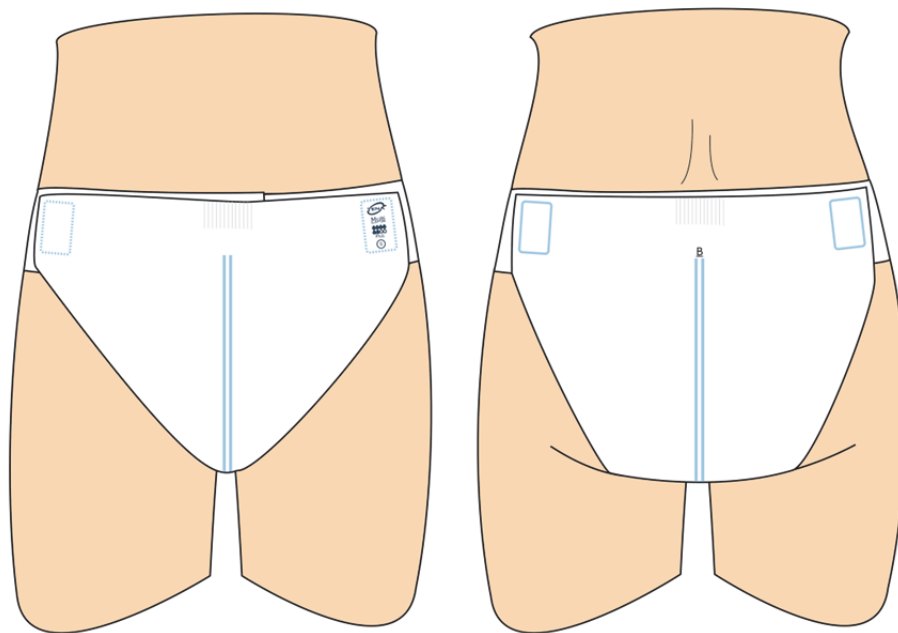


CHALMERS



Development of incontinence care products

- Product solutions generated from studies of extreme situations

*Master of Science Thesis in the Master Degree Programme Industrial
Design Engineering*

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CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden, 2012

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Cover:
Illustration of one of the developed concepts, generated from studies of the caregiver's interaction with incontinence care products in extreme situations.

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ABSTRACT

This Master's thesis was performed in collaboration with Svenska Cellulosa Aktiebolaget, SCA, in Gothenburg. The purpose was to use extreme situations to trigger new solutions within the incontinence care assortment. The purpose was further to evaluate the future potential of the developed concepts to find if they are beneficial for the normal use situation. The goals were to identify and evaluate the users' needs and requirements in each extreme situation, develop concepts that increase the functionality and usability in these situations and to present prototypes of technical solutions designed to fit the conditions of the extreme situations. Combinations of three situations and three products were chosen for the study and theoretical and empirical evaluations of the interaction were performed on care provided by a caregiver to a care taker. The three chosen situations comprised care provided in darkness, with one arm and to a heavy care taker.

The evaluation included usability tests where changes were performed on manikins. Through the tests the caregiver's needs and requirements within each situation were identified. Based on the result product concepts, focusing on the functionality and usability in the extreme situations, were generated. Two concepts were chosen for further development and usability tests were used to validate the developed solutions and to identify areas of possible improvement.

The final result is two separate product concepts, one two piece heavy incontinence protection which enables flexible application and a turn sheet aiding in the turning of the care taker. Based on the result it was concluded that the goal of increased usability and functionality was met through the development of the two concepts. Further it was possible to conclude that using extreme situations as a trigger has the possibility of generate new, interesting ideas with future potential for the normal situation.

Keywords: Incontinence, Usability, Extreme situation

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Gothenburg 28th of May 2012

Sophie Kanerva

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1. INTRODUCTION

This report presents the documentation of the Master's thesis "Development of incontinence care products – Product solutions generated from studies of extreme situations". The product development project has been performed in collaboration with Svenska Cellulosa Aktiebolaget, SCA, in Gothenburg as part of the master in Industrial design engineering at Chalmers university of technology.

1.1 BACKGROUND

Today SCAs' incontinence care assortment comprises a range of products spanning from small protections, used in normal underwear, to larger protections similar to babies' nappies. The products are available in a variety of sizes and they have different ways of being applied to the body as well as different capacity of absorption. The products are divided into four areas; Male Inco, Light Inco, Pants and Heavy Inco. In addition there is also a range of skincare and cleansing products to complement the protections in the care situation. The protections can be changed either by the bladder weak individual or by a caregiver, professional or relative, depending on the care situation. Within this report the bladder weak individual is referred to as the *care taker* whilst the person providing the care, therein changing the incontinence protection on the care taker, is referred to as the *caregiver*.

This Master's thesis has been formulated by SCA with the aim to evaluate how the care can be improved in extreme situations to trigger solutions that can be beneficial for normal use situations. The idea of this approach originated in existing products that has been developed with the intention to fit an extreme situation and thereafter has become widely used in a more common everyday application. One example is the Anti-lock braking system first developed for aircrafts which, since the 1980's, has been common in cars (Roadsafe, 2008; Nationalencyklopedin, 2012).

Traditional thinking limits creativity (Österlin, 2007). Using extreme situations has therefore within this project been regarded as an aid in reaching new ideas for the incontinence care assortment. A number of extreme situations, further presented in section 3.3, were therefore chosen to study within the project.

1.2 PURPOSE

The purpose of this thesis is to use extreme situations to trigger new solutions. The purpose is further to evaluate the future potential of the technical solutions developed with regards to these extreme situations to find if they are beneficial for normal as well as the extreme use situations.

1.3 GOAL

The goals are to identify and evaluate user needs and requirement in each extreme situation, develop concepts that increase the functionality and usability in these situations and to present at least 4-6 prototypes of technical solutions designed to fit the conditions of the extreme situations. The goals will be met through answering a set of research questions:

- What are the users' needs and requirements regarding the product in the extreme situations?
- What are the issues of the existing products with regards to the extreme situations?
- How can the products be optimized with regards to the extreme situations?
- How useful is the method of using extreme situations to trigger new solutions?

1.4 DELIMITATIONS

The development will initially focus on 2-3 products in combination with three extreme situations. After the part time presentation the most interesting concepts for further development will be identified and the further work will thereafter focus on the, for the chosen concepts, relevant extreme situations.

1.5 REPORT OUTLINE

This report consists of a set of chapters, as visualised in figure 1.1, to cover the content of the performed project. After this initial introduction the theoretical outline of the report is covered and the company and the chosen combinations of products and extreme situations are presented further. Thereafter follows an explanation of the product development process used within the project and a presentation of the used methods, tools and their implementation. Furthermore the result of the data collection and analysis is presented and the identified requirements are listed. Thereafter follows the design process and the evaluation of the developed concepts. At last the final result is presented followed by a discussion about the performed project and the conclusions drawn from the result.

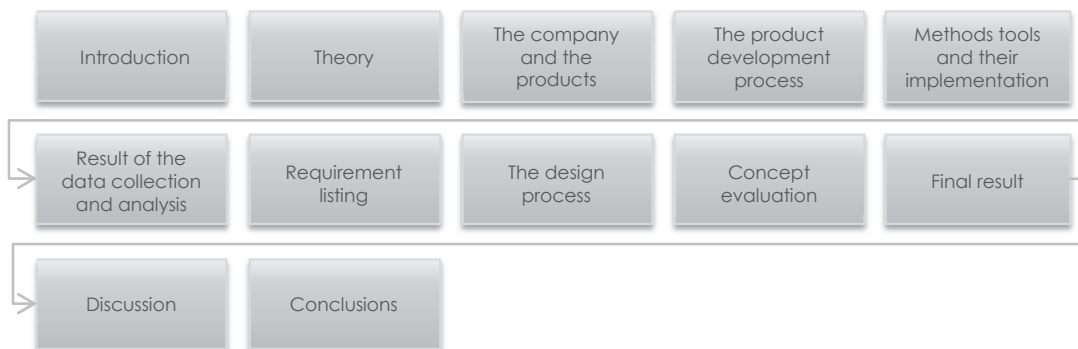


Figure 1.1 Report outline

2. THEORY

This chapter aims at providing the theoretical basis to enable deeper understanding for the project and its content. It covers information about incontinence as well as usability, ergonomics, and the materials used in the products.

2.1 INCONTINENCE

Incontinence, which is a medical condition that can be defined as an involuntary urinary or faeces leakage at an inappropriate time or place, is a problem from both a social and hygienic point of view. The subject is taboo which is leading to that help is often not sought even though help can cure or improve the condition. It is not a life threatening condition but it still has big impact on the quality of life of the bladder weak individual (SCA personal care, 2010).

Incontinence can have many different causes such as loss of mobility, weakened pelvic floor muscles or nerve damage. The volumes of the leakages can vary considerably and the amount spans from very small to the full bladder volume of approximately 3-5 decilitres (SCA personal care, 2010). Urinary incontinence is a common problem, especially amongst women of which about 25% has problems with urinary leakage. Amongst women childbirth is a common cause of incontinence (Rindforth Gillgren, 2011). Men have a lower commonality of incontinence as they have a longer urethrae and stronger pelvic floor muscles (Gullberg, 2011). The severity and occurrence of the condition increase with age and at the age of 75 years urinary incontinence has the same commonality amongst women and men (Malmquist, 2012).

There are different types of urinary incontinence. *Stress incontinence* is most commonly small leakages that arise due to physical effort with increased pressure on the abdomen such as lifting or sneezing. This type of incontinence is often caused by low support of surrounding structure, such as the pelvic floor muscles, caused by for example childbirth (Malmquist, 2012). *Urge incontinence* is a sudden urge to go to the toilet bringing leakages before the toilet is reached. This type of incontinence brings that the individual needs to empty the bladder more frequently. *Mixed incontinence* is a combination of stress- and urge incontinence and is a common type of incontinence (Rindforth Gillgren, 2011). Another type is *overflow incontinence* causing a constant leakage due to an overfilled bladder. Incontinence can also be caused by neurologic damage as this can weaken or strengthen the signals to the emptying muscles. In addition to urinary incontinence there is also faecal incontinence which most often is caused by limited function of the rectum (Malmquist, 2012).

2.2 MATERIALS AND MANUFACTURING PROCESSES

The developed concepts consist of a set of materials processed to get its final characteristics. This section provides the theoretical outline of the used materials and manufacturing processes. The absorbing incontinence protection product consists of a set of layered materials for optimum absorption; these materials are briefly described based on information provided by Kent Vartiainen, Associate Scientist at SCA (2012-02-21). The information of further proposed materials have been gained through studies of the literature referred to in each section respectively.

Nonwoven

Nonwoven is a textile like material that is, as the name implies, not woven. It is manufactured through extrusion of plastic pellets into thin threads stretched by air jets onto a surface in a random pattern. The threads are thereafter pressed together through rolling between heated calenders after which the material is winded up on a roll. Nonwoven has various areas of application such as wall paper, teabags and filters.

High loft

High loft, which is created by polymer fibres, is an open material with good permeability for quick acquisition of the liquid. The high loft is created of blends of polypropylene, polyesters and polyethylene.

Non-return valve/ funnels

Another permeable material that quickly transfers the liquid to the core and brings dryness and leakage security is perforated polyethylene. The perforation creates a material with conical funnels which hinders the liquid to return to the surface material.

Pulp

Pulp is an organic material produced from pine trees. The pulp can absorb 6-10 ml of urine per gram but the liquid is quite easy to press out. The material provides good inlet to the front and the back bringing leakage security as well as dryness and softness.

Superabsorbent

Superabsorbent are oil based polymers with high capacity of absorption. The material can store 25-40 ml of urine per gram. When absorbing urine the super absorbent takes the form of a gel which retains the liquid even under pressure. This brings dryness and leakage security.

Elastics

Elastics are used within the incontinence products to increase fit and discretion. There are two types of elastics used, threaded and laminated.

Back sheet material

The back sheet material, made out of a polymer film, is used for providing leakage security; it can be plastic or “textile”, breathable or non-breathable. When breathable the plastic film has been filled with calcium carbonate, which is eliminated through stretching of the film. Remaining is a film with small perforations enabling steam, but not liquid, to pass.

Polypropylene

Polypropylene is a low price thermoplastic. It is among the top three most used plastics and has good properties regarding for example chemicals, moisture and heat. It has also got low density. Examples of applications are housewares, packaging and bottles (Smith and Hashemi, 2006). Furthermore polypropylene is, as other thermoplastics, recyclable (Terselius, 2012).

Extrusion

Extrusion is the process in which solid material is melted and transferred by a screw through a die. The output is a continuous product such as pipe, film or profiles (McCrum et al. 1997).

Ultrasonic welding

Ultrasonic welding is a quick method in which two materials are joined through application of vibrations of 20-40 kHz under pressure. The joining is caused by the friction and the developed heat (Nationalencyklopedin, 2012).

2.3 USABILITY

According to the ISO standard as cited in Jordan (1998) usability is defined as “... the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environments” (ISO DIS 9241-11). The usability is thereby defined by the user, the use situation, the product and the tasks. Within the definition effectiveness regards to what degree the goal is reached while efficiency is the effort to reach this goal. Satisfaction is how good the product is as a tool to reach the goals and comfort in using the product (Jordan, 1998).

There are different measures of the three components. Effectiveness can be measured through task completion and the quality of the output. Efficiency on the other hand may be estimated through time on task, error rate, mental workload and the deviation from the critical path. Satisfaction can be measured through qualitative or quantitative attitude analysis. Qualitative attitude analyses can be performed through noting comments on the product or asking the user to comment upon the interaction during interviews or in a questionnaire. Quantitative analysis aims at quantifying the satisfaction through for example rating level of confidence during the interaction (Jordan, 1998).

Errors can be slips or mistakes. Mistakes occur due to a mismatch between the mental model of the product and the actual function whilst a slip is an accidental error occurring even though the user knows how to perform the task. There are also different levels of severity of an error; it can be minor, major, fatal or catastrophic. Minor errors are easily detected and adjusted, major errors can also be detected and adjusted but not as easily as the minor. Fatal errors prevent task completion whilst catastrophic errors also may lead to additional problems (Jordan, 1998).

Jordan (1998) further proposes that there are five components of usability; guessability, learnability, experienced user performance (EUP), system potential and re-usability. Herein guessability concerns the effectiveness, efficiency and satisfaction with which the product can be used for the first time while learnability regards the effectiveness, efficiency and satisfaction when performing a previously performed task. Experienced user performance is the effectiveness, efficiency and satisfaction with which an experienced user can perform a task while system potential is the optimal effectiveness, efficiency and satisfaction when performing the task. The final component, re-usability, concerns the effectiveness, efficiency and satisfaction with which a person can perform a task when re-using the product within a longer time frame (Jordan, 1998).

Jordan (1998) also presents 10 design characteristics that are related to usable design and usability; *Consistency* regarding that there should be similarities in the performance of similar tasks which enables the user to gain experience through the interaction which aids in solving upcoming tasks; *Compatibility* which regards how well the handling of the product matches with the users expectations; *Consideration of user resources* which implies that there should be a consideration of how much of the users resources is required by the interaction. *Feedback* relating to that there should be acknowledgement and indication of results of actions; *Error prevention and recovery* minimising the occurrence of errors and enabling quick and easy recovery of errors; *User control* which implies that the user should be in control over the interaction; *Visual clarity* regarding that information, such as labels and feedback should be easily readable; *Prioritisation of functionality and information* implying that the most significant features should be easy to access for the user; *appropriate transfer of technology* regarding increasing the usability through use of technology from other fields and finally *explicitness* meaning indication of functionality and operation (Jordan, 1998).

2.4 ERGONOMICS

Ergonomics is a knowledge area regarding the human in work, including physical interaction as well as work environment and information exchange between the human and the product (Österlin, 2007). It regards the interaction and the affecting factors in a human machine system (Bridger, 2003).

2.4.1 PHYSICAL ERGONOMICS

Physical ergonomics regards the physical interaction between the human and the product. This section provides the theoretical basis of physical ergonomics used in the product development project.

Anthropometric data regards the data of the human dimensions covering structural data of distances, such as body height, as well as functional data such as reach. When applying anthropometrics it is fundamental to consider for whom the product is designed. Should it be designed for everyone, the average, largest or smallest individuals or for disabled individuals? When designing for everyone both men and women are considered and the 5th and 95th percentiles, disregarding the smallest and largest 5 % of the population, are appropriate limits (Bohgard et al, 2008.).

When developing a handle it is of importance to provide a maximum contact between the hand and the handle. According to Bridger (2003) a handle should be at least 11.5 cm wide and the maximum handle diameter is 4 cm. There are a number of gripping types, spanning from the two handed grip to the fingertip grip. Within the span the two handed grip provides the largest maximum grip forces and lowest precision whereas the fingertip grip provides the lowest force but largest precision (Bohgard et al, 2008.).

The body posture during work is affecting the possible power output. There are numerous guidelines regarding body postures to avoid stressing the body. Examples of these are that leaning forward should be avoided and the upper arms should be held close to the body. When working standing it is of importance to regard the working height, a too high working height brings that the arms must be held above the head yielding static load in the arms. Low working height brings increased loads through that the back, neck and head need to be leaned forward (Bohgard et al, 2008).

2.4.2 COGNITIVE ERGONOMICS

Cognitive ergonomics involve mental processing starting with a sensory intake of information from the surroundings. The information is then given attention to where after it is perceived and decisions are made and actions are taken. The information quality can vary but a correct decision can still be made through experience, powers of deduction and increased effort (Bohgard et al, 2008).

THE SENSES

As the brain on its own cannot perceive physical stimuli it takes help from sensory receptors in the ears, eyes, skin and muscles. After being perceived by the receptors the sensations are sent as nerve impulses to the brain for processing of the information. The human body has five senses; the visual, audial, tactile, smell and the sense of taste of which the first three are presented further. Among the senses the

visual sense takes up about 80% of all impressions and is thereby dominant among the senses. When designing for the visual sense it is of importance to consider hue, lightness, intensity, contrast, and angle of view. A stressful use situation requires a well thought through visual representation of the product supporting processing based on the existing physical stimuli, without adding extra information, as well as processing based on previous experience where the individual him or herself can fill in missing information (Bohgard et al, 2008).

Sound is an effective way of getting the human attention as sound is the stimuli that most effectively captures the human attention. The audial sense complements the visual sense and is always open for information intake. Sound is used for bringing attention or as a warning and should not be used unnecessarily (Bohgard et al, 2008).

The tactile sense concerns perception of for example pressure on the skin, mechanical contact, heat, cold and pain through three different types of receptors in the skin. Haptic, which is the combination of the tactile sense and body movements, is the science of effect of touch and movement. Haptic information includes passive information, such as shape and size, and active information such as rhythm and vibrations. Haptic regards the human using her hands to touch objects to get acquainted to her surroundings. The haptic sense is frequently used as a complement to the visual as a means of increasing the performance through increased efficiency and accuracy. This way of using multiple senses to communicate information is called multimodality (Bohgard et al, 2008).

GESTALT LAWS

To be able to make sense of experiences the brain has to screen the provided information. Patterns are sought for to organize the input and the brain looks for the most easily distinguishable form that organizes the experience in an efficient way (Österlin, 2007). To support for this organisation there is a set of classical gestalt laws that are used widely within the area of design. The gestalt laws include the laws of similarity, continuity, proximity and closure. Similarity regards that objects with related functions or meaning should be similar to each other. Continuity concerns that people relate objects that are placed in a line. Proximity regards that objects with relating functions should be placed close to each other and closure relates to that humans tend to complement with information to create a meaning in what is seen (Bohgard et al., 2008).

EXPERIENCE AND EMOTIONS

The experience of the interaction with a product is shaped by the characteristics of the product as well as the user and the context (Desmet and Hekkert, 2007). Desmet and Hekkert (2007) further propose that interaction with a product can cause change in the core-affect. In psychology affect relates to the subjective experience of pleasantness and unpleasantness. The core affect further relates to a two dimensional

model combining level of pleasantness with level of arousal and it is proposed that product experience is the change of core affect (Desmet and Hekkert, 2007).

An emotion is based on an appraisal, the evaluation of benefit or harmfulness of a situation; hence it is founded in a cognitive process. Understanding the users concern regarding the context of the interaction with the product is important in order to understand the emotional response. Individuals are likely to yield different emotional response as they assign different meaning to the product (Desmet and Hekkert, 2007).

3. THE COMPANY AND THE PRODUCTS

This sections aims at providing an overview of the company, the brand and the products. Finally products and situations chosen for further studies within this project are presented.

3.1 THE COMPANY

SCA is a Swedish hygiene and paper company providing products for personal hygiene, soft tissue, packaging, print paper and wood products to over 100 countries worldwide. The company was founded in 1929 starting out being a pure forest company. Since then SCA has continuously transformed through acquisition of other companies and today it is one of the world leading companies in the area of personal hygiene products and the world leading in incontinence care products (Svenska Cellulosa Aktiebolaget, 2011).

SCA is summarized by the expression “c/o life”. C/o implying that the company is part of something larger, taking its responsibility and caring about customers, employers and other stake holders. And Life regarding sustainability as well as that the products have their context in and through life (Svenska Cellulosa Aktiebolaget, 2011)

The company mission is “to provide essential products to simplify everyday life” and the vision is ”to be recognized as the leading provider of value for customers, shareholders and employees in its field”. SCAs’ core values are respect, responsibility and excellence. The respect and responsibility concern human as well as the environment and excellence implies always aiming for better results and exceeding target goals (Svenska Cellulosa Aktiebolaget, 2011)

3.2 THE BRAND - TENA

TENA is SCA’s world leading brand for incontinence care products (SCA personal care, 2010). TENA comprises a range of products, available in over 100 countries, to fit different needs of protection (Svenska Cellulosa Aktiebolaget, 2011). Except for Europe, where TENA has a 40% market share, and USA where the brand is growing expansion is on-going in developing regions such as India and Latin America (SCA Hygiene Products). SCA started manufacturing incontinence protection in the 1960’s and the position as world leader has been reached by many years of research and development, through using front technology and innovative design (SCA personal care, 2010).

The brand mission is “to improve the lives of people living or working with bladder weakness or incontinence around the world”. TENA is aware of the great impact incontinence has emotionally as well as on the everyday life and the goal is not to let

incontinence hinder individuals from living a joyful and normal life (SCA Hygiene Products). Providing ultimate leakage security, being ultra-dry and gentle to the skin is of high importance as well as providing confidence, comfort and discretion to the user (SCA personal care, 2010).

The product range covers female and male incontinence products handled by the bladder weak individual as well as products to be handled by professional caregivers and care giving relatives. As the society is ageing the need for caregivers, both relatives and professionals, are increasing and TENA wants to be an aid in providing a high quality of life to both caregivers and care takers (SCA Hygiene Products).

THE PRODUCTS

The product categories are TENA Lady, TENA Men, TENA Pants and TENA Flex, Comfort, Slip and Belt. All designed to fit specific needs. There are also a category called support products comprising skincare and cleansing products as well as bed protectors and fix pants (SCA personal care, 2010). Figure 3.1 presents parts of the assortment.

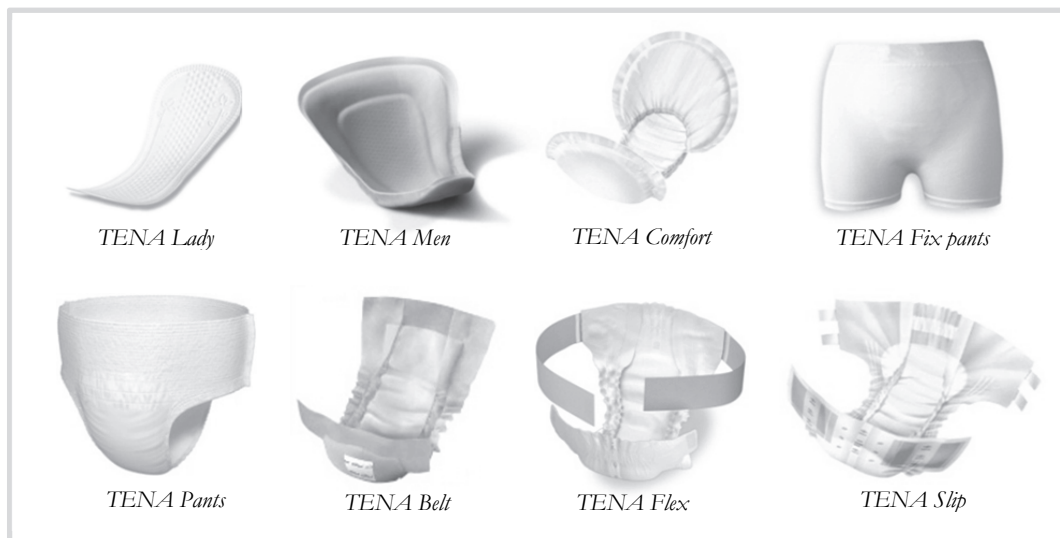


Figure 3.1 Visualization of the TENA assortment (SCA Hygiene Products AB)

SUSTAINABILITY

Since the 1990's SCA and TENA has worked actively with Life Cycle Analyses to measure and decrease the environmental impact. TENA has also implemented an initiative called Eco Actions to develop products and services for increased life quality and decreased environmental impact. To continue improving high aims has been set regarding for example developing sustainable solutions through improving the product design and decreasing waste material (SCA Hygiene Products).

3.3 SELECTION OF SITUATIONS

The project was initiated with a selection of combinations of situations and products. Relevant extreme situations were listed for each product category and care situation after which the choices were screened. The initial set of possible situations for study spanned from changing in public to changing under a tight time limit. The final result was combinations of three different products and three situations. The selection, made in consultation with a group at SCA, was based on relevance for the product range and ability of product evaluation.

The extreme situations had the purpose of triggering new ideas. The situations were therefore chosen based on possibility of triggering new interesting ideas and not on occurrence in real life. It was decided upon to focus on care situations where one caregiver, professional or a relative, is providing care for a care taker. Herein the focus was the interaction between the caregiver and the product; hence the care taker was not active in the analysed interaction process. The chosen situations were:

- A caregiver providing care in complete darkness, in combination with TENA Slip and Belt
- A caregiver providing care with one arm, in combination with TENA Flex
- A caregiver providing care to a heavy care taker, in combination with TENA Slip

To keep a wide scope no special cause was given for getting into the situation and the products were chosen as a starting point for the evaluation of the situational needs and requirements.

3.4 THE SELECTED PRODUCTS

The three products TENA Slip, Flex and Belt chosen to study within the project are herein presented further and visualized in figure 3.2. Additionally the buildup of the products is presented.

