sjöberg och studerar civilingenjör i medicin och teknik på Lunds Tekniska Högskola. Under våren gör vi vårt examensarbete på Arjo i Malmö där vi utvecklar en duschstol för ökad självständighet. Vi är nu i slutskedet och behöver din hjälp för att utvärdera vår prototyp och dess funktioner.

Svaren från denna enkät kommer användas för utvärdering i vår rapport och presenteras i en anonym sammanställning.

Malin Lindström: malin.lindstrom@arjo.com

Cornelia Sjöberg: cornelia.sjoberg@arjo.com

Målgrupp och syfte

Stolen vänder sig till personer som rör sig med hjälp av käpp eller rullator. Dessa användare kan behöva sitta ned när de duschar på grund av minskad balans och ork.

Syftet med stolen är att öka självständigheten och minska behovet av assistans hos dessa användare. Vid behov av assistans ska stolen underlätta för både vårdtagare och vårdgivare.

Stolen bör fungera i flera olika miljöer; hem, äldreboenden och sjukhus.

Enkät

Om respondenten

1. Vad är ditt kön?

- kvinna
- man
- annat alternativ

2. Vad är din ålder?

..... år

3. Vad är ditt yrke?

.....

4. Vad har du för erfarenhet av duschstolar? Ex installerat i hem.

.....

5. Använde du overall under testet?

- Ja Nej

Generellt

1. Jag tror att jag skulle vilja använda den här stolen regelbundet.

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

2. Jag tycker att stolen är mer komplicerad än den behöver vara.

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

3. Jag tycker att stolen är lätt att använda.

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

4. Jag tycker att den här stolen är besvärlig att använda.

--	--	--	--	--

Håller inte alls med Håller helt med

5. Jag tycker att de olika funktionerna på stolen fungerar väl tillsammans.

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

6. Jag tycker det är onödigt mycket funktioner på stolen.

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

Specifikt

Armstöd



1. Jag tycker att armstöden ger mig tillräckligt med stöttning.

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

2. Jag tycker inte att armstöden ger mig tillräckligt bra stöd.

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

3. Jag tycker att armstöden ger tillräckligt med utrymme när jag duschar.

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

4. Jag tycker att armstöden hindrade mig i något moment när jag duschade.

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

5. Jag tycker det är bra att man kan välja mellan två lägen hur långt ut eller in från sitsen armstöden ska vara (se bild ovan).

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

6. Jag tycker att ett läge för hur nära sitsen som armstöden ska vara är tillräckligt.

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

7. Vilket armstöd föredrar du? Ringa in ditt svar.

Vänster

Höger

Kommentar:

Snurrfunktion



8. Jag tycker att det var enkelt att förstå hur man ska få stolen att snurra.

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

9. Jag tycker att det var onödigt svårt att få stolen att snurra.

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

10. Jag tycker att det är lätt att se och nå spakarna.

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

11. Jag tycker man fick sträcka sig onödigt mycket för att nå och se spakarna.

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

Avtagbart ryggstöd



12. jag tycker att det ser enkelt ut att ta på och av ryggstödet (se bilder).

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

13. Jag tycker att det är onödigt komplicerat att ta på och av ryggstödet (se bilder).

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

14. Jag tycker att formen på infästningen av ryggstödet vägleder mig att enkelt sätta fast ryggstödet (se bilder ovan).

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

15. Jag tycker inte att formen på infästningen av ryggstödet underlättar att enkelt sätta fast ryggstödet (se bilder ovan).

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

Ändra stolshöjd



16. Jag tycker att det är bra att man kan finjustera höjden på ett stolsben genom att skruva, för att stolen ska stå stabilare på ojämnt golv (se skiss).

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

17. Jag tycker att det är tillräckligt att man kan justera höjden separat på varje stolsben med hjälp av "kryck-funktion".

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

18. Jag tror att stolsbenens form vägleder och underlättar vid höjning/sänkning av stolen samt vid montering (se bild ovan, tvärsnitt på benet).

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

19. Jag tror inte att formen på benets tvärsnitt underlättar nämnvärt, ett runt tvärsnitt hade fungerat lika bra.

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

Stolstillbehör

20. Jag tycker att en avlastningsyta, t.ex. korgen på stolen, är användbar.

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

21. Jag tycker att en avlastningsyta på stolen är i vägen.

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

22. Jag tycker att det är bra att ha möjligheten att välja till mjukare padding till sits och/eller ryggstödet på stolen.

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

23. Jag tycker att stolen borde ha en sits och/eller ryggstöd som är mjuk, inte att man behöver mjuk dyna som tillbehör.

--	--	--	--	--

Håller inte alls med

Håller helt med

Kommentar:

Benstöd

24. Jag tror att benstödet skulle underlätta för målgruppen att tvätta sina fötter.

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

25. Jag tror att målgruppen har svårt att använda sig av ett sådant benstöd.

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

26. Jag tror att benstödet skulle underlätta för vårdpersonal att tvätta fötterna vid assistans.

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

27. Jag tror inte att benstödet minskar arbetsbelastningen för vårdpersonal vid assistans.

--	--	--	--	--

Håller inte alls med Håller helt med

Kommentar:

Övriga kommentarer till användartestet:

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