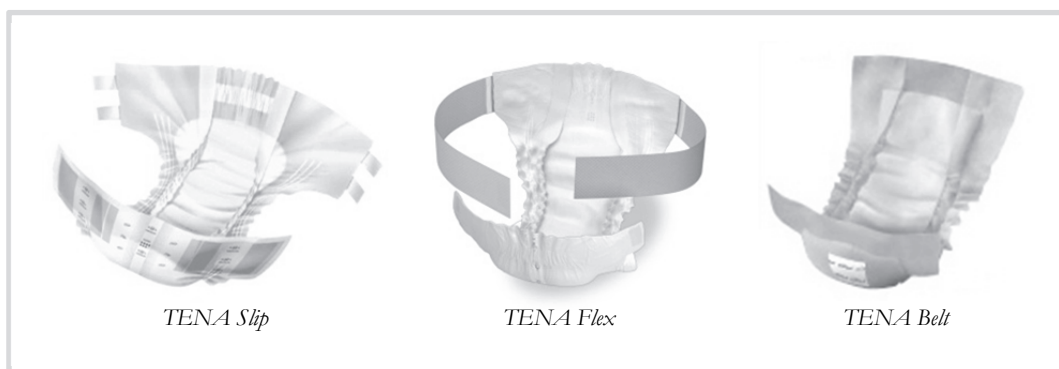


Figure 3.2 TENA Slip, Flex and Belt (SCA Hygiene Products AB)

3.4.1 TENA SLIP

TENA Slip was first introduced on the market in the 1990's (SCA Personal Care, 2010). It is an all in one protection developed for average to large urinary leakages. It has dual cores, good retaining properties, high absorption and can also be used for faecal incontinence. TENA Slip comes in three levels of absorption; plus (blue), super (green) and maxi (purple) which all are available in a variety of sizes. The product is fastened with tapes at the sides and the fixation can be adjusted to bring optimal security and fit. The product comes with a wetness indicator and odour neutralizer. TENA Slip is also available with a breathable back sheet (SCA Hygiene Products AB). Figure 3.3 illustrates the handling of the product as visualised on its package.



Figure 3.3 Handling of TENA Slip, as visualized on the product package (SCA Hygiene Products AB)

3.4.2 TENA FLEX

TENA Flex is a high absorbing urinary incontinence protection (SCA Hygiene Products AB). It was introduced on the market during the 2000's (SCA Personal Care, 2010). It has an elastic waist band bringing a comfortable fit for the care taker and a more ergonomic application procedure for the caregiver (SCA Hygiene Products AB). The protection is both quicker and easier to change compared to the ordinary products. To provide maximum security the protection is equipped with leakage barriers, and to provide discretion the product is noise free (SCA Personal Care, 2010). There are three levels of absorption coming in four different sizes. TENA Flex is quick absorbing and the breathable back sheet brings ventilation of heat and moisture. The product also has odour neutralizer, a wetness indicator and an illustration of procedure of application (SCA Hygiene Products AB). Figure 3.4 illustrates the handling of the TENA Flex product as visualised on its package.



Figure 3.4 Handling of TENA Flex, as visualized on the product package (SCA Hygiene Products AB)

3.4.3 TENA BELT

TENA Belt is a two piece protection. The adjustable waist band is reusable bringing less waste of material. The protection piece is fastened on the belt with four fastenings, two at the front and two at the back. The product has a breathable back sheet, dual cores and leakage barriers. On the protection there is also an illustration of the procedure of application as visualized in figure 3.5.

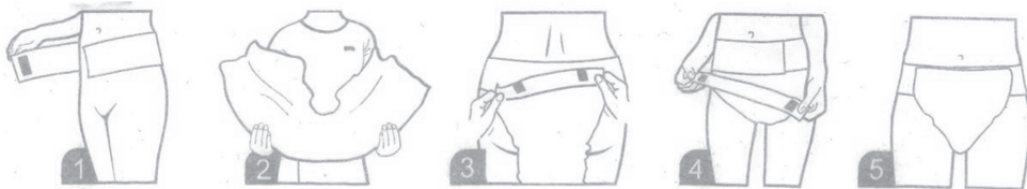


Figure 3.5 Handling of TENA Belt, as visualized at the back sheet of the product (SCA Hygiene Products AB)

3.4.4 BUILD-UP

The three products are built up in a similar manner as presented in figure 3.6. The surface layer consists of nonwoven under which there is a resilient layer consisting of high loft or non-return valve to enable quick transfer of the urine to the cores. Underneath the resilient layer there are two absorbing cores consisting of pulp and super absorbing polymers. Outermost is a barrier layer that can be breathable/non breathable and plastic or textile by means of Nonwoven. The products further have waist and leg elastics for optimum fit. There are also leakage barriers to hinder leakage. The products are fastened through use of hooks or tapes.

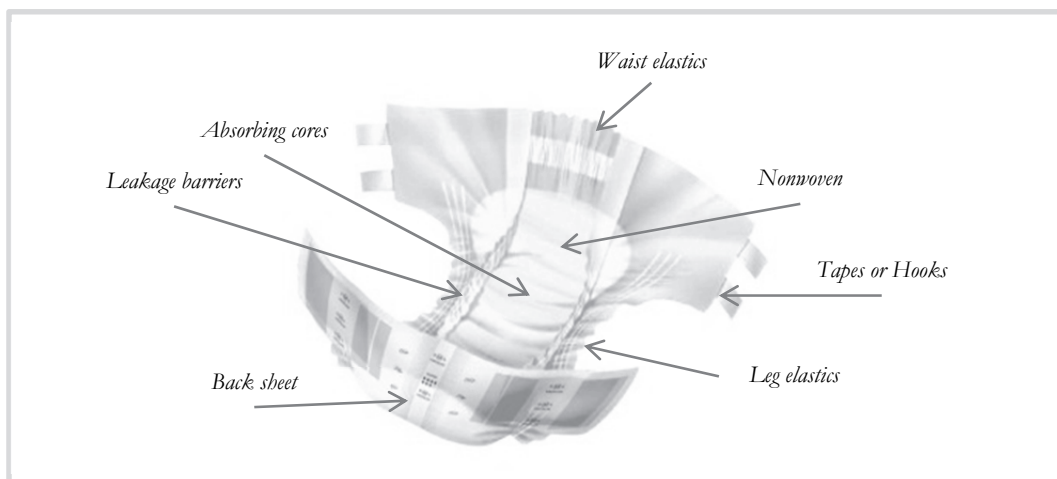


Figure 3.6 Build-up, based on TENA Slip as presented by SCA Hygiene Products AB

4. THE PRODUCT DEVELOPMENT PROCESS

The product development process consists of a set of steps to reach the end result. In this project the development process has been performed as illustrated in figure 4.1. Starting off with the initial project planning then shifting to data collection and analysis to thereafter use the result to list requirements and generate, develop and evaluate product concepts to end up with the final result.



Figure 4.1 The product development process

5. METHODS, TOOLS AND THEIR IMPLEMENTATION

A selection of methods has been used in order to reach the final result. Herein the methods and their implementation in the project are presented further under each step of the project.

5.1 DATA COLLECTION AND ANALYSIS

This section presents the methods used in order to collect data and analyse the interaction. The selection was based on methods regarded as relevant for the specific project.

5.1.1 FUNCTION ANALYSIS

A function analysis is a method to break down the product function in a main function and its part- and support functions. The main function is the reason of the product existence and the part functions contribute to the main function. The support functions on the other hand are functions that support the main function without being necessary. All functions are described by a verb followed by a noun (Österlin, 2007).

IMPLEMENTATION

The function analysis was performed through studies of the use of the selected products. Each product was analysed individually as they all fit different needs and have slightly different sub functions. The result was used as a basis on which to identify the functional requirements of the developed solutions.

5.1.2 USER PROFILE

A user profile is a method for mapping the characteristics of the target group that influence the interaction with the chosen product. It consists of six components; background, usage, affect and responsibility, emotional relation, type of interaction and activities goals and motives. The user profile is based on information collected from studies of the users. There are different classifications of users dependent on their influence on and of the interaction with the product as the different groups may have different needs and requirements on the product. There are four proposed classifications; the primary user using the product for its main purpose; the secondary user using a product with another purpose than the main purpose; the side user, someone affected by the product and finally the co-user which collaborates with a primary or second user without interacting with the product (Bohgard et al, 2008).

IMPLEMENTATION

The User profile was performed through analyses of the different users. Information was gathered from a care centre visit, where a number of changes were observed to

get a general view of the change situation, discussion forums and studies of the users. Both the care taker and the caregiver were considered but the caregiver was the main focus during the study as the project concentrated on the interaction between the caregiver and the product. The result was later used in the creation of the persona.

5.1.3 PERSONA AND SCENARIO

A persona is a user profile of a fictional user and the scenario describes the personas interaction with the product. The persona describes characteristics regarding knowledge, abilities and limitations with regards to the product. The purpose is to map characteristics of importance for the interaction to be able to use this knowledge in the product development process (Bohgard et al, 2008).

IMPLEMENTATION

A persona was performed to act as an aid in the theoretical analyses of the different combinations of situation and products as well as the development of new solutions. The result presents a description of a caregiver and briefly presents her mother whom she is caring for. The persona was based on results from studies of the target groups and has in this project been aimed to represent an intermediate user. In addition to the persona scenarios were created to describe her interaction with the product with regards to the three extreme situations.

5.1.4 HIERARCHICAL TASK ANALYSIS

A Hierarchical Task Analysis, HTA, is a method used to specify the steps required to perform a task to reach a goal. The starting point for the analysis is identification of the main goal of the interaction. The main goal is then divided into part goals which need to be performed to achieve the task. If necessary the part goals are then divided into further part goals until a sufficient level of detail is reached (Bohgard et al, 2008.).

IMPLEMENTATION

A Hierarchical Task Analysis, HTA, was performed for the normal use case of each product. These analyses were performed to get an overview of the overall procedure and the intermediate steps of each task. The HTAs were conducted through looking at instruction videos provided by SCA as well as product testing and observation of real use cases. Each use case was analysed with the starting point that the product should be changed on a care taker lying on its back. For the Flex and Belt which can be attached either on belly or bottom first it was chosen to study the case where the product is fastened on the back first. The result of the HTA was used as a basis for the Cognitive Walkthrough/Predictive Human Error Analysis and for the evaluation of the interaction in the usability tests.

5.1.5 COGNITIVE WALKTHROUGH/ PREDICTIVE HUMAN ERROR ANALYSIS

Cognitive walkthrough, CW, And Predictive Human Error Analysis, PHEA are methods for systematic analysis of the tasks performed by a user in an interface. The methods can be applied to graphical interfaces as well as control rooms and other physical products. They can be used to evaluate usability problems and use errors in existing products as well as for comparison. The gained knowledge can then be used in the development of the new concept (Bohgard et al, 2008).

The CW is an evaluation of the guessability of the system through an analysis of if whether the user will perform the task correctly or not. This is done through answering questions regarding if the user will perform the task correctly and if not why. The PHEA is a method for analysing the interaction between the user and the product to identify possible use errors and their consequences. When both methods have been performed the result is compiled and conclusions are drawn of how to avoid the possible difficulties in the interaction (Bohgard et al, 2008).

IMPLEMENTATION

Cognitive Walkthroughs and Predictive Human Error Analyses were performed with the HTAs as a basis to get an overview of the usability and probable usability problems in the interaction with the products. Each combination of product and extreme situation was regarded separately to bring full attention to the difficulties that the extreme situations might bring to the interaction. In the evaluation it was presupposed that there is only one caregiver performing the change. The persona was used as a basis for the evaluations to make a believable evaluation of a probable interaction scenario in the extreme situations.

5.1.6 USABILITY TEST

A usability test is an empirical method for testing the usability of a product through using realistic and relevant users and tasks. The tests can be performed with existing products or prototypes in a laboratory as well as the real use environment. The usability is evaluated through letting the test subjects perform a pre-set set of tasks and it is measured in means of effectiveness, efficiency and satisfaction. Quantitative data is herein gained through collection of for example time of procedure and goal completion while qualitative data can be collected through use of think aloud protocols (Bohgard et al, 2008).

IMPLEMENTATION

For empirical evaluation of the interaction between the caregiver and the product in the extreme situations two usability tests were performed with the existing and the developed solutions. The two tests were performed in the same manner to enable comparison of the objective data.

PARTICIPANTS

The test participants were employees at SCA. As the test persons simulated the position as caregiver emphasis was put on getting a mixed test group regarding experience of incontinence care protections to simulate a first time caregiver as well as the professional caregiver. The test groups consisted of seven and six test participants respectively. The level of experience differed from not having changed an incontinence protection before to having knowledge of the intended application and use as well as having changed incontinence products previously.

EXECUTION

During the tests the test participant performed a change of product for each of the chosen combinations of products and extreme situation. Darkness was simulated through use of a blindfold, one arm through asking the participants to hold their left hand along the side of the body and the heavy care taker was simulated through use of a heavy manikin. The tests concerned removal of the used product and application of the unused product. The changes were performed on two half body manikins, one in size small to medium to simulate the normal care taker and one in size extra-large simulating a heavy care taker. The smaller manikin had a weight of less than 5 kg whilst the larger manikin had a weight of 82 kg. The tests were held in a simulated care environment at SCA.

All test participants got the same initial information about the test and the product to provide a common knowledgebase. The products were shortly introduced and the participant got to look at all products after which the test started. Each task had a time limit of 6 minutes for the test to come in under the time limit of an hour per participant. Two different scenarios were used in both tests to balance the tasks and minimize the infliction of learnability throughout the tests. During the tests think aloud protocols were used and after each test a questionnaire was filled in by the test participant.

MEASURES OF USABILITY

The usability of the interaction was measured in means of effectiveness, efficiency and satisfaction. Task completion and quality of outcome was used to measure the effectiveness whilst errors and time for task completion was used to measure efficiency. Satisfaction was used through the think aloud protocol and the questions in the questionnaire.

5.1.7 THINK ALOUD PROTOCOLS

Think aloud protocol is a method for gathering qualitative data during a usability test. When using a think aloud protocol the test participant is asked to express his or her thoughts during the use and explain the choices and procedures that are performed.

This method is used to explain and bring understanding of the difficulties that can occur during the use of the product (Bohgard et al, 2008).

IMPLEMENTATION

The think aloud protocol was implemented through asking the test participants to express their thoughts during the usability test. The result was documented through verbal protocols and sound recording for later analysis. The result was used as a basis for analysis of the perception of the product and its handling as well as the satisfaction in the use.

5.1.8 QUESTIONNAIRE

A questionnaire is a method where the respondent subjectively responds in written language to a set of questions. The questions can be open ended; bringing that the respondent him or herself fills in an answer. The questions can also have a fixed response bringing a choice between a set of alternatives (Bohgard et al., 2008). When using fixed response alternatives it is of importance to cover the entire range of possible answers (Jordan, 1998). In a questionnaire it is also of importance how the questions are formulated. Open ended questions yield qualitative data of the respondent experience whilst fixed response question brings quantitative analysis. The language and the questions should be easily interpreted by the respondent. When designing a questionnaire it is of importance to regard the reliability and validity. Reliability concerns if the same result would be reached if the questionnaire was given at another time and the validity regards if the questionnaire actually measures what is supposed to be measured (Bohgard et al., 2008)

IMPLEMENTATION

A questionnaire was filled in by the test participants after each task as the tasks consisted of different combinations of products and situations. The questionnaire contained open ended as well as fixed response questions to gain quantitative as well as qualitative data. Emphasis was put on covering the entire scale of possible answers in the fixed response questions and reliability and validity was considered when designing the questionnaire.

5.2 REQUIREMENT LISTING

Within the project requirements have been identified for the incontinence care products to fit the conditions of the extreme situations. This section presents the methods with which the requirements have been listed.

5.2.1 LIST OF REQUIREMENTS

The list of requirements is a changeable document which can be adjusted and added to over time (Bohgard et al, 2008; Österlin, 2007). It declares the functional,

ergonomic, economical, qualitative and aesthetical requirements on the product (Bohgard et al., 2008). The list is used as a guide for the development of the product as well as a means of evaluation and quality control of the final concepts (Österlin, 2007).

IMPLEMENTATION

Through the gathering of information and theoretical and empirical analysis of the interaction requirements were summoned in a list. The requirements were categorized regarding function, handling and ergonomics, aesthetics, communication, sustainability and economics. The list of requirements was later used as a basis for the idea generation of new product concepts as well as for evaluation of the final result.

5.2.2 EXPRESSION BOARD

An expression board is a collection of images to conclude the expression or message needed to attract the persona. According to Monö (1997) a product, through its gestalt, communicates a message. The message is constructed by the four semantic functions; to describe, to exhort, to express and to identify. The purpose, function and handling of the product can be described through its gestalt. Further it triggers a reaction, expresses the properties of the product and causes identification (Monö, 1997).

The expression board is a tool to express the character of the product through using pictures of a product, form, metaphor colour and material that together forms the expression. The expression board can then be used as a basis for the sketching of new ideas as well as for evaluation of the final result (Wikström, 2008).

IMPLEMENTATION

One expression board was created for each of the extreme situations through identification of the wanted expression for respective extreme situation, thereafter followed gathering of pictures to visualize the expression. The result of the expression board was used to visualize requirements as well as during the design of the developed concept and finally as a tool for evaluation of the final concept.

5.3 THE DESIGN PROCESS

There is a wide set of methods to generate, screen amongst and visualize ideas. Herein the methods used within the design process of this project are presented further.

5.3.1 BRAINSTORMING

Brainstorming is a method for generating ideas through focusing on solving specific problems. The aim is to produce a wide variety of ideas and no critique is allowed (Österlin, 2007).

IMPLEMENTATION

The brainstorming was performed by one person through focusing on the usability issues within the existing solutions as well as existing products fit for each extreme situation. Each extreme situation was regarded individually. Emphasis was put on gaining a wide selection of ideas. The result was later combined in order to generate concepts.

5.3.2 SCAMPER

Scamper is a method for generating new ideas. The method is applied through use the verbs Substitute, Combine, Adapt, Modify, Put to other uses, Eliminate and Rearrange on an existing product to stimulate the appearance of new ideas (Mindtools, 2012).

IMPLEMENTATION

SCAMPER was performed as a part of the brainstorming. The verbs were used to generate ideas based on the existing solutions. The result was used in the formation of concepts.

5.3.3 PUGH MATRIX

Pugh matrixes are used for comparison of concepts. Different concepts are weighed towards a reference object regarding how well they fulfil a set of criterions. The criterions are based on the requirements and desires that have been identified for the product. Each concept is then assigned a plus, minus or zero regarding fulfilment of each criteria compared to the reference. Finally the result is summarized and the different concepts are ranked (Johannesson, 2004).

IMPLEMENTATION

After the initial idea- and concept generation Pugh matrixes were used to compare how well the different concepts fulfilled the requirements regarded as most important. The result was thereafter used as a foundation for the selection of the concepts to present at the part presentation.

5.3.4 SKETCHING

Sketching is a tool which aims at creating work material that represents solutions of the defined problem. The sketches can both be performed by using pen and paper and in 3D using for example prototyping and CAD-Programs (Österlin, 2007).

IMPLEMENTATION

Pen and paper sketches were used to visualize the ideas in the idea and concept generation. Throughout the development of the concepts sketches has been created both by pen and paper and through creating physical prototypes.

5.3.5 MODELLING

There are different types of models that can be used within a project. Examples of these are sketch models, presentation models and prototypes. Sketch models are a simple and quick way to test a design. Prototypes correspond to the planned product regarding material function and form (Österlin, 2007).

IMPLEMENTATION

Sketch models and prototypes have been used throughout the project in order to test and evaluate ideas. Prototypes were further used in the second usability test as well as to present the final result.

5.3.6 CAD- MODELLING

CAD models are three-dimensional sketches created in computer software. It enables use of exact measures and the models can be created through use of surface or solid modeling (Österlin, 2007).

IMPLEMENTATION

CAD models were used to visualize the final result of one of the developed concepts. The choice was based on that CAD modelling was a quick and efficient way of representing the concept and its features.

6. RESULT - DATA COLLECTION AND ANALYSIS

This section presents the findings in the methods used for data collection and analysis regarding the products, the users, the interaction and the situations.

6.1 FUNCTION ANALYSIS

The full result of the function analysis is visualised in Appendix I. The result shows that there are substantial similarities in the functionality of the three products. The overall identified main function is to provide incontinence protection. The product should furthermore enable handling, application and adjustment as well as provide comfort, collect and absorb urine and hinder leakages. Additionally the products should provide instruction and communicate status, brand, level of absorption and size. The differences regards that TENA Flex should enable flexible application, TENA Slip shall manage faeces and that TENA Belt should enable reuse of the belt.

6.2 USER PROFILE

In the care situation both the care taker and the caregiver can be seen as primary users. This is based on that the care taker is the one wearing the product but it is primarily the caregiver that is handling the product. In the care situation there can also be side users, such as non-care giving relatives which can be affected in a negative or positive way by the use situation. Below follows the description of the two primary user groups. The care taker is described in a brief holistic manner as the primary focus in the project is the caregivers and the ability of the products to help the caregivers to provide good care for the care taker.

6.2.1 THE CARE TAKER

The care taker is a primary user of the product, he or she can be of varying age as the reasons of the need of incontinence care protection differs between different individuals, but most common is care takers in their elderly years. The care taker's knowledge about the product segment is varying dependent on the reason for using the protection. Some care takers might be very aware of their situation and need for the product whilst others have limited knowledge about their condition. The mental model of the product differs in many instances. Some care takers can see the protection as an everyday aid, others as a hinder. The use and products used differs based on the need for protection. Primarily the products are chosen to fit the care takers need for protection and the use situation is highly dependent on the condition of the care taker. The product can have high emotional influence as the subject is taboo and diapers are seen as a baby product. It can bring dependence, limitation and embarrassment. At the same time the product is a help in enabling the everyday life. In the situation where there is a caregiver providing the care to the care taker it is mainly the caregiver interacting with the product. The care taker is interacting with

the product through physical contact and the care taker can also help in facilitating the care situation through for example holding the product. The activity the care taker wants to perform with the product is to wear it. The target is to hinder leakages and the motive is to enable such a “normal” everyday life as possible.

6.2.2 THE CAREGIVER

The caregiver is a primary user of the product, he or she is the operator in the system as he or she is the one controlling and directing the handling of the product (Bohgard et al., 2008). The caregiver is an adult and he or she is either a professional caregiver or a care giving relative, CGR.

USE

Due to that the caregiver can either be professional or a care giving relative the knowledge and training spans between none to wide knowledge and training of the used products. The frequency of use is varying between once in a while to numerous times a day and the caregiver sees the product as an aid in the everyday work and life.

INFLUENCE AND RESPONSIBILITY

In the case of a caregiver caring for a relative the caregiver has high influence on choice of product as he or she is often the one buying the product. In this case the caregiver has also high influence on the use situation as he or she is the one providing the care. The care taker also highly influences the use situation as it is the care taker and his or her needs that are the foundation for the use situation and choice of product. In the case of a professional caregiver, the individual can have a more limited influence on use and choice of product as these might be decided by the institution. In both cases the caregiver has responsibility for the product.

EMOTIONAL RELATION

The caregiver is often not the owner of the product as it belongs to the care taker or the institution. The product may bring mental influence on the caregiver regarding providing sufficient protection for the care taker. As incontinence is taboo it can bring an emotion of shame to the caregiver as diapers are seen as children’s products. A care giving relative has probably a strong emotional relation to the product and the care taker as the care taker is family to him or her.

TYPE OF INTERACTION

The interaction with the product is both cognitive, regarding the understanding of how the products should be used and applied, and physical regarding the handling of the product in application and disposal. The products commonly require use of two hands bringing that there might be problem in handling a product for a caregiver with physical disabilities.

ACTIVITIES TARGETS AND MOTIVES

In the care situation the caregiver wants to change product through removing the use product, cleansing the care taker and applying a new unused product. The goal is to provide incontinence protection and the motives are to provide a dignified everyday living for the care taker through comfort, discretion and leakage security.

6.3 PERSONA AND SCENARIO

This is Birgitta; she is a 51 year old math's teacher at an intermediate school just outside of Gothenburg. Birgitta lives in a house with her husband and she has three grown up children of which 2 have moved to study in other Swedish cities. In her spare time Birgitta enjoys gardening, reading, having dinner parties and just relaxing in the home environment. Birgitta is really fond of her work tasks as she likes working with people and seeing the learning process amongst children. At times it can though be a tough environment teaching maths to teenaged children, but the upsides overcome the downsides.

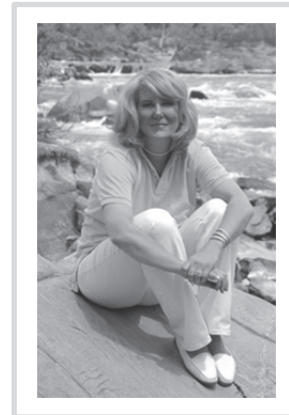


Figure 6.1 Birgitta (Phototogo2)

Besides taking care of her pupils and family she has lately started to take care of her elderly mother Ingrid during the evenings and weekends when Birgitta is not working. Ingrid is 78 years old and has recently gotten dementia, the psychological changes has brought that she has difficulty in reaching the toilet on time, and she forgets to put on a new protection when the old one has been removed. Birgitta, who lives close to her mother, therefore helps her with incontinence care as well as the everyday life. Before her mother got ill Birgitta did not know much about incontinence care products but as her mother now needs heavier protection Birgitta is in a learning process, trying to find the best product to fit her mother's needs. For Birgitta the incontinence care product should let her mother live such a normal life as possible. Before choosing product Birgitta asks for advice and research available products to find the right product to fit her and her mother's needs.

SCENARIOS

The scenarios, presented below, exemplify the chosen extreme situations and how they could emerge in real life.

SCENARIO – CHANGING IN DARKNESS

Birgitta comes home to her mother's house in the evening after a long day of work. The mother's incontinence care product needs to be changed but as Birgitta does not want to wake her mother up the care is provided in darkness.

SCENARIO – CHANGING WITH ONE ARM

Birgitta is working in her garden, but as she is planting the pots she twists her wrist. After washing the dirt of her hands she is off to her mothers' house. She walks in to her mothers' bedroom to change incontinence protection but as the wrist is still sore the care needs to be provided using only one hand.

SCENARIO – CHANGING ON A HEAVY CARE TAKER

Birgitta usually gets help from her sister in assisting her mother as Ingrid is very heavy. One day her sister does not have the possibility to assist her so Birgitta provides the care herself.

6.4 COGNITIVE WALKTHROUGH AND PREDICTIVE HUMAN ERROR ANALYSIS

The result of the Cognitive Walkthrough and Predictive Human Error Analysis was based on the steps in the HTAs (Appendix II) and the result can be seen in Appendix III. The following section covers the result of the analysis of the extreme situations respectively.

6.4.1 CHANGING IN DARKNESS – TENA SLIP AND BELT

When evaluating the handling of TENA Slip in darkness it was found that the caregiver has the intention to perform the task in the correct way, but the darkness brings difficulties in removal, disposal and application. During the evaluation it was found that one possible usability problem regards identifying what product that is to be removed and applied as the different products requires different handling. The non-existent indication of product type and handling brings fumbling and possibly inconvenience for the care taker in the procedure of the task as it might become a trial and error procedure. The cleansing procedure is also possibly negatively influenced as it is impossible for the caregiver to see if the cleansing is sufficient or not. If the user has limited experience of the product it is possible that the product is applied the wrong way around as the most obvious indication of what is front and back is the placement of the tapes. If the protection is applied the wrong way around it might lead to discomfort and insufficient protection. Another possible error is that the darkness brings that the caregiver does not want to turn the care taker around as much as in a normal care situation. This brings difficulties in the application and possible less comfortable fit of the product for the care taker. When bringing the front piece to the front the protection might be placed askew or not be applied tight enough to the body, this can bring discomfort as well as an improper fit and leakage. The darkness might also bring confusion of what end that should be folded over the other, again bringing fumbling.

A number of errors associated with the application of the tapes have been identified. Both concerning finding the tape ends, as they are on the inside of the product, and providing a tight fit. The darkness brings that it is hard for the caregiver to identify if the fit is right. Not providing a good fit can lead to discomfort and leakage. The conclusion of the evaluation is that darkness brings some new use errors but many are similar to those emerging in normal use situations. But as no visible feedback is given the extent of the problem and its effects might be bigger. Many of the identified possible use errors are connected to providing a good fit and security to avoid leakages.

There are many similarities in the result of the evaluation of TENA Slip and Belt in darkness. What are characteristic for TENA Belt are though the problems regarding order of application of the belt and the protection. The two separate pieces brings difficulties as it, when dark, is very hard to distinguish the reach of the protection and thereby the appropriate height for application of the belt. Putting the belt too high brings discomfort or that the protection does not reach the belt. Putting the belt too low brings a loose fit and thereby possibly leakages. The belt can also be brought the wrong way around as it might be tricky to distinguish which end should be applied which way around. Another possible error is applying the protection itself to far up or down bringing a loose fitting product with leakage or a too tight fitting product bringing discomfort. Applying the protection askew also brings possibility of discomfort and leakages.

6.4.2 CHANGING WITH ONE ARM – TENA FLEX

The study of possible usability errors when changing a TENA Flex with one arm shows that the removal of the used product brings only smaller difficulties whereas the application of the new product contains more tasks where use of two hands are necessary. Loosening the belt from the unused product is one example of these more challenging tasks. If the belt cannot be loosened the product cannot be applied and the care taker gets no protection.

The turning over of the care taker is another situation that might bring difficulties for a caregiver with one arm. Not turning the care taker over brings a procedure with fewer steps but the result in means of comfort and protection for the care taker are probably conflicted. Using one arm also brings difficulties in the adjustment of placement and fastening as it requires holding the product in place with one hand and adjusting with the other. Not being able to adjust the product properly brings risk of leakage and discomfort.

6.4.3 CHANGING ON A HEAVY CARE TAKER – TENA SLIP

The main problem detected in the interaction when changing a TENA Slip on a very heavy care taker is the difficulty of turning the care taker over. The mere weight of

the person can make him or her impossible to turn over for a single caregiver and changing without turning is a very difficult if not impossible procedure. If the care taker is big it might also be hard to determine where to put the protection to bring a good fit. A bad fit brings discomfort and leakages. There can also be difficulties in bringing the front between the care takers legs when the care taker is lying on top of it and the care taker is heavy. Another issue is controlling the fit of the product as this might be hard when the care taker is of a big size as it is hard to lean over for attachments and adjustments.

6.5 USABILITY TEST

This section covers the result of the usability test of the interaction with existing products in the extreme situations. For the tasks, test protocol and full test result see appendix IV-VI.

6.5.1 CHANGING IN DARKNESS – TENA SLIP

The test result shows that all test participants managed to change TENA Slip in dark. The quality of the outcome was though differing in accordance with figure 6.2, varying from an overall good fit, to skew fit at the back and a bad fit at the front. The time for task completion which is visualized in figure 6.3 varied between two and six minutes with a median of 3.78 minutes and those who had previously applied the product had a lower average time for task completion. The test protocol also shows that the level of confidence of if the product had a good fit overall varied between unconfident and confident (on a scale between very unconfident to very confident) with a median value of unconfident.

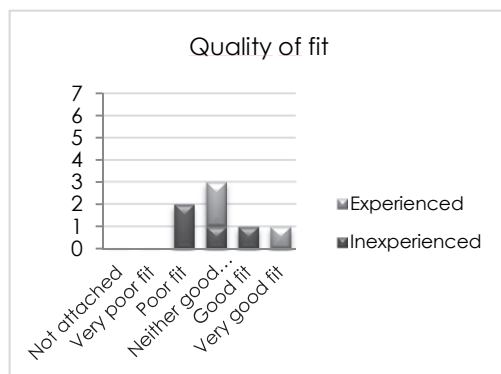


Figure 6.2. Quality of fit, number of participants reaching each level of quality of fit.



Figure 6.3. Median time for task completion

The darkness brought fumbling in the interaction and one major error that occurred regarded thinking that the end with tapes should be at the front bringing that the product was applied back to front. Minor errors that arose were that the new product got stuck in the old product at two separate occasions and in one case the product was initially fastened with one tape per side.

The comments about the interaction show that the test persons were concerned with having to touch to see if the product was in place. In the dark it was experienced as hard to find and grab the tapes and knowing where they should land. The darkness also brought difficulties in judging the height of the product at the front and the back. One test person would have liked something to hold the care taker in place during the change.

IDENTIFIED USABILITY ISSUES

- The interaction provided good effectiveness regarding that all test participants managed to apply the product, but the effectiveness was lowered by the quality of the outcome.
- The result shows a relatively good efficiency as all test participants completed the task within the given time frame.
- The satisfaction in the performance of the task was low as the test participants found it hard to reach the correct height and provide a tight fit. Further the tapes were considered as hard to handle in dark.
- There was a lack of feedback during the procedure and of the quality of the outcome.
- There was a lack of clarity due to the darkness.
- There was no active error prevention.
- There was a lack of explicitness due to that the product did not indicate operation in the darkness.

6.5.2 CHANGING IN DARKNESS – TENA BELT

All the test participants managed to change the TENA Belt product within the given time limit and the quality varied in accordance with figure 6.4. The result of the test protocol though shows that the belt was commonly applied to high, at the waist of the care taker, bringing that the fastenings end up outside of the belt. Initially putting the belt all too high brought additive handling and turning moments for altering the fit. This was caused by that it was not until pulling the front end to front that the caregiver realised that the belt was set to high. Those with the better result had higher confidence of that the fit was good. The overall median level of confidence was unconfident and even in cases with a good quality result test participants felt very unconfident. The inexperienced participants had higher level of confidence than the experienced. It must though be noted that the result of the experienced users are based on only one person as there was only one test participant that had experience of this product.

The major error, occurring in 6 cases out of seven was applying the belt too high; leading to that alteration had to be made later in the procedure. There were also difficulties in concluding if the belt should be applied on top of or under the protection and if the protection should be applied to the belt before applying the entire product to the care taker.

The test participants tried to distinguish the front from the back, and not being able to do this brought insecurity. The belt was experienced as slippery and too long for the care taker. Again it was commented on that it is probably not convenient for the care taker that the caregiver feels his or her way to a good fit. There were also difficulties in knowing where on the belt the product should be attached and guidance for belt application was wished for. The time for task completion varied between two and a half and six minutes with an overall median of just below 5 minutes as visualized in figure 6.5.

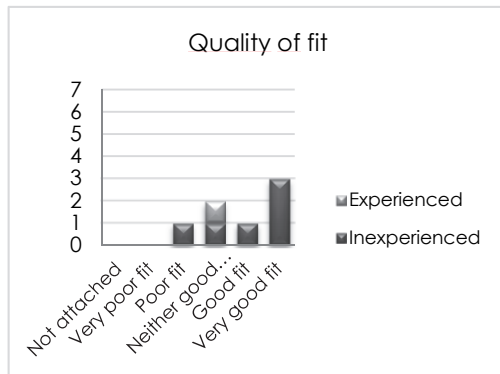


Figure 6.4. Quality of fit, number of participants reaching each level of quality of fit.



Figure 6.5. Median time for task completion

IDENTIFIED USABILITY ISSUES

- The interaction provided good effectiveness regarding that all test participants managed to apply the product and the quality was overall good.
- The result shows reasonable efficiency as all test participants completed the task within the given time frame, though lowered through the common major error of applying the belt too high at the waist. The test showed lower efficiency than for changing the Slip product.
- The satisfaction in the performance of the task was affected negatively by that the belt was seen as long and slippery and there were difficulties in identifying what was front and back on the absorbing part.
- There was a low level of confidence amongst the test participants.
- There was a lack of feedback of the procedure and quality of the outcome.
- There was a lack of visual clarity due to the darkness.
- There was no active error prevention as there for example is no indication of order of application or where to fasten the protection.
- The product provided for late detection of errors and a trial and error procedure for recovery.
- There was a lack of explicitness due to that the product did not indicate order of operation of the two separate parts.

6.5.3 CHANGING WITH ONE ARM - TENA FLEX

All test participants managed changing TENA Flex with one arm, and overall the result was a product with a good fit as visualized in figure 6.6. The level of confidence had a median of “neither unconfident nor confident” and those who previously had applied the product had a higher confidence level than those who had not previously applied the product. The task completion times, illustrated in figure 6.7 differed between two and a half and six minutes, with a total median value slightly below 4 minutes. The experienced participants though had a slightly lower median task completion time than the inexperienced participants.

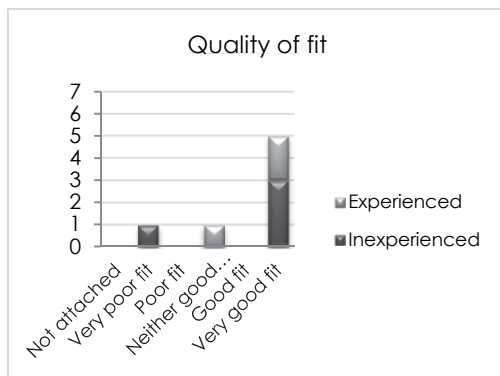


Figure 6.6. Quality of fit, number of participants reaching each level of quality of fit.



Figure 6.7. Median time for task completion

A common major error in the procedure of the task of changing the product was applying the belt to high initially bringing that alterations, and further turnovers of the care taker, was necessary. Changing with one arm also brought difficulties in getting the belt applied tight enough. The loosening of the belt from the protection when unfolding the product was seen as difficult. Some test participants used their legs or mouths as an aid in unfolding the product and loosening the belt. Test participants were also concerned about tearing the product and thought they were damaging the product. An aid to keep the care taker in place was wished for and it was noted that one needs to cooperate with the care taker. One test participant would like a tightening system for the belt and denoted that one should have guidance for the belt position.

IDENTIFIED USABILITY ISSUES

- The interaction provided for good effectiveness regarding that all test participants managed to apply the product and the quality of fit was overall good.
- The result shows reasonable efficiency as all test participants completed the task within the given time frame, though lowered through the common major error of applying the belt to high at the waist.
- The level of satisfaction was affected negatively by the difficulties in unfolding, handling and applying the belt.

- There was a low level of confidence with regards to the quality of the fit.
- There was a lack of feedback of the procedure and quality of the outcome.
- There was a lack of visual clarity in feedback of the positioning of the fastenings.
- There was no prevention of errors such as putting the belt to high.
- The product provided for late detection of errors and a trial and error procedure for recovery.
- The belt had high explicitness in forms of how it should be applied to the body but the explicitness of the entire product was lowered as there was a lack in indication of order of application and application height.
- There was a lack of consideration of user resources as especially unfolding the product and tightening the belt required two hand grips.

6.5.4 CHANGING ON A HEAVY CARE TAKER - TENA SLIP

Changing a TENA Slip on a heavy care taker was the only task where test participants did not succeed in completing the task as visualised in figure 6.8. Four of the tests brought a good fit at the front. At one occasion the product was torn at the side and the test participant solved the situation through tearing of the tapes and attaching them to the remaining product. The confidence levels varied and amongst those who had not previously applied the product the confidence was low whereas the confidence level was higher within the group of experienced users. One of those with experience though felt very unconfident of the leakage security due to the inability of checking the fit at the back. For those finishing the task the time for task completion varied between three and five minutes with a median just below four minutes as illustrated in figure 6.9. During the changes the test participants had differing approaches to the task. One of the test participants heightened the bed for a more comfortable change and moved the bed to ease the change.

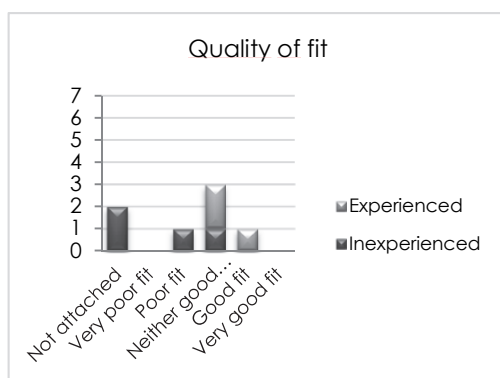


Figure 6.8. Quality of fit, number of participants reaching each level of quality of fit.

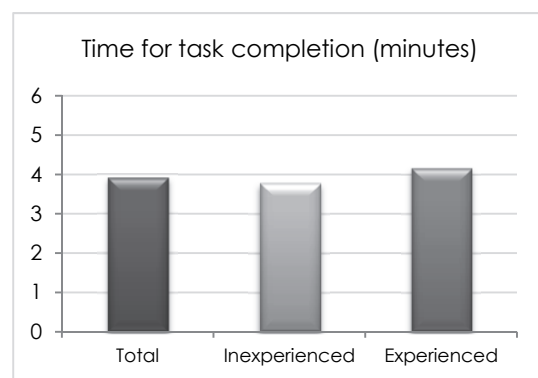


Figure 6.9. Median time for task completion amongst the participants finishing the task

Errors that occurred were pulling the product out as an effect of not managing to move the care taker. A major, possibly fatal, error was damaging the product and a

fatal to catastrophic error was not being able to get the product out from in under the care taker as this brings that no incontinence protection is provided.

The test brought comments regarding the insecurity of the toughness of the product and one test participant would like a stiffer product to help when trying to get it in under the care taker. As the care taker was very heavy the used product was also commonly pulled out. One of the test participants would have asked the care taker to help as much as possible and another commented on possible aids such as handles on the wall that the care taker could hold on to in order to simplify the change. It was also commented on that it is possibly not so comfortable for the care taker to be turned over a lot as it is heavy.

The fit at the back was another concern as it was hard to check. One test participant remarked on not caring so much about the fit as the care taker was too heavy and there was a comment on that the care did not provide dignity for the care taker. The care taker normally does not have such a good surface and there was concern of pinching the care taker. Several test participants experienced back pain from the changing procedure and there was concern of urine and faeces during the handling.

IDENTIFIED USABILITY ISSUES

- The interaction provided the lowest effectiveness of the tasks as 2 test participants did not complete the task and there was a low quality level.
- The efficiency was low as there was much deviation from the efficient way of procedure, and fatal and catastrophic errors occurred.
- There was a very low level of satisfaction as the care situation did not enable thorough control of the fit at the same time as it was perceived as undignified and the test person's experiences back pain.
- There was a low level of confidence of the fit.
- There was a lack of visual clarity of the feedback given, it was possible to see that the fastenings had been fastened but there was no indication of if it was correct.
- The product did not provide any active error prevention.
- There was a lack of feedback of result of actions such as pulling at front, how does the product then fit at the back?
- There was a low consideration of user resources as the interaction demanded much more physical resources than available.

6.6 QUESTIONNAIRE

The following section comprises the result of the questionnaire filled in after performing each task with the existing product solutions. The full questionnaire and its result can be seen in Appendix VII-VIII.

6.6.1 CHANGING IN DARKNESS – TENA SLIP

In the task of changing a TENA Slip in darkness applying the new product was seen as the most difficult part task, bringing a median of hard, with a spread between very hard and hard.

Concerning the level of control experienced when performing the task it got an overall median value of 3 where 1 corresponds to a very low level of control and 5 to a very high level of control. The result though shows that the inexperienced users experienced themselves as having a higher level of control than the experienced. Regarding the clarity of the product communication of handling and achievement of task the experienced test persons overall experienced the clarity as higher than the inexperienced. The level of clarity was in both the handling and achievement of task rated with a median of neither unclear nor clear.

The steps of procedure that was experienced as most challenging were applying the product, getting it at the same height at the front and the back, fastening it and getting a tight fit at the front. The tapes and that there are two of them was found hindering the procedure of the task as well as that it is hard to know what is the front and the back. Being able to attach and reattach the tapes and that the product was relatively stable was seen as a help in performing the task.

IDENTIFIED USABILITY ISSUES

- There was a low level of experienced control, though higher for the inexperienced users.
- There was a low experienced level of clarity in both communication of handling and achievement of task.
- There was difficulty in reaching the same height at the front and the back.
- There was difficulty in positioning the protection and its parts.
- There was a low explicitness regarding front and back.
- Altogether the satisfaction experienced in performing the tasks were low as the test participants did not experience themselves as in control of the interaction. Further the test participants did not experience clarity in the interaction.

6.6.2 CHANGING IN DARKNESS – TENA BELT

In the task of changing a TENA Belt in darkness applying the new product was the step that was experienced as most difficult to perform amongst both inexperienced and experienced test participants. The results of the experienced are based on one single answer as there was only one test participant that had previously changed this specific product.

The level of control experienced when performing the tasks had a median rating of 3, and a spread between 1 and 4, where 1 corresponds to a very low level of control and

5 to a very high level of control. Herein the inexperienced rated the control level higher than the experienced user. Regarding the clarity of the communication of the handling of the product it had a uniform median rating of clear communication whilst the communication of achievement of task was rated with an overall median of nor unclear nor clear and the experienced test person had a lower median than the inexperienced.

It was commented that it was hard to apply the belt and find the appropriate height for this. The order of application was also found confusing. The biggest difficulties were found in the positioning of the belt and whether it should be placed on the inside or the outside of the protection. Defining what end were the back and the front of the protection part was found difficult and the centring of the belt and product both sideways and height wise was a step that was experienced as hard. Another experienced difficulty was holding the care taker while applying the back piece.

The belt was seen as the main hinder of the achievement of task as it ended up too high, sliding towards the waist. The protection part felt too small and the fastenings easily ended up on the body instead of the belt. Another hindering factor was the lacking indication of front and back. The belt was though found as helping the removal of the used product and there were good grip in the fastenings at the belt. The two sided belt helped in the understanding of the application.

IDENTIFIED USABILITY ISSUES

- The test participants experienced a low level of control.
- There was a low to medium level of experienced clarity in communication of handling and achievement of task.
- There was difficulty in identifying the order of application.
- There was difficulty in reaching the appropriate height with the belt.
- There was difficulty in reaching same height at the front and the back.
- There was difficulty in positioning the protection and its parts.
- There was difficulty in defining front and back of the protection.
- Altogether the above mentioned difficulties resulted in a low satisfaction in performing the task.

6.6.3 CHANGING WITH ONE ARM - TENA FLEX

The task that was experienced as most difficult to perform when changing TENA Flex with one arm was applying the new product. The test participants commented on the difficulty in keeping the belt in position for fastening as well as tightening the belt. There were also difficulties in knowing how high the belt should be attached. The steps that were perceived as most challenging were identifying back and front as well as applying the belt tight and at the correct height.

The level of control had an overall median of 3, where 1 corresponds to a very low level of control and 5 to a very high level of control, with the inexperienced test persons yielding slightly lower ratings. The clarity of the communication of handling and achievement of task had an overall median rating of clear with a spread between unclear and clear. The experienced participants experienced higher degree of clarity than the inexperienced.

That the belt is attached to the protection at the start was seen as a hinder. The test persons also experienced difficulties in getting the belt in the correct position, bringing that the product felt short. The belt was though seen as an aid in solving the task with one arm and that the grey fastenings should be applied to the grey belt.

IDENTIFIED USABILITY ISSUES

- Applying the new product was experienced as the most difficult task.
- There was a low level of experienced control.
- There was a medium experienced level of clarity in both communication of handling and achievement of task.
- There was difficulty in loosening the belt from the protection part.
- There was difficulty in positioning the belt.
- There was a lack of communication of positioning of the belt.
- There was difficulty in tightening the belt.
- There was low explicitness regarding front and back.
- Altogether the above mentioned difficulties resulted in a relatively low satisfaction in performing the task.

6.6.4 CHANGING ON A HEAVY CARE TAKER - TENA SLIP

When changing TENA Slip on the heavy care taker the turning of the care taker was rated as the hardest task to perform. It was commented on that the heavy weight brought focus on just getting the product changed rather than the fit of the product. The application of the new protection was also experienced as very hard.

The level of control had a median rating of 2 where 1 corresponds to a very low level of control and 5 to a very high level of control. The inexperienced had a slightly lower median than the experienced, ending up at between very low and low level of control. The tasks that were found most difficult to perform were turning the care taker, getting the protection under the bottom and placing it in the correct position. The clarity of the communication of handling and achievement of tasks was experienced as neither unclear nor clear by the inexperienced and as in between neither unclear nor clear and clear by the experienced participants. That the product was not tough enough and had low elasticity was found as hindering the application.

IDENTIFIED USABILITY ISSUES

- Turning the care taker over was experienced as the hardest task closely followed by applying the new product.
- The test person experienced a low level of control.
- There was focus on change rather than fit and comfort.
- There was overall missing clarity in communication of handling and achievement of task.
- Altogether the above mentioned difficulties resulted in a very low satisfaction in performing the task.

6.7 SUMMARY OF RESULT OF INTERACTION ANALYSIS

The theoretical and empirical analysis of the interaction yielded a wide set of data which is herein summarized. The result of the usability test confirmed the result of the theoretical analysis and identified additional usability issues.

6.7.1 CHANGING IN DARKNESS

The result shows that changing in darkness brought an acceptable level of efficiency but both the effectiveness and satisfaction were low bringing a low usability when performing the task. Using the two piece system yielded a higher effectiveness but a slightly lower efficiency due to the late detection of the error of positioning the belt to high. The confidence level was low, lowest with the two piece system caused by the lack of explicitness and user control brought by the darkness, the many handling moments and that the fastenings could be applied incorrectly. The products provided insufficient feedback of the procedure of application and the quality of the outcome. Today the products rely mainly on visual feedback, which cannot be seen by the care taker in darkness, visual clarity is therefore lacking leading to fumbling. As there is no limitation of the fastening zones there are no prevention of putting the fastenings on the wrong place, there is neither any prevention of putting the protection (TENA Slip) on backwards nor putting the belt to high or low. The trial and error procedure identified in the theoretical evaluation as well as the empirical brought lowered user control and thereby lowered the satisfaction of the use.

6.7.2 CHANGING WITH ONE ARM

The outcome of the interaction analysis shows that the task of changing TENA Flex with one arm had good effectiveness. The efficiency was though lower as the belt was frequently applied to high leading to need for error recovery. The satisfaction was higher than in the other tasks but there was still need for improvement. Even though it in this situation was fully visible for the test person how the product was positioned on the manikin there was a low level of confidence regarding the fit. This can be related to the lack of feedback and visual clarity from the product during the interaction. There was no clear communication of front and back bringing lacking

explicitness. There is an illustration of how the product should be handled but the position of the illustration though makes it blend in in the visual clutter and none of the test participants looked at the instructions. The test persons though experienced that the communication of handling and achievement of task was neither clear nor unclear. The late error detection was caused by the overlapping belt and the non-existent indication of where the fastenings should be attached to end up at an appropriate level. As identified both theoretically and empirically there are steps in the application of the product that requires the use of two hands. The interaction therefore had a high demand on user resources and brought a low level of experienced control.

6.7.3 CHANGING ON A HEAVY CARE TAKER

The result of the interaction analyses implies that changing on a heavy care taker was the task with the lowest effectiveness, efficiency and satisfaction. The heavy care taker brought difficulties in the handling, application and assessment of achievement of task and brought focus from the target, which is to provide dignified care. The test participants experienced low level of confidence of the fit as it was hard to check the fit at the back. There was also a lack of feedback and visual clarity of appropriate fastening area and quality of the fastenings. The recommended procedure of application was not appropriate for the circumstances as it required many turning moments, for both application and control of fit, which the caregiver did not manage. Not being able to turn the care taker over and having to pull the used product out and push the new product in brought a low sense of control during the interaction. The participants experienced the clarity of handling and achievement of task as neither unclear nor clear.

6.8 COMPETITOR ANALYSIS

A competitor analysis was performed to gain better insight in the existing incontinence care assortment. The analysis focused on heavy incontinence protections and emphasis was put on identifying similarities and differences in the product assortments compared to TENA.

The result showed large similarities in the product assortment amongst the different competitors. The product that most of the competitors have in common is the Slip-like product. They though come in different designs with either thin or wider tapes. There are also products developed for large care takers in form of slip products of larger sizes with wider side panels. Flex-products are also common and many of them have big similarities to the TENA Flex. There is further another brand that has a Belt-like product.

6.9 SITUATION ANALYSIS

To complement the result of the analyses of the existing products it was chosen to perform an analysis of the situations themselves to create a thorough foundation for the upcoming idea generation. Information, such as limitations and existing solutions was sought after.

6.9.1 DARKNESS

To be able to use products in dark information must be communicated either through use of other senses or enabling visual feedback despite the darkness. The visual sense is dominant but the haptic sense is often used as a complement to increase efficiency and accuracy (Bohgard et al, 2008). To find products developed for situations where one cannot see, aids and products developed especially for visually impaired individuals were studied. The result of the study showed that haptic features such as braille are often used. Sound is also frequently used for different applications. Buttons used are big to be easily distinguishable. There are also guidance aids such as guide-dogs and white sticks. Regarding enabling visual feedback in dark there are products that are self-luminous, there are also product that enables dark vision such as night vision cameras, night vision goggles and use of displays.

6.9.2 ONE ARM INTERACTION

To assess the needs of one armed individuals videos of solving everyday situations and information material aimed at stroke patients with decreased mobility were studied. The result shows that there are some products developed especially for individuals that can only use one arm such as cutting boards with a corner brim to keep for example vegetables in place while cutting. The study also showed that there is a preferring of using slip on products such as for example sandals instead of laced shoes that requires use of two hands. It was also seen as beneficial to be able to attach for example bras in advance and then put it on already mounted.

6.9.3 HEAVY CARE TAKER

Enabling handling of a heavy person requires providing facilitating products. On the market there are a selection of products available designed with regards to heavy patients. Products regarding the handling concerns for example lifts and beds that enables turning. Looking at only the ease of turning there are multi time use products, in various fabrics, such as belts and sheets with handles.

7. LIST OF REQUIREMENTS

The overall requirements regarded as most relevant are listed below, the full list of requirements can be seen in appendix (IX) and the numbers in front of the requirements corresponds to their number in the lists of requirements. The first number corresponds to the type of requirement. Those starting with a one are regarded as functional requirements while those starting with a two or five are handling and ergonomics requirements and communicative criterions respectively. Overall the three situations have the majority of the requirements in common; of which some are the most crucial for the product segment.

1.2 – 1.4) The product shall collect and absorb urine as well as hinder leakage.

1.5-1.8) The product shall enable handling, application, adjustment and removal in the given situation.

These requirements are crucial for the functionality of the product and are corner stones in a successful product fit for the market needs.

2.1) The product shall provide comfortable use for the care taker.

2.2) The product shall provide for good skin health.

The use of incontinence care protection is based on the needs of the care taker and it is of importance for the wellbeing of the care taker to provide comfort and good skin health.

2.3) The product shall facilitate the positioning of the product and its parts.

2.4) The product shall enable effective and efficient handling in the given situation.

2.6) The product shall communicate achievement of task.

2.7-2.11) The product shall enable error detection and recovery, consider user resources and provide visual clarity, explicitness and feedback.

To yield control and confidence of achievement of task is important that the product enables easy positioning and communicates procedure of application and achievement of part goals as well as the entire task. It is also of importance that the caregiver is able to perform the task effective and efficient. As a means of effective and efficient handling it is, as proposed in section 2.3, of importance to provide for visual clarity, explicitness, feedback throughout the interaction as well as error detection and recovery and consideration of the users resources during the interaction.

2.12) The product shall enable handling with one hand.

2.13) The product shall minimize the needs of turning the care taker.

2.14) The product shall facilitate the turning of the care taker.

These first of these three requirements are crucial for the one armed caregiver whilst the other two are of specific importance during the care of a heavy care taker. Providing care in darkness did not have any unique requirements.

5.1) The product shall communicate security.

5.2) The product shall communicate dignity.

To bring the wanted experience of the use it is of importance that the products communicate security as well as dignity. In addition for the one armed situation the products shall express simplicity, in the dark clarity and in the situation with a heavy care taker the product shall express facility. The wanted expression for each case is visualized in the expression boards in figure 7.1-7.3 below.



Figure 7.1 Expression board for changing in darkness



Figure 7.2 Expression board for changing with one arm



Figure 7.3 Expression board for changing on a heavy care taker

8. THE DESIGN PROCESS

After the data collection, analysis and identification of requirements followed the design process. This section presents the result of the idea and concept generation as well as the selection and further development of the product concepts regarded as especially interesting.

8.1 IDEA GENERATION

Within the idea generation the methods used focused on solving the identified usability problems one at a time. After generating ideas to solve one issue the idea generation moved on to the next problem. Comparison was thereafter performed to see if any ideas solved more than one issue. The result was a wide selection of ideas solving the identified usability issues. Each situation was regarded individually but the developed solutions had similarities in for example solving the issue of lacking feedback and visual clarity.

8.2 CONCEPT GENERATION

The various ideas that emerged in the idea generation were used to form concepts suited for the conditions of the three situations. The outcome of the concept generation was numerous product concepts to solve the usability issues in each extreme situation. After screening with Pugh matrixes (Appendix X) 10 concepts remained. These concepts are further presented in section 8.2.1-8.2.3.

8.2.1 CHANGING IN DARKNESS

The developed concepts emphasized facilitating the removal, handling and application through enabling clarity and control for the care taker despite the darkness. Three different concepts were proposed in which focus was put on tactile feedback and self-luminous materials.

SLIP TACTILE

Slip tactile, illustrated in figure 8.1, is a TENA Slip like product with two large fastening zones, an elastic waist and tactile feedback. The back is communicated through using a tag like in ordinary underpants as this is a product that everyone is accustomed to. One wide fastening per side is chosen for prioritization of the functionality through easing the access of the fastening system and to decrease the number of handling moments. The size of the fastenings and landing zones brings that they are easily found yielding increased user control. The fastenings and their landing zones are clearly distinguished from the rest of the product through tactile feedback such as pattern or material. Ideally these fastening zones should only be able to fasten on each other to prevent errors. The clear indication of front and back as well as fastening zones would then bring increased feedback on achievement of

task. Another proposal is to let the product have a self-luminous outline visible in the dark to enable visual feedback of the alignment of the sides and fastenings as well as feedback of the overall fit.

FLEX TACTILE

Flex tactile, visualized in figure 8.2, have many similarities with Slip tactile: Clear tactile indication of fastenings and their landing zones. The thought is to use a belt length that is carefully balanced with the size of the care taker and indicates the landing zones for the belt itself as well as for the fastenings. This yields increased feedback of procedure of task and stepwise achievement of part tasks. The choice to make a concept from Flex was based on the good quality when applying Belt in dark and the higher level of control experienced when applying an all in one product.

LIGHTAWAY

Lightaway which can be seen in figure 8.3 is an additive product. The system consists of a display connected to the incontinence protection. It provides quick real time feedback of the fit and its leakage security. Use of this system could bring increased quality of the fit, increased experiences level of control and increased visual clarity of the procedure of the task. This is though a futuristic concept, requiring development of the technology to map the fit, but various sorts of other measurements could be incorporated in the software.

8.2.2 CHANGING WITH ONE ARM

The developed concepts focused on enabling handling with one arm and bringing similarities with other products chosen by the one armed for its usability. Noted was also that the packaging is a possible future development area for one armed care takers as the packaging today require use of two hands.

HOOP

Hoop, illustrated in figure 8.4, is based on that slip on products is wanted for this extreme situation. It has a flexible full circle, non openable, separate belt and a protection with clearly indicated fastenings and landing zones. The indicated landing zones bring increased quality of fit as the appropriate placement is indicated and the risk for the fastenings ending up outside of the belt is decreased. As the belt is a flexible full circle it provides for quick and easy recovery if the belt is initially set too high. It is just to slide the belt down until the appropriate height is reached. The eased error recovery as well as the indicated fastening zones brings increased control and feedback on achievement of task. To further communicate the procedure of application the illustration has been moved to the belt, between the two fastening zones, as this area yields high readability throughout the application and is the last area that is covered. Covering the instruction with the protection also brings higher

discretion when applied. The protection could also have a distinguished t-shape to bring further feedback that the fastenings are placed within the preferred are.

LOOP

Loop, illustrated in figure 8.5, is as Hoop based on that slip on products is wanted for this extreme situation. It is based on a Flex with a flexible full circle, non openable, integrated belt and clearly indicated fastenings and landing zones. The indicated landing zones bring increased quality of fit as the appropriate placement is indicated and the risk for the fastenings ending up outside of the belt is decreased. As the belt is a flexible full circle it provides for quick and easy recovery if the belt is initially set to high. It is just to slide the belt down until the appropriate height is reached. The eased error recovery as well as the indicated fastening zones brings increased control and feedback on achievement of task. Herein it is proposed to use a fastening system with visual feedback of contact between fastening and fastening zone. This would bring clear visible feedback bringing quick error identification and recovery as well as clear indication of achievement of tasks. The product can be based on either Flex or Pants for products with different characteristics.

BUCKLE

The concept called Buckle, visualised in figure 8.6, is based on a TENA Flex product with an integrated belt with the functionality often seen in children's shoes or gloves where Velcro is used for fastening. This solution can bring increased quality of fit and eased handling as it is easy to adjust the length of the belt. The appropriate length is also indicated, bringing fewer errors. This type of adjustment system is easily used with one hand and herein the fastening areas are easily distinguishable.

SUPPORT

Support which can be seen in figure 8.7 is an additive product in form of a pillow to enable secure changes with a high user control and consideration of user resources. The product enables changing protection with one hand whilst the care taker is securely leaning towards the pillow. This product could also be beneficial for use in the dark situation to ensure the position and security of the care taker.

8.2.3 CHANGING ON A HEAVY CARE TAKER

The concepts developed for changing on a heavy care taker focused on enabling a good fit for the large user as well as an eased handling for the caregiver.

STRETCH

Stretch, visualised in figure 8.8 is based on a TENA Belt product as the decreased handling moments, due to the reusability of the belt, and decreased skin coverage was seen as beneficial for this specific situation. The product consists of a belt with clearly indicated fastening zones for higher clarity and user control. The belt could be

made out of low friction material to aid when a new belt needs to be applied. The belt could also be layered and thereby able to peel to decrease the need of turning. The protection part has stretch areas to provide for a better fit and thereby also higher leakage security for the user with a wider belly. It is proposed that after applying the belt the front part should be applied first. This brings that the front is applied, the care taker is turned over, the back is applied and the fit is checked, the care taker is then turned back and small alterations can be made at the front. This procedure brings that the user is in control and can see the performance on the back when the product is fully applied.

SUPER STRETCH

Super stretch illustrated in figure 8.9 has the same belt as stretch but the protection part has the same execution as a TENA Pant. This brings a very stretchy protection part increasing the leakage security. Again the fastening and fastening zones are easily distinguishable and related through colour and shape.

TURNER

Turner, visualized in figure 8.10, is an additive product to aid in the turning of the care taker and thereby facilitates the change of incontinence protection. The concept is based on that pull sheets are commonly used in care today and the basic concept is to apply handles to these pull sheets. Either the handles can be incorporated in the product or come as an ad-on. Use of the product is likely to increase the experienced level of control as well as the comfort of the care taker and the caregiver. It also provides for increased dignity in the care situation as well as increased quality of fit and decreased risk for leakages.

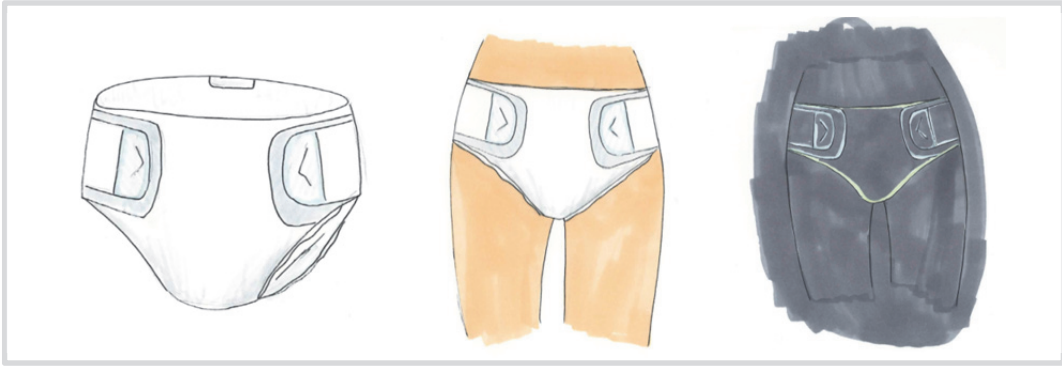


Figure 8.1 Slip tactile

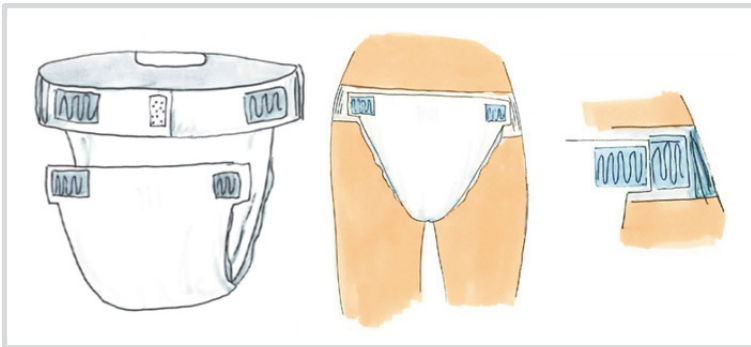


Figure 8.2 Flex tactile

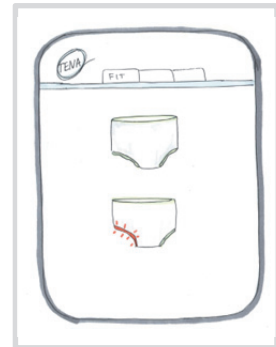


Figure 8.3 Lightaway

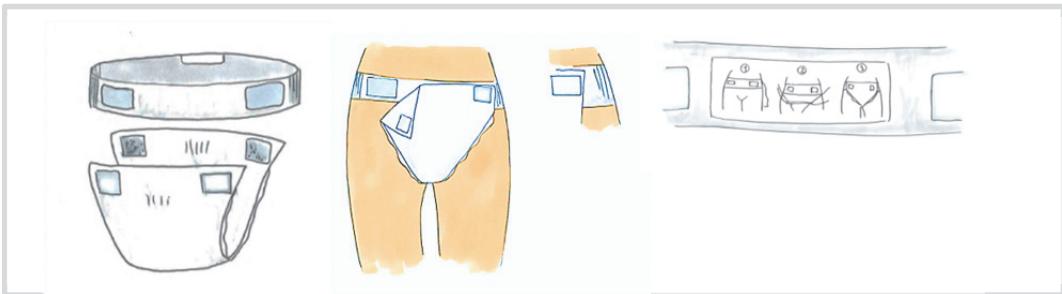


Figure 8.4 Hoop

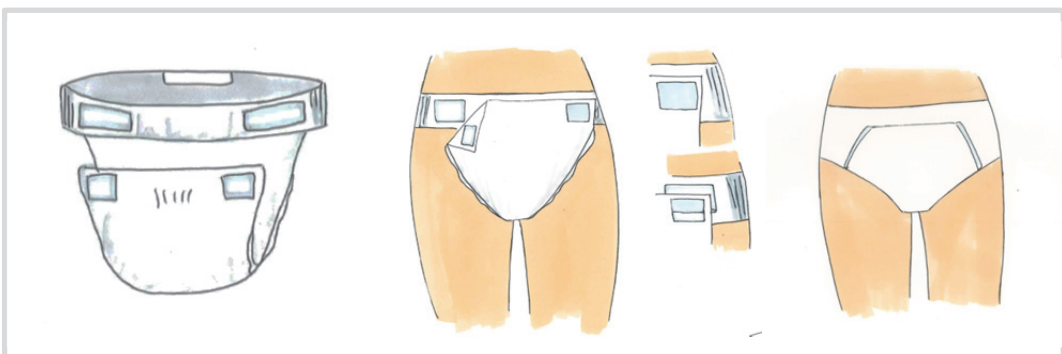


Figure 8.5 Loop



Figure 8.6 Buckle

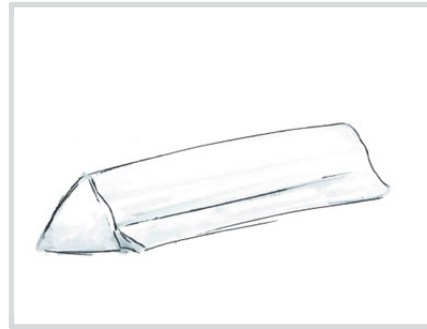


Figure 8.7 Support

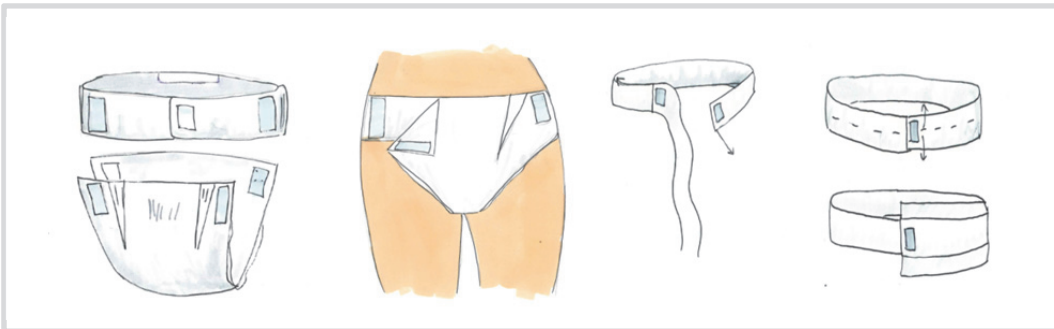


Figure 8.8 Stretch

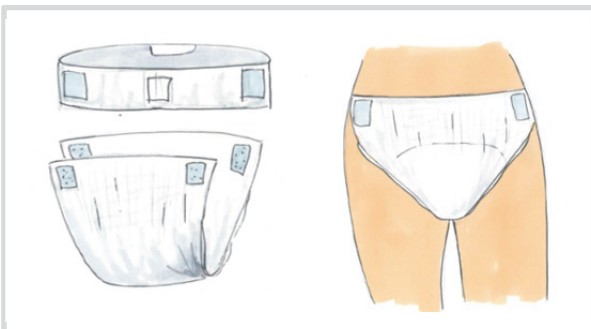


Figure 8.9 Super stretch

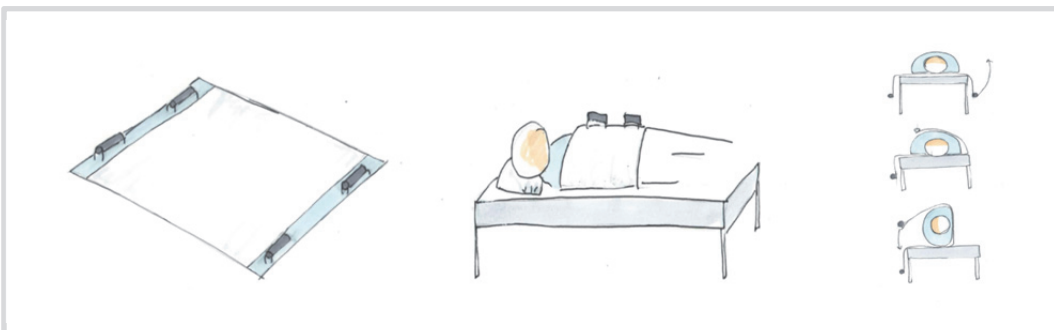


Figure 8.10 Turner

8.3 CONCEPT SELECTION

To select concepts for further development meetings were held with key competences within the area of incontinence care products at SCA. Before the meetings an evaluation (see appendix XI) was made of the possibility of solving the usability issues identified in the analysis to visualize what problems were possibly solved by the concepts. Each concept was presented after which discussion was held and interesting parts of the concepts were identified. All concepts were hereafter put into a matrix (see appendix XII) visualizing feasibility versus consumer satisfaction for the extreme and normal use case. After further discussion it was decided to focus on one concept regarding one arm interaction and one regarding the heavy care taker. The change in total darkness scenario was thereby omitted for the further development. The concepts that were decided to develop further are explained below.

THE COMBINATION CONCEPT – TENA MULTI

As there was a selection of concepts with the possibility of solving the majority of the existing key criteria it was chosen to focus on a combination of some of the different solutions. Focus was put on creating a module based system enabling different ways of application, such as pull-up or wrap around, fit for different use situations. The wanted outcome was a flexible loose openable belt, as presented in the stretch concept and a protection part similar to the Hoop concept enabling one hand application as well as eased application on the heavy care taker. The aim was therefore further to increase the usability in these situations through especially focusing on the functionality of the product as well as its explicitness, visual clarity and feedback through the further development. It was furthermore decided to call the concept TENA Multi.

TENA TURNER

TENA Turner was seen as having benefits for the home care situation or institutions where no advanced aids or technologies are available. It was additionally regarded as beneficial as the weight of the population is increasing. The solution was further seen as having an advantage for the institutional care where the number of personnel is decreasing. TENA Turner was also in line with the existing TENA assortment so it was chosen to further develop the product solution as a side branch to the development of the TENA Multi concept.

8.4 CONCEPT DEVELOPMENT

When the most interesting product solutions had been identified the further work focused on developing these two product concepts. In this section the execution and result of the development is presented for the TENA Multi and Turner concepts respectively.

8.4.1 CONCEPT DEVELOPMENT – TENA MULTI

In the further development of the TENA Multi concept focus was put on creating a flexible belt with increased usability especially for the one armed caregiver as well as for the normal situation. The already existing “Belt” absorbing part was used as a basis and the development work herein focused on creating a product with consistency through the application that further communicated handling and achievement of task. The basic thought of the concept was to enable the caregiver to decide in what state the product should be applied. As the belt is flexible it enables application of the product in a “slip-on” manner in addition to the existing wrap around function bringing a versatile product which can be applied based on the situational needs. The starting point for the development was the European market and the intended use were approximately 3 absorbing products per belt used.

THE BELT

The development of the belt was performed in steps. Initially the sizing possibility and characteristics of existing elastics were mapped after which focus was put on the communication of handling and achievement of task.

Sizing

The development of the belt was started with identifying the sizing needs. One initial thought was to sell the belt separately in sizes similar to ordinary belts as this would bring an increased quality of fit as well as an increased feel of individuality. Selling the belt in these small range sizes would though bring that the belts and absorbing parts would have to be sold either separately or that they would need to come in a wide range combinations of pads and belt lengths. The other alternative was to hold on to the already existing sizing scale spanning from XXS to XL as that is what TENA customers are familiar to.

As the absorbing parts of TENA Belt come in a predefined size range (S-L) it was concluded that it would be beneficial for the belts to have sizes correlating to these to ease the purchase of the product. To be consistent with the existing range and keep it easily understandable it was decided to aim at holding on to the existing scale of sizes and add an XL product for the heavier care taker.

The overall product has the circumference of two protection widths plus the elastic areas and joining zones. The protection width and minimum elastics width, for

providing sufficient total stretching, was therefore determining the waist circumference for each size. A proposal of product width and length for size XL was taken forward based on the XL Slip product used for the evaluation of the existing products. The proposed width was 45 cm and the length 95 cm.

The proposed waist size spans were 72-90 cm for a size S, 82-100 for a size M, 97-120 for L and 117-160 for XL. Herein the proposed elastics width was 5 cm for S and M, 7.5 cm for L and 12.5 cm for XL. To calculate the needed elastics a recent study of anthropometric measurements in elderly Italians was studied. The result herein showed that the Waist-hip ratios varied between 0.80-1.05 for the 5th and 95th percentile of women and men aged 65-84 (Perissinotto et al., 2002). Molarius et al. (1999) performed a study on waist hip ratios of 25-64 year olds in 19 populations. The result herein shows an increase in waist hip ratio with age and presents values for the waist hip ratios for each population. As the data did not cover the intended target group it was solely used as a mean to confirm the data provided by Perissinotto et al. (2002). Based on the values provided by Perissinotto et al. (2002) and the proposed waist spans the maximum hip measure within the sizes would be 105 cm for S, 125 cm for M, 150 for L and 200 for XL.

The values brought a need of elastics enabling slightly above 5 times the initial length. The waist measures were thereafter adjusted to provide for an elasticity of 5 times the initial length, bringing the following sizing: 72-88 cm for S, 84-99 for M, 97-120 for L and 117-160 for XL.

Elastics

The conclusion of the sizing was that to enable covering the existing sizing range and allow for using the belt as a slip-on product a highly elastic material was required for the side elastics. A meeting was therefore held with Anders Silfverstrand, Material Innovation Manager at SCA (2012-03-28). At the meeting it was concluded that there were materials with the wanted characteristics, making it the design possible. These materials included threaded elastics as well as laminates.

To visualize the probable end result of choosing threads or laminates as elastics mock-ups were built. These are visualized in figure 8.11. The laminated elastics had an advantage regarding look and feel whilst the threaded elastics had an advantage in being fully breathable. The laminated elastics though proved not to practically enable enough elastic for the intended purpose, so the threaded elastics were chosen for the concept to be evaluated. The advantage in look and feel in the laminated elastics though brought that it was taken forward as a possible future area of development.

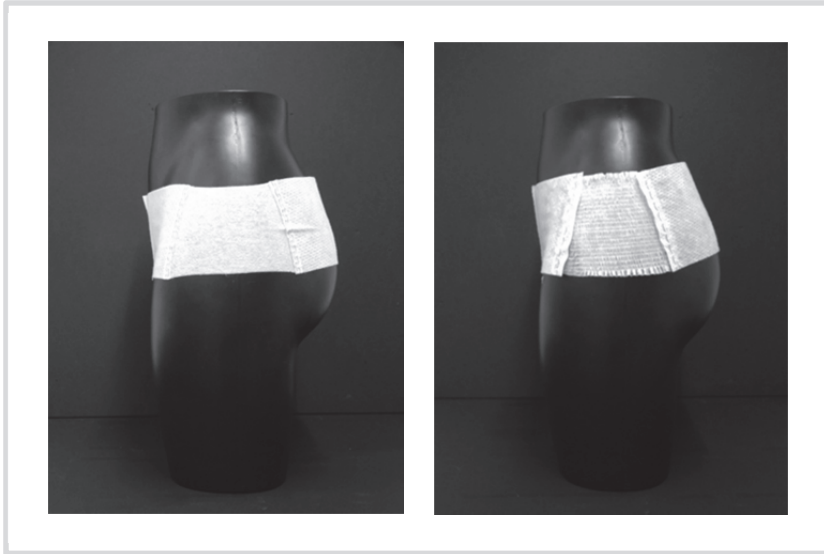


Figure 8.11 Laminated vs. Threaded elastics

Disposable versus washable

During the meeting with Anders Silfverstrand (2012-03-28) the possibility of a washable belt was further discussed. It was concluded that the joining of the materials was the critical factor for the ability to wash the product. The joining, as well as the materials, must be able to stand heat to be durable for washing. Another important factor for washable belts is how many times they can be washed. As the absorbing part has fastenings that scratch the landing zones the landing zones are worn and the fastening on the belt itself catches “dust” and other material decreasing the quality of the fastening. With the existing fastening system it was therefore questioned if it is reasonable to have a belt that can be washed more than a few times.

THE OVERALL PRODUCT

As previously stated it was chosen to base the developed absorbing part on the existing TENA Belt product. Emphasis was herein put on increasing the visual clarity and the feedback given through use of the gestalt laws such as similarity in colour coding's and shapes.

Fastenings and their landing zones

One of the main issues of the existing products was that there is no indication of appropriate fastening zones. A set of design proposals, visualized in figure 8.12, were developed for the visual representations of the appropriate fastening zones of which the first, based on the aimed visual representation presented in the expression board, were chosen for further development.

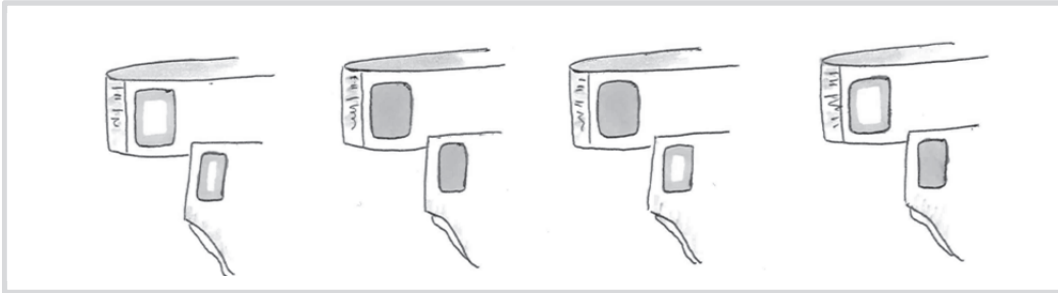


Figure 8.12 Design proposals of fastening zones

The proposal for the developed concept was to use neutral, yet instructive colouring to provide visual clarity and feedback of the appropriate fit. The existing belt is grey, but to highlight the landing zones and make them easily distinguishable from the belt it was chosen to have a white belt. In the presented concepts blue were used as an outlining colour but to increase the communication regarding level of absorption and to be consistent with the existing assortment it was chosen to use the absorption coding, blue, green and purple for the fastenings on respective absorption level. It was also proposed to use the same shape on the fastenings and their landing zones to provide for grouping through similarity in shape as well as colour. The shape and size was based on the rectangular outline of the fastenings. The landing zone size (60*80 mm) was based upon the size of the fastenings (30*50mm) plus some variation of the fastenings. The position of the landing zones was based on the protection product width. The landing zones were centred height wise on the belt to decrease the risk of a fastening ending up outside the borders of the belt.

To distinguish the fastening zone of the belt itself from the fastening of the protection a set of proposals of which some are illustrated in figure 8.13 were developed for the belt fastening and its landing zone. Screening amongst the proposals was performed with regards to visual clarity and manufacturing. It was decided to mark the belt fastening and landing zone with a dot as this also is metaphorical with a belt.

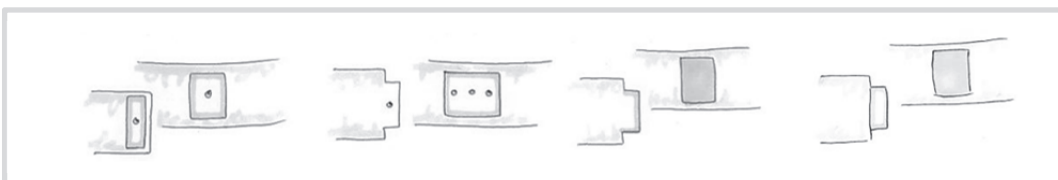


Figure 8.13 Design proposals belt fastening

Information

To reach the aim of visual clarity it was decided to rearrange the information on the outside of the protection as the information herein ended up in a visual clutter. The existing product has information about size, level of absorption, procedure of application and a wetness indicator on the back sheet of the product, visualised in

figure 8.14. The aim of the positioning of the information on the new product was to make the information visible at logical positions when relevant for the caregiver.

A need analysis (appendix XIII) was performed for the information, in which it was analysed when respective piece of information is needed. The result showed that the information about brand, product, level of absorption and size should be provided when taking a product out of the pack as it brings quick confirmation of that the correct product has been picked. It also enables distinguishing between products if there is more than one care taker. This information should furthermore be



Figure 8.14 TENA Belt

visible when changing as for example the product name distinguishes the product from the very similar Flex product which has different functionality and handling. To group the information and make it easily visible, yet discreet during use it was proposed to put it on the area covering the front right fastenings. To make it easily visible when picking the product the folding in the package was studied and it was concluded that the crotch area of the product would be appropriate for placement of the information as it is visible when picking the product yet hidden when the product is applied, yielding a discreet product. The proposals of information zones and their visual representation are visualized in figure 8.15.

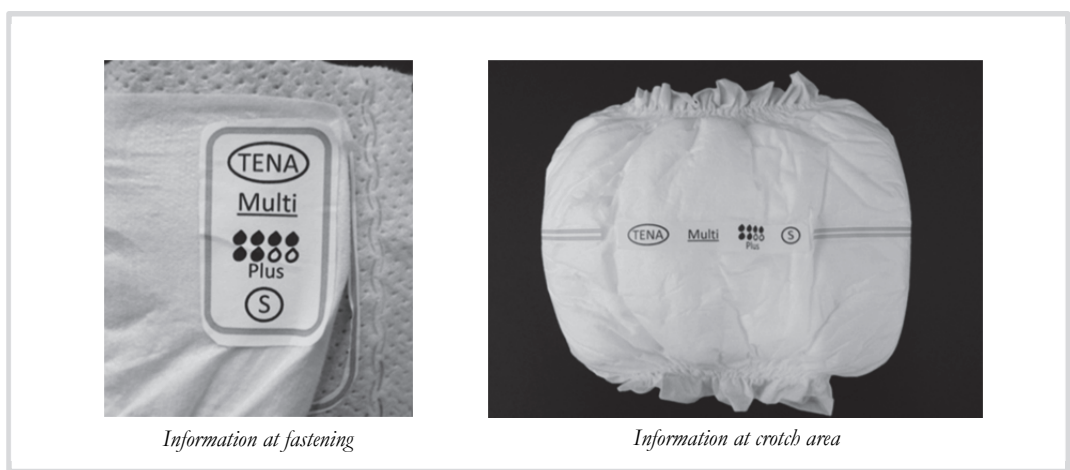


Figure 8.15 Information zones

The instruction is active during the application as it indicates the order of application. To highlight the instruction and make it easily readable it was decided to move it to

the belt. This would also bring a decrease in the information given at the front of the product and an increase of the dignity in the product.

Communication of fit and achievement of task

The fastenings and corresponding landing zones were used as a communication of achievement of task. Matching five fastenings with five landing zones were chosen to provide visual clarity, consistency and explicitness. Further the communication of fit was aimed to be increased through use of two centre lines surrounding the wetness indicator. The dot on the belt fastening ending up in the middle as well as the symmetry created by the fastening zones and the elastics were also seen as an aid in the communication of fit.

Instructions

In the existing product solutions the instructions are placed on the back sheet, visible at the outside of the product. As there are five ways to apply the developed product on the care taker it was chosen not to have a complete set of instructions. In the development of the instructions emphasis was instead put on highlighting the ability to use the product as a pull up or wrap around, and further to communicate that the protection should be applied on the outside of the belt, the proposed instruction are visualized in figure 8.16.

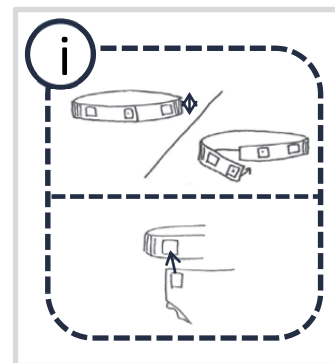


Figure 8.16 Instruction

MANUFACTURABILITY

During the development of the concept there were continuous checks of the manufacturability of the product. As the protection is based on an existing product the manufacturing process is already known and thoroughly tested. The design of the belt was based on existing manufacturing techniques and as printing on non-woven is a known technique the design is possible for production.

CONCEPT FOR EVALUATION

The overall TENA Multi product for evaluation is presented in figure 8.17. Herein the belt and the combination of the belt and protection are visualized. Figure 8.18 further presents the visual representations of the products used during the second usability tests.

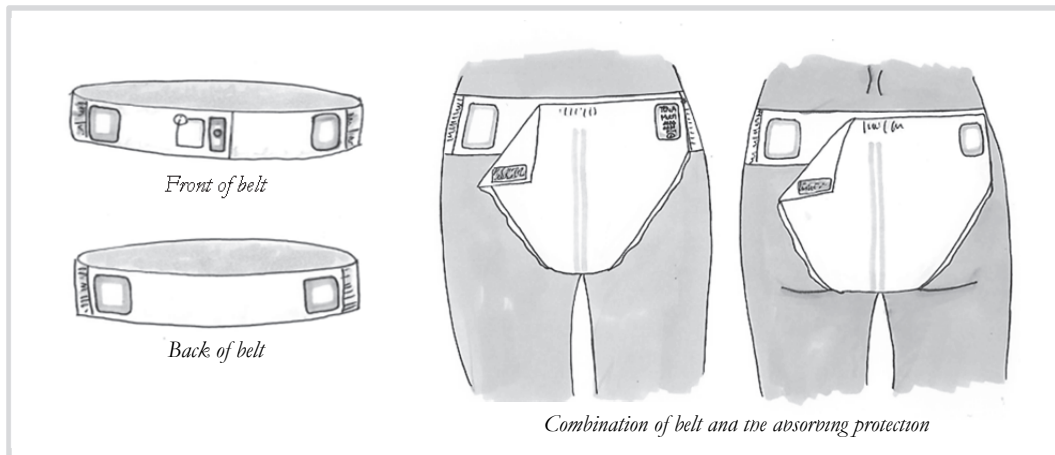


Figure 8.17 Concept for evaluation

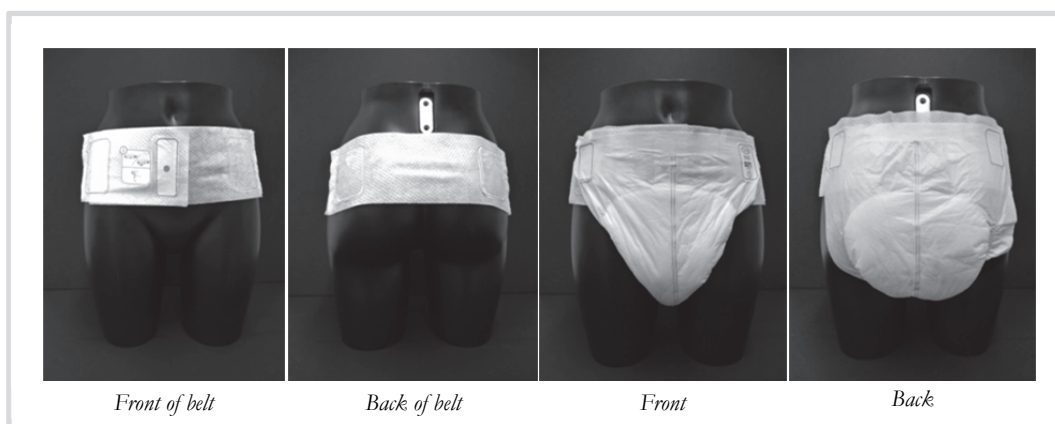


Figure 8.18 Prototypes used in the second usability test

8.4.2 TENA TURNER

In the development of the turning product the initial focus was put on identifying the most important requirements for the product within the list of requirements and some new requirements were added to fit this type of the product. The result can be seen in appendix XIV. The main requirements were to enable and facilitate turning and provide for effective and efficient handling. Further it was regarded essential to provide for grip surfaces ergonomically developed for the caregiver and to provide dignity and comfort for the care taker

It was decided to use the existing TENA assortment as a starting point for the development of the concept. An initial testing of the existing TENA sheet assortment was performed to see if these were fit for the purpose of turning the care taker. The result showed that the existing products were not fit for the task of turning as the products could not withstand the forces needed to turn the heavy care taker. There was therefore a need to strengthen the sheets to enable turning.

Gonzales et al. (2009) propose that the force required to logroll a patient is 32% of the body weight. Logrolling implies maintaining a straight line through the body

during the turn. The force is estimated based on a set of assumptions, including that the patient is immobile and cannot help him or herself. The force is lowered when using assisting devices and when the patient can aid in the turning (Gonzales et al., 2009).

MATERIALS

Focus was put on identifying materials fit for the purpose of turning a heavy patient. Materials were especially sought after in the existing TENA assortment to go in line with the existing products as it would be a benefit to make use of already existing material instead of adding new materials to the assortment. The required characteristics were found in the material used for the belts in TENA Flex and Belt. To enable using the sheet as a bed protection a plastic back sheet was proposed, a future potential was herein identified in finding a low friction back sheet material to facilitate the repositioning of the care taker in the bed.

USE

The development aimed at generating a product solution enabling use over a reasonable amount of time and changes. It was proposed that the sheet should be used over a time frame of ten changes. This proposal was founded in the characteristics of the material chosen for the product. To minimize the environmental impact and to provide for a sustainable economic situation for the customer it is suggested that additional bed sheets are applied to the turning device if leakages are common.

BUILT IN OR REMOVABLE HANDLES

The concept presented at the part time presentation proposed incorporated handles or handles as add-ons to existing turn sheet products. As the developed sheets are made of disposable material it was considered essential to develop handles not requiring extra material or to develop a solution with removable handles to decrease the environmental impact as well as the price of the product. After an additional idea generation three concepts visualized in figure 8.19 were evaluated in a Pugh-matrix (Appendix XV).

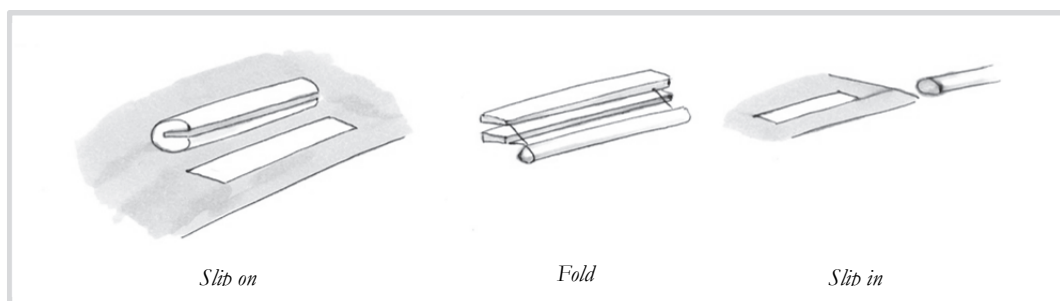


Figure 8.19 Handle concepts

The result showed a clear favour for the first concept which was chosen for further development. The idea was initially tested through prototyping and testing on the

heavy manikin. The result showed that reinforcement was needed in the gripping area not to damage the product and to distribute the load over a larger surface.

The basic functionality of the chosen handle design was a simple slip on procedure of the handle on the sheet (see figure 8.20). The handle position is secured through the turning as the applied force is always directed in the slip on direction. The reinforcement of the sheet also provided for stability of the positioning of the handle. Using the combination of handles and reinforcement brings distribution of the force over the handle area as well as the through the reinforcement over the entire side edge of the sheet.

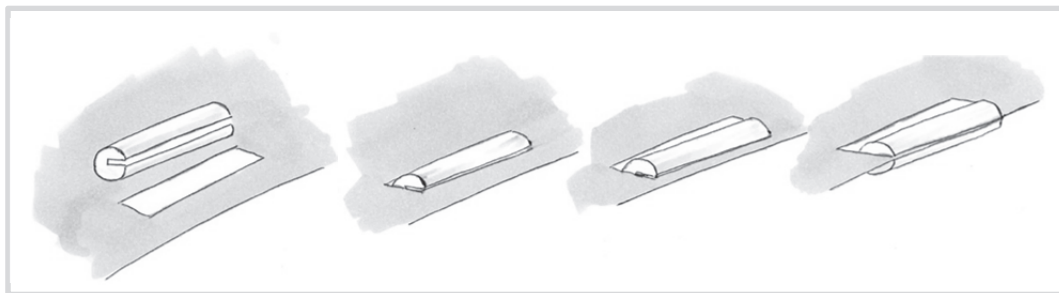


Figure 8.20 Slip on procedure

HANDLE DESIGN

To provide for a good grip and maximum grip force it was chosen to use a cylindrical handle. The diameter of the handle was based upon anthropometric data on maximum grip diameter within a group equivalent to the standard reference group. Herein the maximum grip diameter spanned between 43 mm for the 5th percentile and 59 for the 95th percentile (Pheasant, 1996). As the handle should be designed to enable overlap of the thumb and the fingers, as well as be wide enough to provide for a product withstanding ten changes, it was decided to use a handle with a diameter of 38 mm (Bridger, 2003).

To define the length of the handle the anthropometric data of the width of the hand was studied for the group equivalent to the standard reference group. The hand width including the thumb spanned between 84 and 114 mm for the 5th and 95th percentile respectively (Pheasant, 1996). As the hand handle contact should be maximized, and the minimum handle length should be 115 mm combined with that an increased hole length for the handle would bring less stability to the product, the length of the handle was set to 120 mm (Bridger, 2003).

To decide upon materials appropriate for the handle similar existing products were studied. The study provided a set of materials fit for the application. Considering its good properties, recyclability and low cost polypropylene was suggested for the product which is proposed to be manufactured through extrusion.

To provide for an explicit handle it was proposed to have text on both sides of the slit. This text was oriented to be readable when holding the handle in the appropriate direction for application.

OVERALL DESIGN

To provide a large support area to spread the pressure over the body of the care taker but still provide a manageable product it was decided for the product to cover the distance between hips and shoulders. The sitting shoulder height of elderly people was therefore studied and the result showed a spread between 445 mm and 615 mm for the 5th and 95th percentile respectively (Pheasant, 1996). To cover the area between the hips and shoulders as well as enabling leakage security through covering the area below the hips it was decided to have a product breadth of 900 mm. To decide upon the product width simple empirical evaluations were performed. Herein the task of turning was performed using different product widths and the conclusion was that to fit the common bed size of 900 mm and provide comfort in the use situation a product width of 1200 mm was sufficient. This width also allows for tucking in the handle area at the side of the bed while not used to make the product stay in place in the bed. The shoulder breadth of the 5th and 95th percentiles of the standard reference group spans from 325 to 430mm (Pheasant, 1996). To enable the care taker to keep his or her arms close to the body during the procedure it was therefore decided to have a distance of 160 mm between the centres of the handles. The holes for the handles were set to 33*120 mm to provide for space for the handle as well as the fingers when the handle is grabbed. Further rounded corners were chosen for the openings to not create any indication of fracture.

To spread the force on the sheet over a larger surface it was chosen to use a reinforcing polymer profile along the handle edge. This reinforcement was proposed to be 3 mm thick 30 mm wide, 900 mm long and be made out of extruded polypropylene. The material choice was based upon its low price and weight as well as its good properties and recyclability. The width of the reinforcement and the slit in the handles were designed to provide for an overall smooth surface when the handle was applied.

CONCEPT FOR EVALUATION

The overall TENA Turner product for evaluation is presented in figure 8.21. Herein the combination of the sheet and handles are visualized. Figure 8.22 further presents the visual representations of the product used during the second usability test.

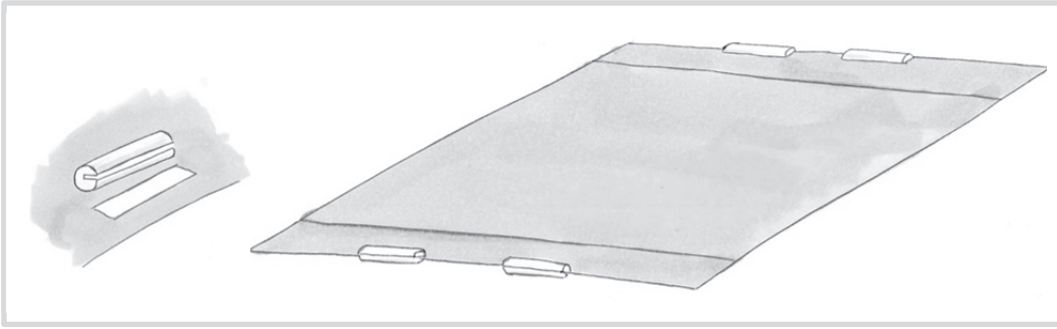


Figure 8.21 TENA Turner

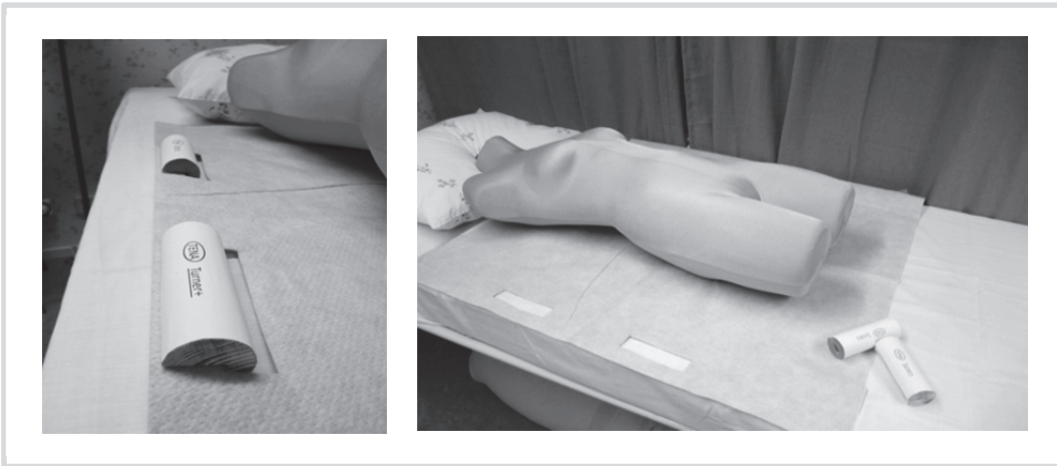


Figure 8.22 Prototype

9. CONCEPT EVALUATION

To validate the further developed TENA Multi and TENA Turner designs in terms of functionality, usability and understanding empirical evaluations were performed. TENA Multi was evaluated through usability tests while TENA Turner was evaluated regarding the explicitness and guessability of the system and the required force for turning. Herein the results of the tests are presented, areas of needed improvements are identified and design changes to solve issues in the design are proposed.

9.1 TENA MULTI

This section presents the result of the empirical analysis of TENA Multi. The developed product solution was evaluated in accordance with the first usability test to enable comparison of the collected objective data and after each test a questionnaire was filled in by the test participants.

9.1.1 USABILITY TEST 2

Herein the result of the second usability test, performed in accordance with the procedure of the first usability test, of TENA Multi is presented. For the tasks, test protocol and full test result see appendix XVI-XVIII. The product was tested during change with one arm as well as on a heavy care taker and under normal circumstances. The result is presented for each situation respectively.

CHANGING WITH ONE ARM

The result from the usability test showed that all test participants managed changing TENA Multi with one arm, and overall the result was a product with a good to very good fit and high leakage security as visualized in figure 9.1. The level of confidence had a median of “confident” and the experienced test participants had a higher confidence level than the inexperienced. The level of confidence was clearly related to the achieved quality of fit. The task completion times, illustrated in figure 9.2, differed between just below three to four and a half minutes, with a total median value slightly below 4 minutes. The experienced participants though had slightly lower task completion times than the inexperienced participants.

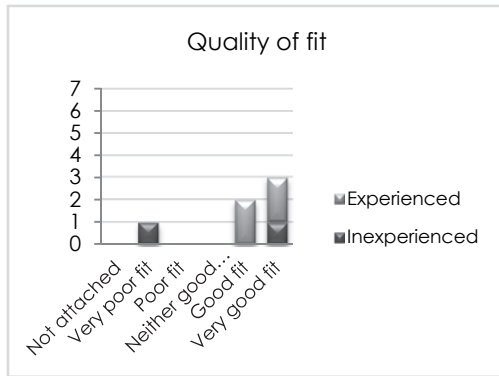


Figure 9.1. Quality of fit, number of participants reaching each level of quality of fit.



Figure 9.2. Median time for task completion

Either the belt was applied to the manikin first after which the protection was applied to it, or the protection was first applied to the belt whereupon the combination was applied to the manikin. Minor to major errors that occurred involved not applying the fastenings in the intended landing zones and the belt getting stuck in itself. When the fastenings ended up at the elastic zones there was a risk for damaging the elastics. At one occasion the belt was twisted so that the elastic zones ended up under the protection instead at over the hips. When changing on the manikin it was denoted that it would probably be harder with a real care taker as the manikin is very light. What was front and back also brought some initial confusion but all test participants put the product the intended way around.

Identified improvements

- There was a remained high leakage security, no fastenings ended up outside of the belt.
- There was an increased efficiency through the introduction of the elastic belt.
- The developed product brought lower level of errors, and less of a trial and error procedure, compared to the previously tested product.
- The test provided a level of confidence with a more clear correlation to the quality of fit founded in increased feedback of the quality of the outcome.
- There was an increased visual clarity of appropriate fastening zone, especially for the belt itself.
- There was an increased consideration of user resources in fastening of the belt as the elasticity provided for an eased reach of intended position.
- The product provided a high guessability of front and back.
- The satisfaction level was lowered by the insufficient communication of front and back.

Identified usability issues for further improvement

- There was still a need to increase the explicitness of front and back.
- There was a need to increase the clarity and explicitness in the fastening zones, further to distinguish between front and back fastenings.

CHANGING DURING NORMAL CIRCUMSTANCES

The result of the test of changing TENA Multi during normal circumstances showed that the outcome overall was a good to very good fit with high leakage security (figure 9.3). A minor error was though fastening the fastenings outside of their intended landing zones, but this did not inflict on the fit and leakage security. The time for task completion, visualised in figure 9.4, varied between one and a half and just below three minutes.



Figure 9.3. Quality of fit, number of participants reaching each level of quality of fit.

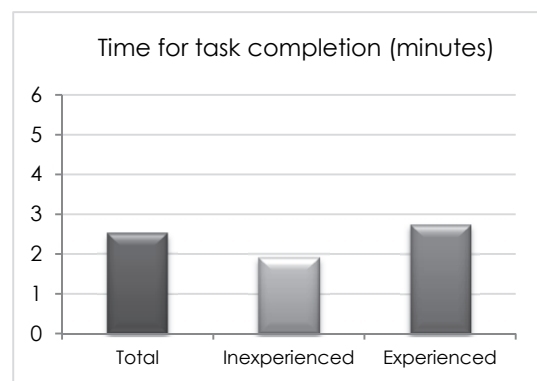


Figure 9.4. Median time for task completion

In one case the test participant denoted that it noticed that the fastenings ended up at the wrong positions and that they should be within the markings. The result also shows that the elastic zones were used to centre the product over the hips. If the belt was initially fastened high at the waist the elastics provided possibility to quickly adjust the position to enable fastening of the front. The information on the belt was also used during the interaction to gain information.

Benefits for normal situations and issues for improvement

The test result shows that TENA Multi provided effective and efficient handling in the normal use situation. The product provided for leakage security and enabled flexible handling. The usability issues for further improvement comprised the same issues as identified in the one armed situation, there was a need to increase the clarity and explicitness of the fastenings and distinguishing between front and back.

CHANGING ON A HEAVY CARE TAKER

Like in the initial usability tests changing a TENA Multi on a heavy care taker was the only task where test participants did not succeed in completing the task. The

overall results both in quality of the output and the time for task completion, as visualised in figure 9.5-9.6, were similar to those of the change of TENA Slip on a heavy care taker. The experienced participants had higher quality of the result as well as a slightly higher time for task completion than the inexperienced participants. Overall the time for task completion varied between three and a half and four and a half minute. Either the belt was applied to the manikin first where after the protection was applied to it, or the protection was first applied to the belt where after the combination was applied. During the test the instruction on the belt was used for indication of application.

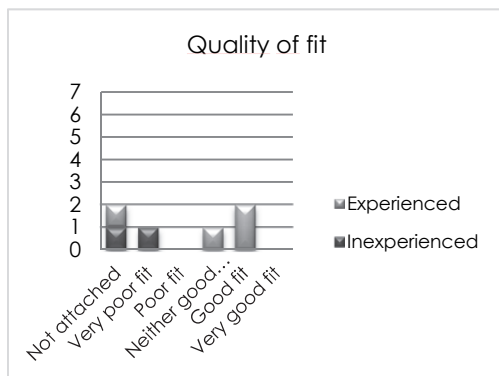


Figure 9.5. Quality of fit, number of participants reaching each level of quality of fit.

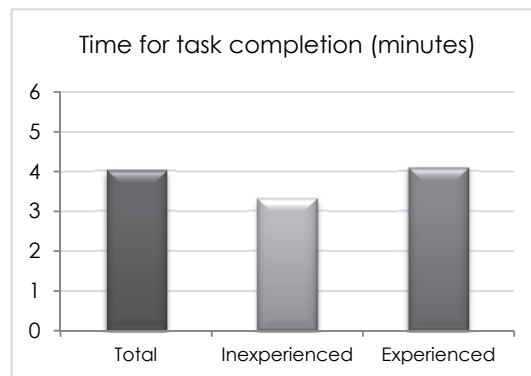


Figure 9.6. Median time for task completion for those finishing the task

A minor error was putting the fastenings outside the intended landing zones. A fatal to catastrophic error was not being able to get the product in or out from in under the care taker as it brought that no incontinence protection was applied.

As the care taker was very heavy the used product was commonly pulled out. It was also herein commented on that it is possibly not so comfortable for the care taker to be handled in this manner and turned over a lot as it is heavy. The fit at the back was another concern as it was hard to check, and it was commented on that one does not know if the fastening has landed on the belt at the back.

Identified improvements and usability issues

The result does not provide any evidence for observable improvements in TENA Multi compared to a change of TENA Slip in the case of a the heavy care taker. It was apparent that the aid of a turning device was needed.

9.1.2 QUESTIONNAIRE 2

After each test a questionnaire was filled in in accordance with the procedure of the first usability test. The full questionnaire used and the full result can be seen in appendix XIX –XX. As the tests were performed by different test participants than in the first test no comparison could be made of the subjective ratings of the

interaction (Rexfelt, 2008). The result was therefore solely used as an estimation of the satisfaction of each specific case.

CHANGING WITH ONE ARM - TENA MULTI

The task that was experienced as most difficult to perform when changing TENA Multi with one arm was applying the new product gaining a median of between neither easy nor hard and easy. The steps that were perceived as most challenging were to pull the protection to attach to the belt. The test persons also experienced difficulties in identifying front and back of the protection.

The level of control had an overall median of 3.5 and a spread between 1 and 5 where 1 is very low level of control and 5 is very high level of control, with the inexperienced test persons yielding slightly lower ratings than the experienced. The clarity of the communication of handling had a median of neither clear nor unclear. The communication of achievement of task had an overall median rating between neither clear nor unclear and clear. The experienced participants experienced higher degree of clarity than the inexperienced. That the fastenings got stuck in the product was seen as a hinder and the markings were seen as an aid in the performance of the task. The ratings indicated that the level of satisfaction was higher among the experienced than the inexperienced test participants. Further the satisfaction was increased by the use of markings.

CHANGING DURING NORMAL CIRCUMSTANCES – TENA MULTI

The part task that was experienced as hardest to perform when changing TENA Multi during normal circumstances were applying the new protection, yielding a total median value between neither hard nor easy and easy with a spread between hard and easy. The test participants found it most challenging to apply and reach the correct position of the belt and protection.

The experienced level of control had a median towards in control with a value of 3.5 and a spread between 2 and 5 where 1 is very low level of control and 5 is very high level of control. The communication of handling and achievement of task had a spreads between unclear and clear. The overall median value for the clarity of handling was rated between neither unclear nor clear and clear. The achievement of task reached a value of neither unclear nor clear. In both cases the experienced test participants rated the clarity higher than the inexperienced.

The fastening zones and the elastics were seen as aids in completing the task whilst the missing information of back, front, up and down was seen as a hinder. It was also commented on that the similarity of the belt landing zone and protection landing zone could bring confusion. Another test person pointed out that the dot for the fastening of the belt clarified in where to put the different fastenings.

The ratings showed an indication of that the experienced test participants perceived a higher satisfaction than the inexperienced when changing TENA Multi during normal circumstances. As in the case of the one armed change the satisfaction was increased by the use of the outlining of the fastening zones and lowered by the lack of information of back and front.

CHANGING ON A HEAVY CARE TAKER - TENA MULTI

When changing TENA Multi on the heavy care taker the turning of the care taker and the application of the new product was rated as the hardest tasks to perform. The application of the new protection was experienced as very hard. It was commented that the heavy weight brought focus on just getting the product changed rather than the fit of the product.

The level of control had a median rating of low; the inexperienced had a lower median than the experienced, ending up at a very low level of control. The procedure of task found most challenging were turning the care taker, getting the protection under the bottom and placing it in the correct position at the back.

The clarity of the communication of handling had a median rating of clear, with higher median among the experienced participants than the inexperienced participants. The fastenings getting stuck in inappropriate places were seen as hindering the performance of the task. The markings on the other hand were seen as an aid in the performance.

The result shows that using TENA Multi on a heavy care taker generated a low level of satisfaction as the product is an insufficient tool to reach the goal of changing product on the heavy care taker as it does not simplify the task of turning the care taker.

9.2 TENA TURNER

The usability test equipment showed insufficient for testing the TENA Turner concept which therefore was evaluated by brief empirical evaluation of its explicitness and the force required for turning.

Five randomly selected SCA employees were asked to apply the handles to the sheet. All of the test participants applied the handles the correct way around. This brief empirical evaluation of the explicitness of the sheet and handles showed that the handle and sheet provided high guessability and compatibility through an explicit design.

In addition simple measurements were performed to estimate the force required to turn a person with the sheet. The force was measured through applying two luggage scales to the handles and pulling the handles to turn the person. A bed with a height of 60 cm was used for the test. The result showed that a total load of 10.2 kg

corresponding to approximately 100N which is 47% of the force proposed by Gonzales et al. (2009) to be required to logroll a person of the same weight. The result thereby implies that the force needed to turn the patient is decreased by the use of the product compared to logrolling.

9.3 CHANGES FOR THE FINAL CONCEPT

Based on the result of the evaluation of the concepts some changes were proposed for the final design. These changes are herein presented further.

9.3.1 TENA MULTI

Based on the result of the usability tests the proposed final alterations of TENA Multi focused on further increasing the visual clarity and explicitness of front and back of the absorbing part. There was also a need to increase the clarity and explicitness in the fastening zones, and herein to distinguish between front and back fastenings.

To visually distinguish between the three types of landing zones, belt landing zone, front landing zones and back landing zones it was decided to highlight the differences visually. As the shape of the landing zones were set by the shape of the fastenings it was decided to focus on the appearance of the outlining in form of colour or type of lines. Regarding colour the aim was to keep to a limited set of colours as colours were already used to distinguish between the levels of absorption. The most efficient way of communicating the different landing zones was therefore seen to be through the type of lines used for the outlining.

To provide clear communication and consistency throughout the application the same type of outlining were placed on the corresponding fastenings on the absorbing part. In addition a B for back was placed on the back of the absorbing part as well as the belt. The B aims at clarifying back and front for quick identification and the B at the belt aims at clarifying the positioning of the belt on the body as well as the alignment of the absorbing part.

It was also proposed that every third product comes half mounted, with the back part of the absorbing pad already attached to the belt. This as it would increase the explicitness of the product as it is shown how the absorbing part should be applied to the belt. It is also the intermediate way of application, making all possibilities close at hand for the caregiver, which probably would be especially beneficial for when changing with one arm. This proposal put the foundation of the decision to not, at this stage, propose a washable belt.

An additional change for the final concept was a change of the colours of the markings. The change was based on the aim to create a discreet product that fits better in with the existing TENA assortment.

9.3.2 TENA TURNER

As the brief empirical evaluation showed that the handles provided high guessability and explicitness, no design changes were needed regarding its functionality. The design in the testing stage was though very simple and changes were performed in the aim to get the handle in line with the remaining TENA assortment. The length of the handle was altered to 130 mm to enable a rounded edge and provide for a sufficient grip surface. The hole in which the handle is to be applied was also altered, to 132 mm to fit the new handle design.

10. FINAL RESULT

The final result consists of two separate product solutions; one absorbing incontinence care protection, TENA Multi, and one support product to aid in turning the care taker, TENA Turner. In this section the final product solutions are presented.

10.1 TENA MULTI, ONE PRODUCT MANY POSSIBILITIES

Herein the final result of TENA Multi is presented. The product consists of a highly flexible, reusable belt and an absorbing part, the overall illustration of the product is presented in figure 10.1.

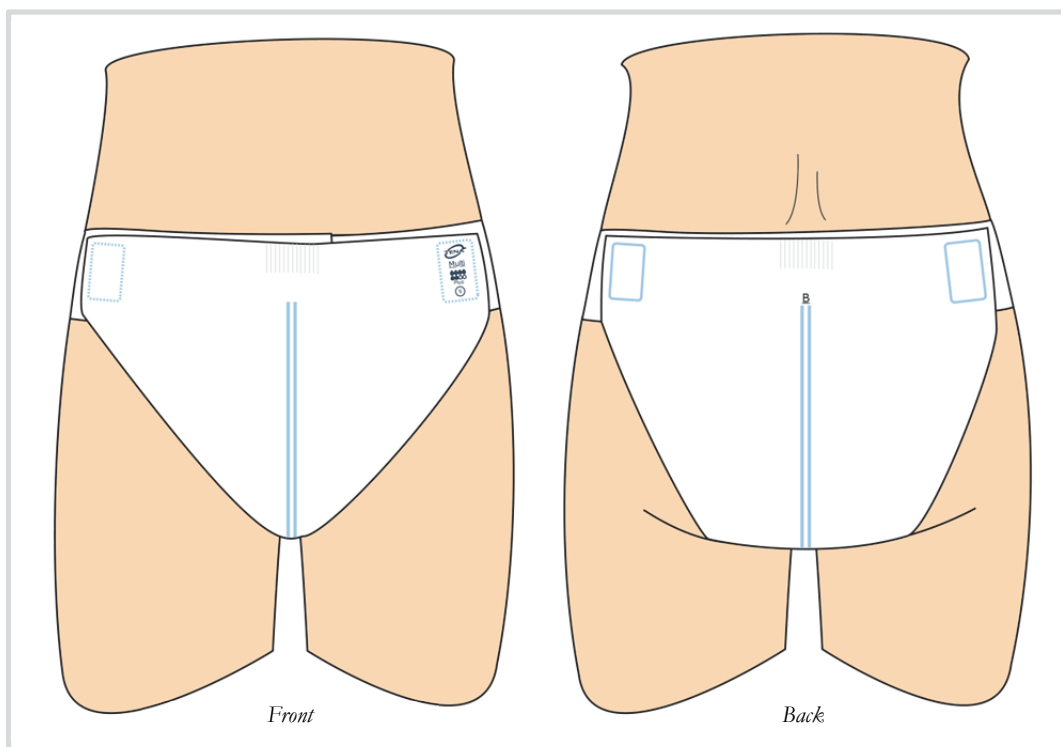


Figure 10.1 Overall illustrations

10.1.1 THE BELT

The belt is constructed by three non-woven panels joined by two elastic panels which are placed over the hips when the belt is applied to the user (for drawings see Appendix XXI). The elastic and non-woven panels are joined by ultrasonic welding. The belt has a breadth of 110mm whilst the width is size dependent. Further the belt is equipped with a hook to enable fastening. The fastening and its intended landing zone has been highlighted and made easily distinguishable from the other features through a corresponding print. Furthermore the intended fastening zones for the absorbing part has been highlighted through outlining. Front and back have different

outlining, to increase the explicitness of the product and the visual clarity in the application of the belt to the body and the protection to the belt. To further increase the visual clarity a B has been added on the middle of the back panel, furthermore the instruction has been placed on the belt to thereby always be placed horizontal and easily readable. The belt fastening the protection fastenings zones, back indication and instructions are further visualized in figure 10.2.

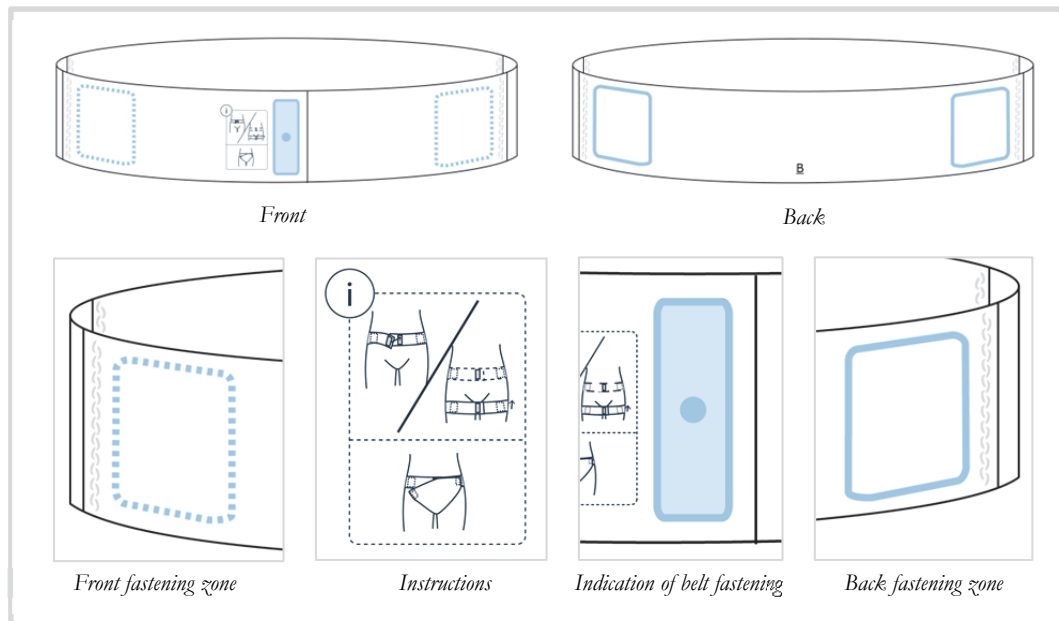


Figure 10.2 The belt

The highly flexible belt enables multiple ways of application to fit situational needs. The flexibility also facilitates the fastening of the belt, adjustment of its position and provides for quick error recovery. The flexibility is achieved through use of elastics. Figure 10.3 illustrates the visual appearance of two different kinds of proposed elastics, threaded and laminated elastics. These flexible areas, placed over the hips, aids in the positioning of the product.

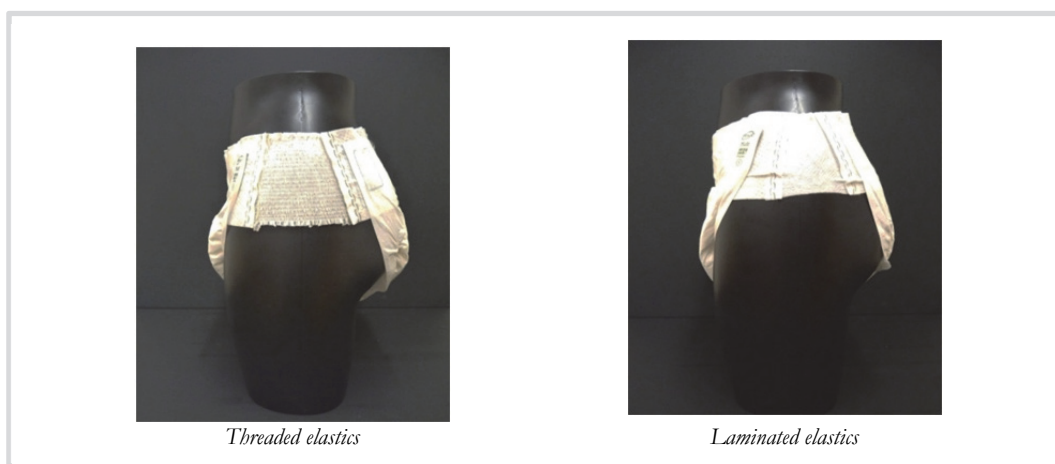


Figure 10.3 Elastics

The belt is reusable and it is proposed that three absorbing parts are used per belt. The belt comes in sizes corresponding to the sizes of the absorbing part. The elasticity has been based on data on waist-hip ratios of an elderly population and the sizes and maximum elasticity is presented below:

Small	Waist: 72-88cm	Maximum hip measure: 105cm
Medium	Waist 84-99cm	Maximum hip measure: 125cm
Large	Waist 96-117cm	Maximum hip measure: 150cm
Extra Large	Waist 120-160cm	Maximum hip measure: 200cm

10.1.2 THE ABSORBING PART

The outline of the absorbing part is based on the existing TENA Belt product. It has a textile back sheet, high loft for quick absorption, dual cores, leakage barriers, a wetness indicator and is fastened through use of hooks. The back sheet of the product has gotten a print synchronized with the fastenings as visualized in figure 10.7. The print highlights the position of the fastenings and aids in the positioning of the fastenings on the belt. The outlining also aids in identification on what is front and back as they corresponds to the outlining of the landing zones on the belt. The use of outlined fastening zones provides consistency in the procedure of application. In addition, as the belt, the protection has gotten a B to mark the backside of the product.

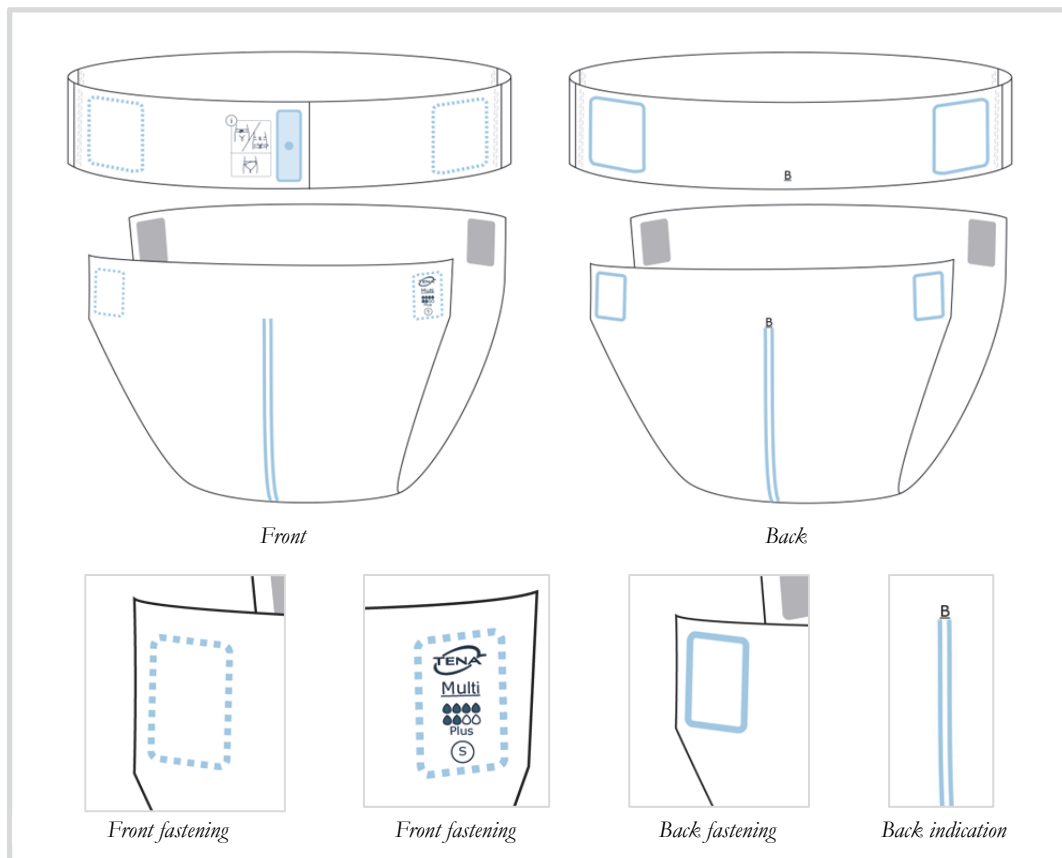


Figure 10.4 The absorbing part

The information on the protection comprising brand, product name, level of absorption and size has been grouped and placed discretely and strategically in accordance with when the information is needed. The information at the crotch area enables quick identification when the product is picked out of the package. Further the information at the front fastening provides information during removal and application. To aid in the communication of fit two lines, surrounding the wetness indicator, outlines the midline of the product. The information zones and the midlines are visualised in figure 10.5.

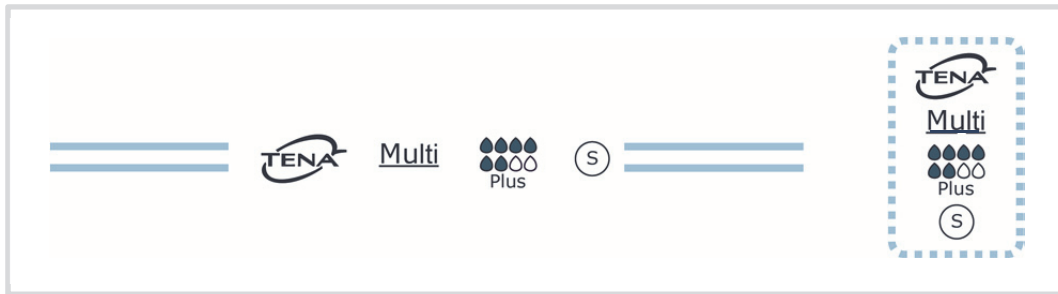


Figure 10.5 Information zones

10.1.3 THE OVERALL PRODUCT

As proposed by the previous sections the belt and the protection have been equipped with corresponding prints. To further use the outlining for transfer of information the outlining colour corresponds to the color-coding of level of absorption. This allows for quick identification and feedback of that the appropriate protection has been picked to match the belt as well as the needs of the care taker. Figure 10.6 illustrates the visual appearance of the three levels of absorption, plus (blue), super (green) and maxi (purple).

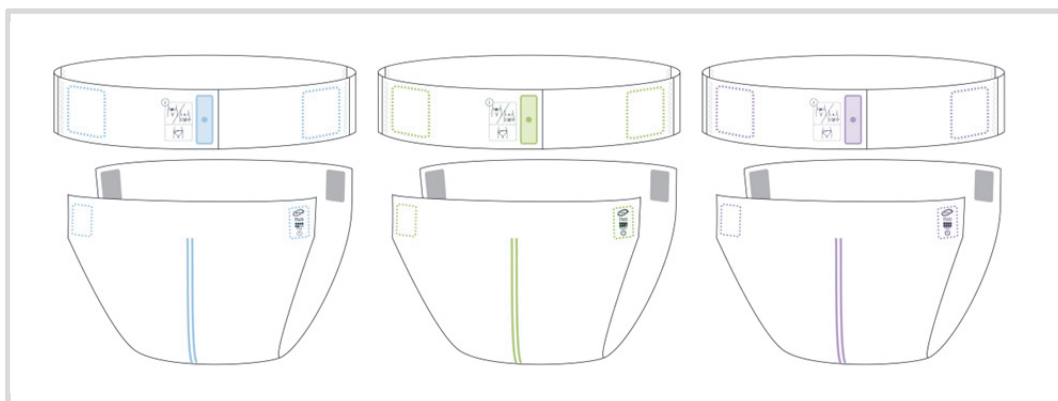


Figure 10.6 Visual appearance of the three absorption levels plus, super and maxi

The highly flexible belt enables application in a wraparound as well as a slip on manner. The caregiver can him or herself decide in what state the product is applied. Either the belt is applied first after which the absorbing part is applied, the belt and protection can also be applied half mounted similar to a Flex product or entirely

mounted, pulled up as a TENA Pants product. The different ways of application is visualized in figure 10.7.

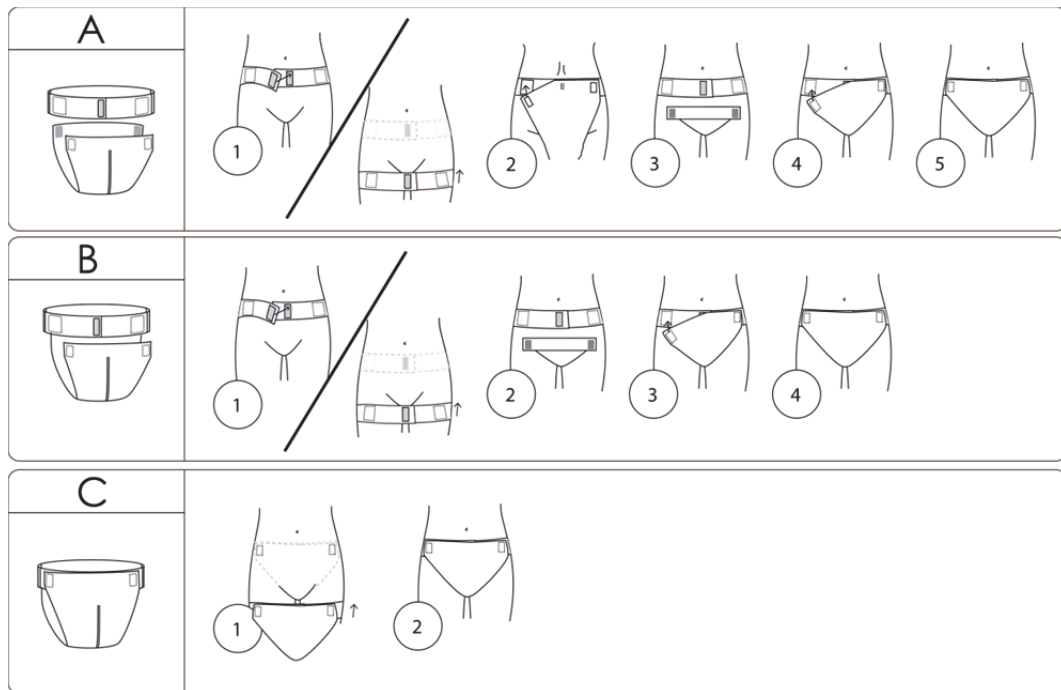


Figure 10.7 Application alternatives

The flexible belt allows for application in accordance with situational need and the product can be used for active as well as bedridden care takers. It is proposed that every third absorbing part comes with a belt half applied as visualised in case B in figure 10.7. This enables quick handling and every possible way of application is close at hand for the caregiver. When changing to the second and third protection the applied protection is simply removed and replaced by an unused one. The reuse of the belt decrease the handling moments and allows for quick and simple changes.

Prototypes have been manufactured to illustrate the final result. The prototypes cover the three levels of absorption, two different types of side elastics and two sizes. The prototypes are further visualized in figure 10.8

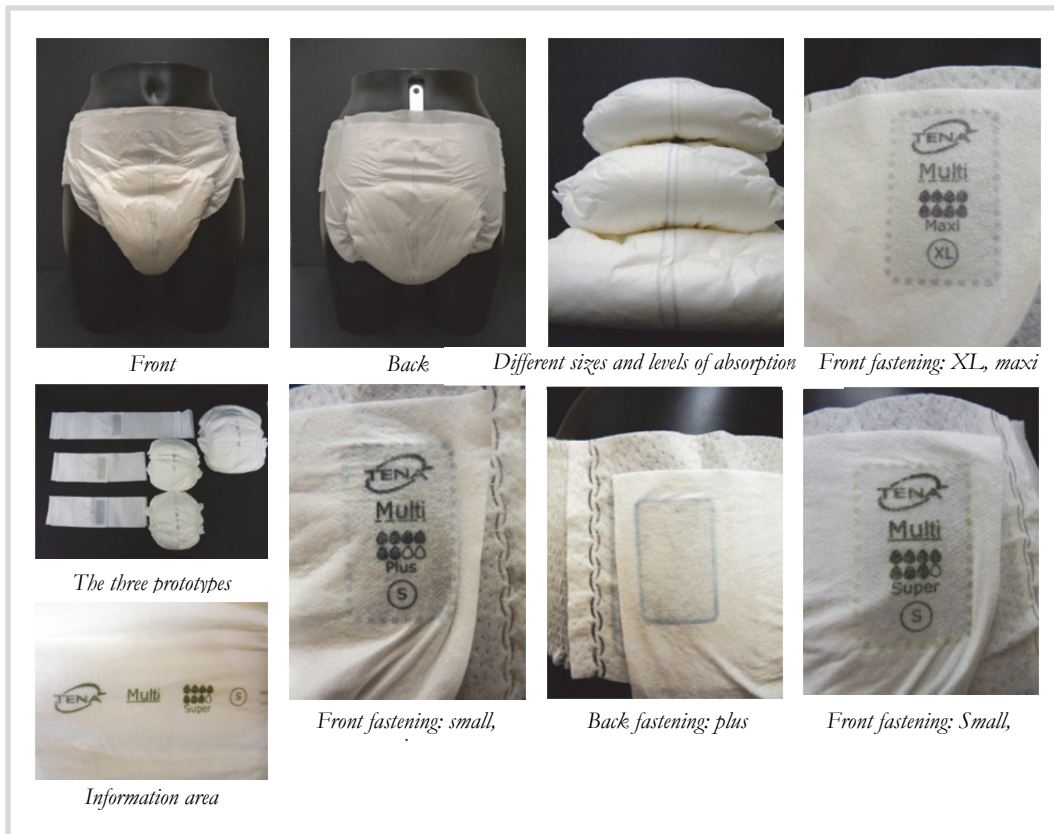


Figure 10.8 Prototypes of TENA Multi

10.2 TENA TURNER

This section presents the final result of the turning aid named TENA Turner which has been developed throughout this project. The final product proposal visualized in figure 10.9 consists of one disposable sheet and a set of four handles.



Figure 10.9 TENA Turner

The sheet is built up by a nonwoven laminate, polypropylene reinforcement and a plastic backside. The sheet is manufactured through a folding process in which the reinforcement is incorporated in the product.

The rectangular sheet enables tucking the sheets in as well as application of an under pad for bed protection. Two holes are placed at each short end at a distance to allow for comfortable turning for the caregiver as well as distribution on the pressure on the skin of the care taker. For drawings of the sheet see appendix XXI.

The handles, visualized in figure 10.10, made out of extruded polypropylene, are cylindrical with a diameter to enable a large grip surface and a slight overlap of the fingers when grabbed. The handles are applied to the sheet in a slip on manner, securing the position of the handles while the care taker is turned. The direction of application is indicated by the orientation of the brand and product name on the handle. The removable handles are easily stored and provides for a more sustainable product as they are reusable. The use of the sheet implies a turning procedure which further is visualised in figure 10.11.



Figure 10.10 Handles and slip on procedure



Figure 10.11 Turning procedure

10.3 EVALUATION OF CONCEPTS

The formulated purpose of the project included evaluating the future potential of the developed solutions. As a means of evaluating the future potential the material cost, needed process investment and the environmental impact has been analysed. Further the concepts have been evaluated towards the list of requirements.

10.3.1 MATERIAL COST AND PROCESS INVESTMENT

The two concepts were evaluated with regards to material cost and needed process investments. The cost estimations were based on the price of the material in the product, disregarding waste. The needed process investments were based on estimations, provided by the Process development manager Richard Fredriksson, (2012-05-03), of the cost of the needed machine parts to enable the manufacturing of the products.

TENA MULTI

When estimating the material cost of TENA Multi it was assumed that the absorbing part would have the same cost as the existing TENA Belt protection. When comparing the cost per product based on use of one belt per three protections for both TENA Belt and TENA Multi the result shows that using the laminated elastics yields a material cost of 102% and the threaded elastics 108% relative the existing TENA Belt corresponding to 100%.

In addition to the belt manufacturing machinery there is a need to invest in machine parts for the handling, slitting and direction of the elastics. Furthermore four separate ultrasonic systems are needed. The total needed process investment, additional to that of the belt manufacturing machinery, was approximated to 0.45-0.67 million euros. A lowered manufacturing rate or a decreased elastics width would though decrease the needed investment. It is of importance to denote that these are brief estimations and before any decision are made deeper analysis and supplier contact, which has not been performed in this case, is needed (Richard Fredriksson, 20120503).

TENA TURNER

When estimating the cost of the TENA Turner concept the material cost of the sheet was calculated separately. The result was compared to that of the existing bed protectors and the comparison shows that the developed solution has a material cost of about 600% relative the bed protectors. The products though have differing functionalities; the comparison was therefore performed solely to relate the cost of the developed product to the existing assortment.

The process investment needed for the manufacturing of TENA Turner comprises machine parts for the handling of the nonwoven, the gluing equipment, the handling of the polymer reinforcements, the cutting of the handles, the cut off of the products and the folding procedure. The total cost was approximated to 0.34-0.56 million euros. The conclusion was that if sold in a smaller scale it would probably be beneficial to manufacture the sheets manually. It is again of importance to denote that these are brief estimations and before any decision are made deeper analysis and supplier contact, which has not been performed in this case, is needed (Richard Fredriksson, 20120503).

10.3.2 ENVIRONMENTAL IMPACT

As the environmental impact of the incontinence product is foremost depending on extraction of resources, production of raw materials and the waste handling the most efficient way to decrease the environmental impact is to choose the right materials and be resource effective (Madeleine Pehrson, 2012).

A simplified life cycle analysis was performed in order to assess the environmental impact of the developed TENA Mutli solutions. In the LCA the two variants were compared to the existing TENA Belt and TENA Flex regarding Global Warming Potential (GWP) in grams of carbon dioxide equivalents per product. The result of the LCA was provided by Madeleine Pehrson, Environmental Specialist at SCA, 2012-05-10.

The analysis considered cradle to grave excluding the downstream transports of belt. The analysis was also based on the assumption that the Flex product is used one time whereas the belt in TENA Belt is used 30 times and washed two times. The two belts in TENA Mutli are assumed to be used during use of three absorbing parts. The result shows that using TENA Flex as a reference the two belts resulted in a decrease in environmental impact by 4-15%. Whereas compared to TENA Belt it had an increase in environmental impact between 5-15 %.

No Life Cycle analysis was performed for the TENA turner as it is a new product for TENA and there is no product in the existing assortment that could be used as a relevant and fair comparison.

10.3.3 FULFILMENT OF REQUIREMENTS

The evaluation of fulfilment of requirements (appendix XXII) shows that TENA Multi fulfils the majority of the listed requirements for one arm interaction. Regarding changing on the heavy care taker the product on its own did not fulfil the requirement of enabling effective and efficient handling or facilitating the turning of the care taker. The evaluation further shows that TENA Turner fulfils or partly fulfils the majority of the requirements listed as relevant for the support product. The verification of fulfilment has been performed through the usability test, comparison with the expression boards or quality assurance through use of for example existing proved functioning solutions and materials. The not fulfilled requirements are further discussed in section 11.1.1 and 11.1.2.

11. DISCUSSION

This Master's thesis started off with the idea that product solutions developed with regards to extreme situations could have benefits also for the normal use case. This chapter provides a discussion about the result, the fulfilment of the set goals, the methods used, possibilities for further development and finally the benefits from using extreme situations to trigger new product solutions.

11.1 RESULT

Herein the result of TENA Multi and TENA Turner are discussed respectively. The discussion includes the final result, its sustainability, fulfillment of requirements and future potential.

11.1.1 TENA MULTI

The usability of one arm interaction with incontinence care products has been improved through analysis of existing solutions and identification of their shortcomings with regards to the user needs in the given situation. This improvement has been achieved through increased consideration of user resources with regards to the situation in combination with aiming at increasing the feedback, visual clarity and explicitness. The highly elastic belt provides for quick error recovery, flexible application dependent on situational needs and simplified reach of the correct circumference.

However even though the identified improvements it is crucial to denote that when choosing the concept for further development both the benefit for the extreme situation and the normal situation was considered. Thereby the end result may not have fully been optimized with regards to the extreme situation, but rather be an improvement of the extreme situation with focus on probable benefits for the normal situation.

As declared in section 10.3.3 the majority of the set requirements were fulfilled for TENA Multi in the one armed situation. It does though not facilitate the turning of the care taker, but the concept as a whole decrease the need of turning of the care taker as the second and third change only includes change of the absorbing part, bringing less turning moment. Further the comfort for the care taker has not been evaluated. The tests have to this stage only been performed on manikins bringing that no assessment of comfort have been made. The materials and joining techniques are though used in products today implying that the developed product will bring a comfort level similar to existing products.

The functional requirements on the elastics has been achieved through use of threaded elastics meanwhile the wanted visual expression further is reached with use

of laminated elastics. Theoretically there are laminated elastics that are fit for the purpose but further development of the elastic material is needed to fit the purpose practically. As the threaded elastics has the advantage of being fully breathable and today enables the wanted characteristics both product solutions were presented in the final product concept.

The sizes of the products are based on data gathered from one population, namely the Italian elderly population. There is today a lack of information regarding the hip-waist ratios on elderly populations and as the scope of the project did not cover an anthropometric study this available data was used as a starting point. To validate the sizes and further to fit different market needs thorough studies are needed. It can be argued that the proposed sizes are somewhat large, a more elastic material or a smaller width of the absorbing part would though enable smaller sizes.

Sustainability has been regarded throughout the development of the product solutions. SCA has a profound work on their environmental impact and the performed simplified LCA has showed that through further developing the already existing product with a reusable belt the usability of the product is increased while still having less environmental impact than the existing one piece solutions. Future sustainability potential lies in further examining the ability to wash the belt which would decrease the environmental impact further.

Based on the final result of the TENA Multi concept and the evaluation regarding cost, needed process investments and the fulfilment of requirements it is argued that the product solution has a good future potential. The second usability test also implied that the product provided effectiveness efficiency and satisfaction in the normal use case. The concept has thereafter been developed to further increase the usability implying a future potential through an explicit design which considers the user resources as well as provides visual clarity and quick error recovery

11.1.2 TENA TURNER

The TENA Turner product solution has been developed with the aim of simplifying the turning of the care taker in the home care environment and institutions where no advanced turning aids are available. The goal has been met through development of a sheet like product that decreases the force needed for turning. It can though be argued that the product does not fit for very heavy care takers as the product concerns manual handling. Even though it is a facilitating support product there is an ethical aspect in not encouraging caregivers to turn very heavy care takers as it brings large loads to the body of the caregiver. However the product solution can be regarded as an aid in situations where no advanced aids such as mechanical lifts are available.

Regarding sustainability the used materials have been chosen on the basis that they are available in the existing material assortment. No new materials have therefore

been added but further sustainability optimizations can be performed through for example minimising the use of material which was the requirement that was regarded as not fulfilled. The product itself and its function require a comparably large amount of material. The product is though designed for multi time use to decrease the environmental impact and the handles have been detachable for the same purpose.

As the product distributes the load and provides for turning requiring lower forces than conventional turning the product is regarded as having a good future potential. Further development and analysis is though needed to evaluate the full potential.

11.2 THE FULFILMENT OF SET GOALS

As proposed in section 11.1.1-11.1.2 the goal of developing concept that increase the usability and functionality in the extreme situations have been met. The questions posed have been answered through use of a wide selection of theoretical and empirical methods which has identified the users' needs and requirements and the issues of the existing solutions.

The choice of further developing 2 product concepts brought a conflict with the goal to present at least 4-6 prototypes of technical solutions designed to fit the conditions of the extreme situations. The presented prototypes herein instead focused on presenting the visual representation of TENA Multi with two different belt types in two different sizes in the three different absorption level colours. Further TENA Turner and a set of two handles were prototyped. It can thereby be concluded that all the set goals have been met in the performance of the project.

11.3 METHODS AND EXECUTION

Throughout the project a wide selection of analysis methods have been performed in order to gain a holistic view of the products, the user and the interaction. The chosen methods have provided a deep insight in the problems during the interaction in the extreme situations. Furthermore the methods have put a foundation for the understanding for these problems and enabled identification of possible solutions.

The products have been evaluated both theoretically and empirically. During the usability tests manikins were used. It can be argued that changes on real persons would have brought a more realistic result, but as the change situation is vulnerable manikins were used in order to be able to get willing test participants. As the think aloud protocol showed that test participants imagined a real care situation despite the use of the manikin it is argued that the method generated a result which was a good foundation for the evaluation of the interaction in the extreme situation.

The smaller manikin, with a low weight compared to a real person, enabled handling in a way not possible with a real person. In addition a real person could him- or

herself have aided in the turning and the arms and legs could have been used for stabilization of the body. The validity can thereby be somewhat questioned. The test and the following questionnaire though had validity based on that it met the aim of the test, which was to study and measure the usability of the interaction with the incontinence care protection in the extreme situation.

One task in the second usability test in which the validity could be questioned was the task of changing on the heavy care taker. The intention was to herein test TENA Multi in combination with TENA Turner but as the test equipment proved insufficient for testing TENA Turner TENA Multi was tested on its own. The overall improvement for the situation with a heavy care taker was therefore not thoroughly tested. All the performed tests concerned changing the entire product. Thereby the improved usability from just having to change the absorbing part at the second and third change of TENA Multi was not tested. As proposed in the ideas generated for the heavy care taker this specific feature could have a benefit for the extreme situation and it is therefore a possible topic for future evaluation.

As stated in section 2.1 incontinence is a subject of taboo, it is therefore argued that the overall low level of satisfaction can be related to the shame in the situation. Further adding less control through the extreme situation thereby decrease the satisfaction in applying the product.

Regarding the testing of TENA Turner the performed evaluation was very simple, measured by simple means. The performed test was in this project used to get an indication of the force required so before making any further conclusions about the needed forces and the benefits from the solution further testing is therefore needed.

11.3 SUGGESTIONS FOR FURTHER DEVELOPMENT

Regarding TENA Mutli the suggestions for further development mainly focus on the characteristics of the elastics. A material with higher elasticity could bring possibilities for smaller sizes with higher flexibility. Further a greater elasticity could bring less use of material as well as smaller distances between the ultrasound welding bringing the advantage of a decreased required investment cost. In the final result two types of elastics were presented, the laminated elastics are today not sufficient for providing the needed elastics but can be seen as an area for future possibilities for improvement.

Validation of the sizes is needed and additionally the sizes would need to be adjusted for the intended markets. As there is limited research performed on waist-hip ratios on elderly it would be beneficial to perform anthropometric studies to gain this information. It is also proposed that empirical evaluation should be performed with real care takers and caregivers to further identify the benefits and the areas for possible improvements for the products.

Concerning TENA Turner it is suggested to perform thorough ergonomic evaluations to estimate the loads on the caregiver. Further the back sheet should ideally ease repositioning in bed through having a slippery surface, the development could therefore further focus on identifying materials fit for this purpose. Additionally the environmental impact should be calculated and interventions performed to decrease the environmental impact.

Simplifications have been made in the estimation of cost and cost for implementing the processes. Further calculations, analysis and discussion with suppliers are therefore needed before any decision making.

11.4 BENEFITS FROM USING EXTREME SITUATIONS TO TRIGGER NEW SOLUTIONS

The result of this Master's thesis is two new product solutions which through evaluations have been concluded to have future potential. It is therefore argued that there are benefits in using extreme situations to trigger new solutions as the use of extreme situations enables identification of new requirements which requires new ways of thinking regarding the products.

In this project the main benefit from studying the extreme situations was seen in the idea generation and initial concept generation after which the focus somewhat shifted towards the benefits for the normal situation. It is therefore suggested that extreme situations should be used as a tool in the data collection, analysis and idea and concept generation to thereafter focus on the developed ideas and their future potential within the normal use cases.

12. CONCLUSIONS

The goals set in the initiation of this project were to identify and evaluate user needs and requirement in each extreme situation and develop concepts, presented as prototypes, which increase the functionality and usability in these situations.

The goal of increased functionality and usability has been met through development of two separate solutions. The first is a two-piece incontinence protection, TENA Multi, with a flexible belt which enables handling according to situational needs and quick error recovery. It has also been equipped with indication of the fastenings and their intended landing zones to provide for visual clarity, explicitness and consistency throughout the application.

Further the goals have been met through the development of the second solution which is a turn sheet, TENA Turner, with a simple design which facilitates the turning of the care taker and distributes the pressure over the care takers body.

The target of presenting at least 4-6 prototypes have been met through manufacturing three absorbing protections visualizing two sizes and the three levels of absorption. Additionally corresponding belts have been prototyped for the absorbing parts in which two different types of elastics are illustrated. Furthermore a turn sheet and two handles have been presented.

The concepts have received positive response from the company. Based on this, the results and the evaluation of the concepts it is therefore finally possible to conclude that using extreme situations as a trigger has the possibility of generating new, interesting ideas with future potential for the normal situation.

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14. APPENDIX

I. FUNCTION ANALYSIS

II. HIERARCHICAL TASK ANALYSIS

III. COGNITIVE WALKTHROUGH/PREDICTIVE HUMAN ERROR ANALYSIS

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VII. USABILITY TEST 1: QUESTIONNAIRE

VIII. USABILITY TEST 1: RESULT QUESTIONNAIRE

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XVIII. USABILITY TEST 2: RESULT TEST PROTOCOL

XIX. USABILITY TEST 2: QUESTIONNAIRE

XX. USABILITY TEST 2: RESULT QUESTIONNAIRE

XXI. DRAWINGS

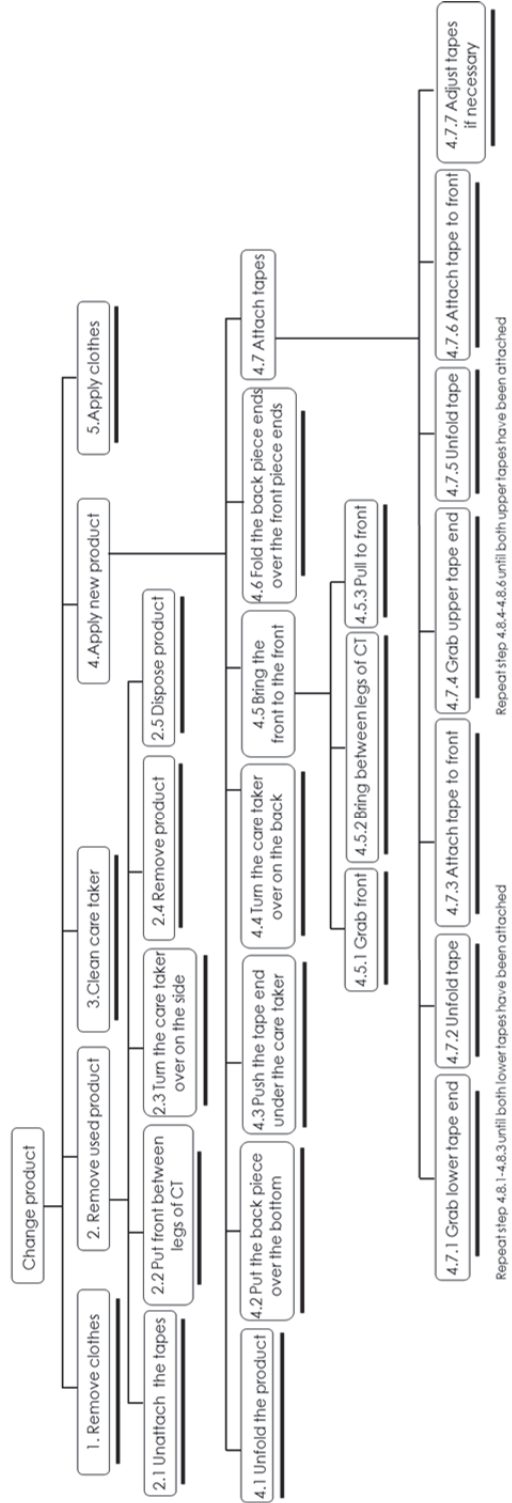
XXII. FULFILMENT OF REQUIREMENTS

I. *FUNCTION ANALYSIS TENA SLIP, FLEX AND BELT*

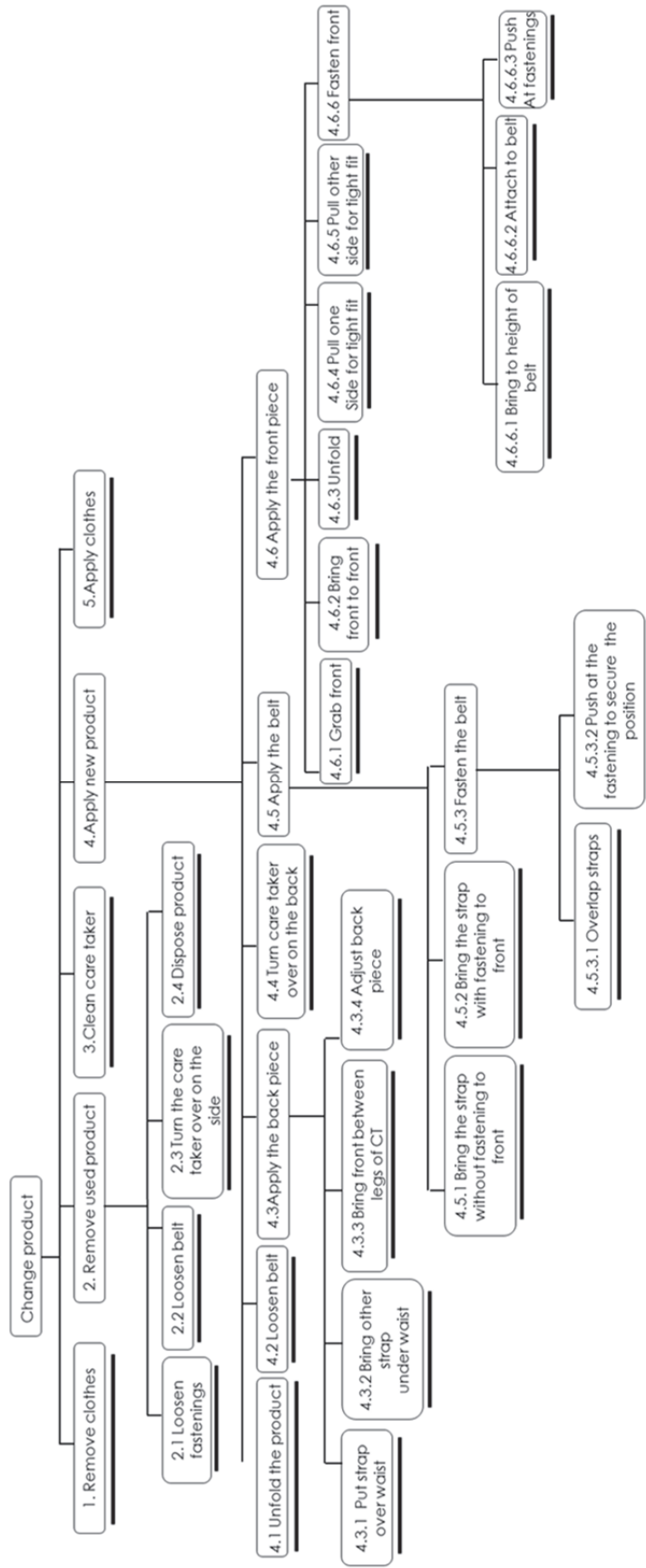
TENA Slip	TENA Flex	TENA Belt
<u>Main function</u>	<u>Main function</u>	<u>Main function</u>
Provide incontinence protection	Provide incontinence protection	Provide incontinence protection
<u>Part functions</u>	<u>Part functions</u>	<u>Part functions</u>
Enable handling	Enable handling	Enable handling
Enable application	Enable flexible application	Enable application
Enable adjustment	Enable adjustment	Enable adjustment
Provide comfort	Provide comfort	Enable reuse of belt
Collect urine	Collect urine	Provide comfort
Absorb urine	Absorb urine	Collect urine
Hinder leakage	Hinder leakage	Absorb urine
Manage faeces		Hinder leakage
<u>Support functions</u>	<u>Support functions</u>	<u>Support functions</u>
Communicate dignity	Communicate dignity	Communicate dignity
Provide instruction	Provide instruction	Provide instruction
Communicate status	Communicate status	Communicate status
Communicate brand	Communicate brand	Communicate brand
Communicate level of absorption	Communicate level of absorption	Communicate level of absorption
Communicate size	Communicate size	Communicate size

II. HTA TENA SLIP, FLEX AND BELT

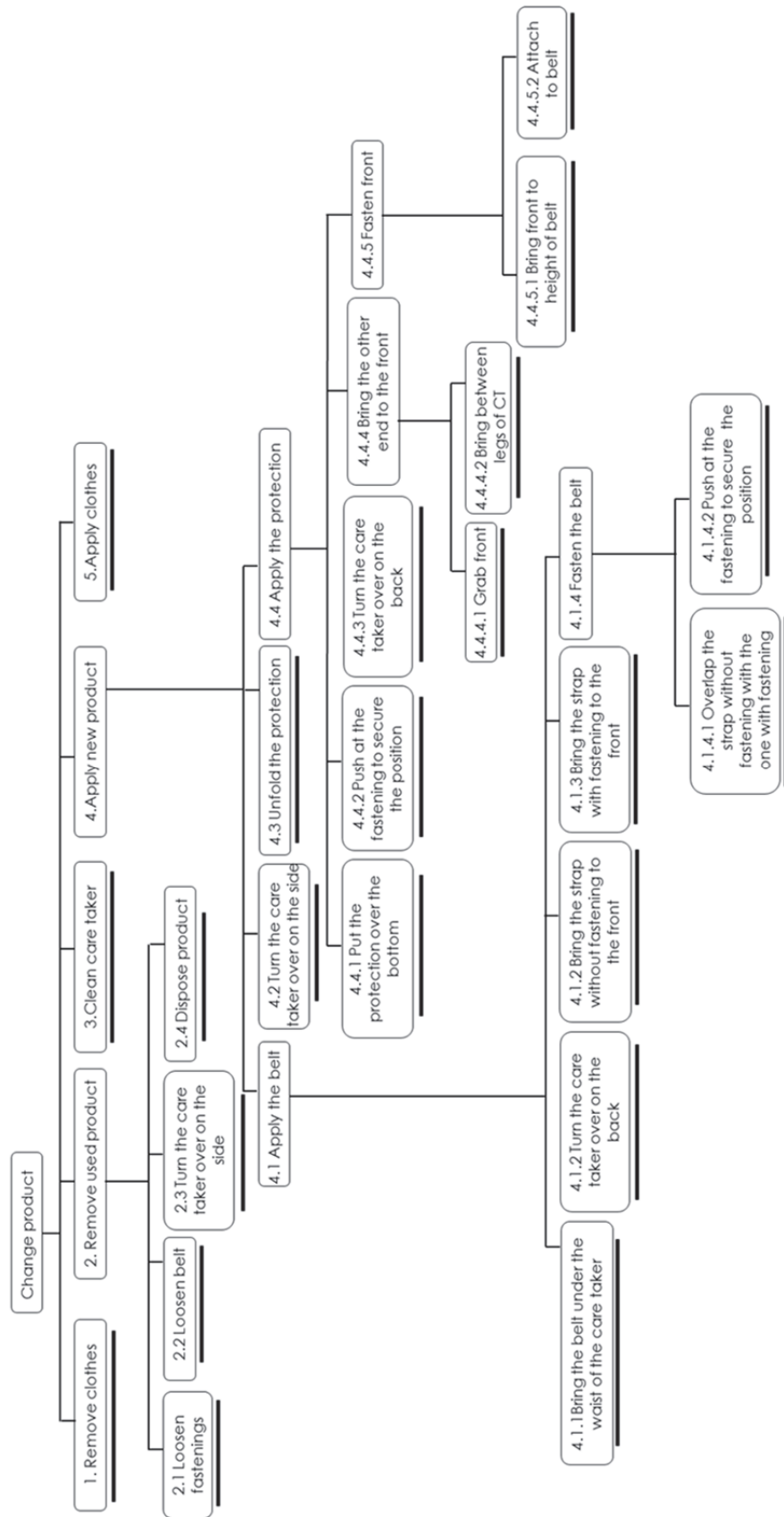
TENA Slip



TENA Flex



TENA Belt



III. COGNITIVE WALKTHROUGH/PREDICTIVE HUMAN ERROR ANALYSIS

The full result of the Cognitive Walkthrough/Predictive Human Error Analysis comprises over 100 matrixes, due to the extensive result a set of four matrixes have been chosen to exemplify the result.

TENA SLIP CHANGED IN DARKNESS 2..1 Detach tapes	Y/N	Fail/Success story	Usability problem	Notes
Will the user try to achieve the right effect	Yes	Product needs to be removed before application, tapes needs to be unattached to remove product		
Will the user notice that the correct action is available	Yes/no	Yes if using hands to feel the fastenings, otherwise no		
Will the user associate the correct action with the effect that the user is trying to achieve?	Yes	Knows that the product needs to be unattached to be removed.		
If the correct action is performed, will the user see that progress is being made toward solution of the task?	No	It is dark	No visible indication when dark	
<ul style="list-style-type: none"> - What action can the user do wrong at the right time - What action can the user do correct at the wrong time - What happens if the user performs an incomplete action or omits an action? 				
Use error	Cause	Consequences	Detection	Recovery
Look for the tapes at the wrong place	The caregiver cannot see the fastenings	Fumbling	When the fastenings are not found at that position	"Looking" for the fastenings at other spot
Just loosen some of the tapes	The caregiver cannot see the tapes	Cannot take the product off easily	When the protection does not come off	Loosening the other fastenings
Does not loosen fastenings	Thinks that the product is removed in another manner	The product is not removed in a correct and efficient way	Product does not come off	Look for, find and loosen fastenings.

TENA BELT CHANGED IN DARKNESS 4.1 Apply the belt	Y/N	Fail/Success story	Usability problem	Notes
Will the user try to achieve the right effect	Yes	Change implies putting on a new protection		
Will the user notice that the correct action is available	Yes	Though it is dark the caregiver will try to find the product		
Will the user associate the correct action with the effect that the user is trying to achieve?	Yes	Applying a new product brings the wanted protection for the care taker.		
If the correct action is performed, will the user see that progress is being made toward solution of the task?	No	No visibility but the caregiver can use his or her hands to feel if the protection is in place	It is dark, no visibility of object status	
<ul style="list-style-type: none"> - What action can the user do wrong at the right time - What action can the user do correct at the wrong time - What happens if the user performs an incomplete action or omits an action? 				
Use error	Cause	Consequences	Detection	Recovery
Applies protection to belt first	Thinks that this brings an easier application of the product	Bad fit	Protection does not sit at wanted, might not be detected in dark!	Remove protection and apply the belt first
Overlaps wrong	Does not see the fastening	The belt is not fastened	The does not stay in position	Find the fastening, put it in the correct direction and overlap correctly.
Applies belt after applying protection	Thinks that the belt should cover the protection	Insufficient protection, difficult application and bad fit.	Protection does not sit at wanted, might not be detected in dark!	Remove protection and apply the belt first
Put the belt to high up at the waist	Cannot see where the belt is placed/does not know where to place it	Protection does not fit correctly	When the fastenings on the front does not reach the belt	Alternate the fastening of the belt.
Put the belt too far down on the hips	Cannot see where the belt is placed/ does not know where to place it	Protection does not fit correctly	Hard to detect in the dark.	Change position of the belt

TENA CHANGED ONE ARM 4. Apply new product	FLEX WITH	Y/N	Fail/Success story	Usability problem	Notes
Will the user try to achieve the right effect?	Yes	Yes	Change implies putting on a new protection		Hard to apply product using one arm as the application process contains many steps where the product needs to be held in place and adjusted simultaneously
Will the user notice that the correct action is available?	Yes	Yes	There is a new product in the room		
Will the user associate the correct action with the effect that the user is trying to achieve?	No	No	The user is probably not familiar with the procedure of applying this specific product		
If the correct action is performed, will the user see that progress is being made toward solution of the task?	Yes	Yes	Visible that a product has been applied		
<ul style="list-style-type: none"> - What action can the user do wrong at the right time - What action can the user do correct at the wrong time - What happens if the user performs an incomplete action or omits an action? 					
Use error	Cause	Consequences	Detection	Recovery	
Does not apply the protection	Cannot manage to apply protection	Care taker has no protection	-	Apply protection	
Applies the protection the wrong way around	Does not know how it should be applied	Not as comfortable and safe	-	Apply protection properly	

TENA SLIP CHANGED ON A HEAVY CARE TAKER 4.3 Turn the care taker over on the back	Y/N	Fail/Success story	Usability problem	Notes
Will the user try to achieve the right effect?	Yes	Yes	The user realizes that it is easier to apply the front to the back when the care taker is laying on its back	Hard to move care taker when heavy
Will the user notice that the correct action is available?	Yes	Yes	-	
Will the user associate the correct action with the effect that the user is trying to achieve?	Yes	Yes	-	
If the correct action is performed, will the user see that progress is being made toward solution of the task?	Yes	Yes	-	
<ul style="list-style-type: none"> - What action can the user do wrong at the right time - What action can the user do correct at the wrong time - What happens if the user performs an incomplete action or omits an action? 				
Use error	Cause	Consequences	Detection	Recovery
Does not turn the care taker over	Wants to apply the product while lying the side, cannot roll the care taker over	Harder to apply, does not fit perfectly, leakage	When turning the person back on the back again	Adjust tapes when lying on the back

IV. *USABILITY TEST 1: TASKS*

Scenario 1

You are taking care of four elderly individuals and need to change their incontinence care protections. You are now facing four situations in which you are to remove the used product and apply a new one. The test is not including the task of removing clothes or cleaning the care taker to keep focus on the removal and application. The test is performed to measure the usability in the product, not your personal abilities, in various situations. To manage all four tests in an hour each task has a time limit of 6 minutes.

1. You just arrive at your care takers. For the first change you just have one arm available. You can only use your right arm, please hold your left arm loosely along the side of your body. Your task is to remove the used product and apply a new one.
2. Unfortunately the electricity is down so the care of the next care taker has to be provided in darkness. You though know that the person is situated in the bed to the right and the product is situated on the bedside table to the left of the bed. Your task is to remove the used product and apply a new one.
3. The electricity is still down when you are moving to the next care taker, so the care has to be provided in darkness once again. You though know that the person is situated in the bed to the right and the product is situated on the bedside table to the left of the bed. Your task is to remove the used product and apply a new one.
4. The electricity is back. The last care taker is heavier than the previous, usually you are two persons providing the care but today you have to solve the situation on your own. Your task is to remove the used product and apply a new one.

Scenario 2

You are taking care of four elderly individuals and need to change their incontinence care protections. You are now facing four situations in which you are to remove the used product and apply a new one. The test is not including the task of removing clothes or cleaning the care taker to keep focus on the removal and application. The test is performed to measure the usability in the product, not your personal abilities, in various situations. To manage all four tests in an hour each task has a time limit of 6 minutes.

1. You just arrive at your care takers; the first care taker is heavier than the other three, usually you are two persons providing the care but today you have to solve the situation on your own. Your task is to remove the used product and apply a new one.
2. Unfortunately the electricity is down so the care has to be provided in darkness. You though know that the person is situated in the bed to the right and the product is situated on the bedside table to the left of the bed. Your task is to remove the used product, and apply a new one.
3. The electricity is still down when you are moving to the next patient, so the care has to be provided in darkness once again. You though know that the person is situated in the bed to the right and the product is situated on the bedside table to the left of the bed. Your task is to remove the used product and apply a new one.
4. The electricity is back but you just have one arm available. You can only use your right arm, please hold your left arm loosely along the side of your body. Your task is to remove the used product and apply a new one.

V. TEST PROTOCOL

Usability test

Achievement of task: Yes No

Time for task completion: _____

Errors: _____

Procedure: _____

Comments: _____

Level of confidence (1 is very unconfident and 5 is very confident)

1 2 3 4 5

VI. RESULT TEST PROTOCOL

Slip changed in dark						
Test person	Achievement of task	Quality	Level of confidence	Time for task completion	Errors	Comments
Test person 1	Yes	2. Bad fit at front	2	5:97	Major part first the test person believes that the tapes should be at front. Later solves situation by changing because of bad fit at front.	The tape is sticky. Trying to identify direction through finding attachments. Immediately recognise that something is not right. Does not feel ok for the care taker that I am touching.
Test person 2	Yes	4. Good fit	4	2:5		Feels like it is hard to get a tight fit. The tapes are "lippliga". Hard to know where the tapes should land. The tapes feels to small
Test person 3	Yes	2. Bad fit at front	2		Minor: the new product gets stuck in the old product. Minor: Initially the product is fastened with one tape per side.	The test person feels at the used product to notice direction of application.
Test person 4	Yes	3. Slightly skew at the back and the tapes have a somewhat skew position at front	3	3:58		This feels like a slip. It has tapes. If I did not already know that the tapes are on the back it would have been harder. Feels a bit small in size
Test person 5	Yes	3. Ok fit	3	3:75		Does not know what is the front and what is the back. Should the tapes be at the front or at the back. The tapes should be at the back, should come out at the front. Feels like I am touching the person inappropriately. Does not know where I am ending up height wise. Felt like a big product and a small manikin but it does almost not reach around the care taker.
Test person 6	Yes	3. Skew at the back, otherwise good	3	5:03		No indication on upper and lower tape. If one does not see what is it can become unpleasant, needs a good way of rolling the product. . . Want something that holds the person in the turned over position. . . Indication of centering in the bed. Hard to get grip of the tapes. Hard to find the tape landing zones, risk of damaging the plastic. One should not have to fold the product at the crutch.
Test person 7	Yes	5. Very good fit	2	2:13	Minor: the new product gets stuck in the old product.	According to the recommended procedure.
		Where 0 corresponds to that the product is not applied and no leakage security is provided and 5 corresponds to a very good quality of fit with high leakage security.				Centering heightwise tricky. Grips front and back for indication in height. Feels where the product starts and ends in side direction.
		Where 1 corresponds to very unconfident and 5 corresponds to very confident				Puts the product between the legs and pushes backwards. Makes the TENA-fold.

Belt changed in dark		Achievement of task	Quality	Level of confidence	Time for task completion	Errors	Comments	Notes
Test person 1	Yes	4. Belt is a bit high otherwise achieved.	1	4.77	Major: At first the test person believes that the protection part is the entire product. Major: When the test person realizes that there is a belt the person is unsure if the belt should be applied under or on top of the protection. At first the belt is applied on top of the protection. Minor: The belt is first applied at the waist (too high up). Minor: The belt is first applied with the fastening outwards.	The product seems to be to small, very weird.	-	
Test person 2	Yes	5. Very good fit	4	3.92	Major: The belt is first applied at the waist (too high up). Minor: The belt is first applied with the fastening outwards.	Does not know what is the front and what is the back. Here is the rear elastic. Poor person. Feels like the product is not long enough. Maybe I do it wrong, maybe it should not be like this. Feet tight, feels like it has the correct fit.	-	
Test person 3	Yes	3. Skew at the back, belt too high and the protection does not reach the belt at the front.	1	5.75	Major: The belt is applied at the waist, which is corrected but the belt is still to high.	It does not feel obvious what is the front and what is the back, in the beginning I thought that this product would be easier to apply, but now it is harder. It does not feel good but it won't become better.	examines the used product thoroughly	
Test person 4	Yes	5. Very good fit	3	4.75	Major: The belt is applied to high initially, alterations are therefore needed.	Slippery belt. Not fun for the care taker that one touches to feel the fit. Is the belt a standard size?	When applying the new product the person first grab the belt, find the middle, rolls one end and puts under the waist of the care taker. Feels where the middle of the bum is, feels so that the fastenings ends up at the belt. Touches areas that are private.	
Test person 5	Yes	5. Very good fit	3	4	Major: The belt is applied at the waist - too high. First fastens the protection at the belt.	A little strange when it is two parts. Should one attach the two parts first? The belt is very long for the small manikin. Hard to know what is the front and what is the back. The fastening is covered. Hard to know where on the belt the fastening should be attached. Does not feel comfortable for the patient to turn around and adjust.	-	
Test person 6	Yes	3. Half of one fastening on the outside and a little skew	2	6	Major: Belt to high up	Easy to put the hands in the wrong place. Want to use the old belt to attach the new one. One could attach many belts at the same time and keeps some of them protected. Would have needed guidance in the fastening position. Indication needed if there is a front and a back, the height is unclear. It is firstly when you come to the front that you can adjust	Uses the used belt as guidance, use the hips as guidance for centering.	
Test person 7	Yes	2. Some of the attachments are outside of the belt	2	2.57	Major: Belt to high up at the beginning, waist	Belt - oh this was long	TEHA-folding.	

Where 0 corresponds: Where 1 corresponds: to that the product is not applied and no leakage security is provided and 5 corresponds to a very good quality of fit with high leakage security.

Flex changed with one arm						
Test person	Achievement of task	Quality	Level of confidence	Time for task completion (minutes)	Errors	Comments
Test person 1	Yes	1. The belt is applied on top of the protection at one end and under at the other. Bad fit.	2	6		Confused by the belt. Feels like I am damaging the product. Not possible to distinguish front from back. At least it is on, but it is not good. Obvious that it is going to leak.
Test person 2	Yes	5. Very Good fit	3	2.533	-	Very difficult with the belt. Lucky that it is this product and not belt. This product was the easiest one to handle.
Test person 3	Yes	5. Very good fit	3	3.85	-	Not easy to unfold the product and loosen belt. Hard to know how fragile the product is. Does not want to tare apart too much. Complicated, try to remember how the other product was applied. You might not be able to do this in a real use case. Easy to open and alternate.
Test person 4	Yes	5. Very good fit	5	3.08	-	To remove the product is not a problem. Here one really has to cooperate with the care taker. This is not easy. Hardest part is to attach the belt. Wish she had a nightgown to fasten the fastenings temporarily. Hardest to attach the belt.
Test person 5	Yes	5. Very Good fit	4	4.72	Major: initially belt high up	Does not want to be in contact with urine or faeces. Does not feel ok to pull out the product. Should the belt stay on the care taker? Hard to get the belt tight, gets lumpy. Hard to place the belt. Felt good to put it at the waist. Does not manage to pull the product with one hand.
Test person 6	Yes	5. Very good fit	4	5.25	Major: initially belt high up	Want something that holds the person in place. If the bed is standing towards a wall there is no danger but when free standing there is a risk for the person falling out. Would like a tightening system for the belt. The elastic side compensates for the elastics. Hard to get the fastenings out at the front. Should have guidance.
Test person 7	Yes	3. Slew	3	2.78	Major: initially belt high up	To remove the product was not hard. Hard to make the TBUA-folding with one arm. Hard, very lumpy. Easy to lift but in a real situation one would probably not lift at the same places. Hard to hold and get tight.

Where 0 corresponds to that the product is not applied and no leakage security is provided and 5 corresponds to a very good quality of fit with high leakage security. Where 1 corresponds to very unconfident and 5 corresponds to very confident

Slip changed on a heavy care taker						
Test person	Achievement of task	Quality	Level of confidence	Time for task completion, minutes	Errors	Comments
Test person 1	No	0 The product is not attached when time is out	1	-	Fatal: Catastrophic: One end is under the care taker, can not manage to get it out.	I hope the product does not break. This is a test of how durable the product is. I realise that I have big difficulties.
Test person 2	Yes	3 Ok quality at front	2	3.67	-	Oh he was heavy. Think if he has pooped. Wish that the person would be able to help. Does not know if it is tight enough. The front and sides feels secure. Want something as a help, a stiffer product.
Test person 3	No	0 Product not applied	1	-	Fatal: Catastrophic: Not able to get the product on the care taker.	Pulls out product - does not feel like one should do this. I feel like I don't know how to solve this. Belt would probably have been better.
Test person 4	Yes	4 Good	4	4.17	-	I should have prepared the new product before removing the used. I would have asked the person to help as much as possible. Normally the person has not got such a good grip surface. It must be hard work for the person to be turned this much. It is hard to control the fit of the back. The slip is hard to apply alone, now one has to count on leakages
Test person 5	Yes	2 Ok fit but the product is damaged.	2	3.92	Major: Fatal: The product is damaged when it is pulled out from under the side of the care taker	This is not possible Now it feels like we have pee and poo all over the place. Does not feel like I am thinking so much about the product. Pain in my back. Does not care about the fit, it is to heavy.
Test person 6	Yes	3 Ok quality at front	5	4.65	-	Wants to get support from the bed. Now i grab like handles, pinching the care taker. The person could help with for example handles on the wall. The fastenings are hard to reach. The bed should maybe have been higher. Can feel my back. Would have wanted to see how the product looks at the backside. The product would benefit from more elastic.
Test person 7	Yes	3 OK quality at front	1	3.03	-	Oh my god. I don't think that this will succeed. Not possible to lift. Does not feel as providing dignity to the patient.
		Where 0 corresponds to that the product is not applied and no leakage security is provided and 5 corresponds to a very good quality of fit with high leakage security.	Where 1 corresponds to very unconfident and 5 corresponds to very confident			

VII. *USABILITY TEST 1: QUESTIONNAIRE*

Questionnaire

Age: _____

Gender: Male Female

Have you previously applied this product to yourself or another person?

Yes No

Have you previously changed a baby diaper?

Yes No

1. How hard/easy did you experience the performance of the overall task?

Very hard corresponds to having big difficulties performing the task and very easy corresponds to performing the task without any difficulties.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very hard	Hard	Neither easy nor hard	Easy	Very easy

1.a How hard/easy did you experience the task of removing the used protection?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very hard	Hard	Neither easy nor hard	Easy	Very easy

1.b How hard/easy did you experience the task of turning the care taker over?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very hard	Hard	Neither easy nor hard	Easy	Very easy

1.c How hard/easy did you experience the task of applying the new product?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very hard	Hard	Neither easy nor hard	Easy	Very easy

Comments _____

2. What level of control did you experience that you had when performing the task?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very low level of control				Very high level of control

3. What step of the procedure did you find the most challenging to perform and why?

4. How unclear/clear did the product communicate how it should be handled?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very unclear	Unclear	Neither unclear clear	Clear	Very clear

5. How unclear/clear did the product communicate if the task was achieved?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very unclear	Unclear	Neither unclear clear	Clear	Very clear

6. Was there anything in the product that you found hindering the progress of the task?

-
7. Was there anything in the product that you found helping the progress of the task?

VIII. USABILITY TEST 1: RESULT QUESTIONNAIRE

Result questionnaire- Slip changed in dark										
Question	1p 1	1p 2	1p 3	1p 4	1p 5	1p 6	1p 7	Median	Median not changed earlier	Median changed earlier
Changed product before	No	No	No	Yes	No	Yes	Yes			
Changed diaper before	Yes	Yes	Yes	Yes	No	Yes	No			
1	2	3	1	3	3	2	2	2	2.5	2
1.a	4	4	2	4	4	3	4	4	4	4
1.b	4	3	3	4	4	5	3	4	3.5	4
1.c	2	2	1	2	2	2	2	2	2	2
Comment	-	-	-	-	Hard to know where in "height" that the product should be applied, feels like it ended up to low.	-	-			
2.	3	3	1	3	3	2	1	3	3	2
3.	attach the product	To make the product tight at the front	Apply the product at the correct height at the back	To get the protection at the correct height at the back	Fastening the tape because it was hard to get the product around the care taker and get it to the correct position.	Centering in length and width	To get the product at the same level at the front and at the back			
4.	3	3	2	4	2	2	4	3	2.5	4
5.	3	3	2	4	3	2	4	3	3	4
6.	-	Thin tapes	Two tape-	-	What is front and what is back? Hard to know. Where should I apply the product? That the tapes are attached from start, how the product is folded.	Folding in crotch	-			
7.	-	-	-	-	That one could detach and reattach the tapes.	Relatively stable, rigid sides	-			

Where 1 corresponds to very hard and 5 to very easy

Where 1 corresponds to very hard and 5 to very easy

Where 1 corresponds to very hard and 5 to very easy

Where 1 corresponds to very hard and 5 to very easy

Where 1 corresponds to very hard and 5 to very easy

Where 1 corresponds to very low level of control and 5 corresponds to very high level of control

Where 1 corresponds to very unclear and 5 to very clear

Where 1 corresponds to very unclear and 5 to very clear

Result questionnaire: Belt changed in dark										
Question	Ip1	Ip2	Ip3	Ip4	Ip5	Ip6	Ip7	Median	Median not changed earlier	Median changed earlier
Change product before	No	No	No	No	No	Yes	No	-	-	-
Change diaper before	Yes	Yes	Yes	Yes	No	Yes	No	-	-	-
1.a	2	2	1	2	2	2	1	2	2	2
1.b	4	4	4	4	4	3	4	4	4	3
1.c	2	2	3	4	4	5	2	4	3.5	5
1.d	2	2	1	2	2	1	1	2	2	1
Comment: Did not know how to use the belt should fit	-	-	-	It's harder when the diaper is on. How do I feel for the one I take when one has to feel with the hands?	Did not know if the belt fits. The belt fits the protection to the belt fast or the belt. Hard to put the belt at the correct height.	-	-	-	-	-
2.	3	4	1	3	4	1	1	3	3	1
3.	The belt fit should be attached inside or outside of the protection	Unsure what end is front and back and how the belt should be positioned.	Apply the product	to get the correct height of both belt and protection at the back.	Apply the belt at the correct height and so it didn't get wrinkled.	Centering belt and later product both sideways and in height.	Apply the belt at the correct height. Hold the bottom while the backside of the product were attached to the belt.	-	-	-
4.	3	4	4	4	2	4	4	4	4	4
5.	3	2	3	4	3	2	4	3	3	2
6.	The belt should be easily added up at the body	The belt included at the side up to high up	The belt included at the side up to high up	No not at the height of the belt may become too big or small.	That it did not fit the front and what material was attached to the fastenings.	The belt was sliding towards the belly from the hips	Hard with a loose belt	-	-	-
7.			The belt helped during the removal		God g'p in the fastening at the belt. That the belt has two sides lead to that finally they were way apart should be strapped.	If the belt was used several times without changing it would help.				

Result questionnaire- Flex changed with one arm										
Question	Ip1	Ip2	Ip3	Ip4	Ip5	Ip6	Ip7	Median	Median not changed easier	Median have changed easier
Changed product before Changed diaper before	No Yes	No Yes	No Yes	Yes Yes	No No	Yes Yes	Yes No	- -	- -	- -
1	2	3	2	5	2	2	2	2	2	Where 1 corresponds to very/hard and 5 to very easy
1.a	4	4	3	5	3	3	4	4	3.5	Where 1 corresponds to very/hard and 5 to very easy
1.b	4	3	2	4	4	5	3	4	3.5	Where 1 corresponds to very/hard and 5 to very easy
1.c	2	3	2	2	2	2	2	2	2	Where 1 corresponds to very/hard and 5 to very easy
Comment	-	-	-	It was hard to get the belt to stay in position on that case	Hard to know at what height the waistband should sit.	Keeping the loose belt in	-	-	-	-
2	1	4	2	4	3	3	2	3	2.5	Where 1 corresponds to very/low level of control and 5 corresponds to very high level of control
3	Fatten the new product was too heavy I know product is good and the front attach and what is the back.	Happy that it was this product I know product is good and the front attach and what is the back.	Put on the product reaching the front attach and what is the back.	To tighten the belt with one hand. The belt sides down to the side of the core giver. Hope that there is a comment on what is possible to fatten the fattenning somewhere.	To put the waistband at the correct height because that determined if the protection could be placed correctly.	Apply the belt around the hips	To attach the new product and special apply the new belt	-	-	-
4	3	4	4	4	2	3	4	4	3.5	Where 1 corresponds to very/unclear and 5 to very clear
5	3	4	3	4	4	3	4	4	3.5	Where 1 corresponds to very/unclear and 5 to very clear
6	-	-	-	-	That it is "guided" from the beginning. How the product is folded does not give clues on how it should be applied.	The belt was loose	Hard to get the belt far enough down, the product belt to go in.	-	-	-
7	-	The belt helped a lot	-	-	The grey fattenning shall be attached to the grey belt.	Relatively easy to centre	-	-	-	-

Result questionnaire- Slip changed on heavy person									
Question	Ip1	Ip2	Ip3	Ip4	Ip5	Ip6	Ip7	Median value not changed earlier	Median changed earlier
Change product before	No	No	No	Yes	No	Yes	Yes	-	-
Change product before	Yes	Yes	Yes	Yes	No	Yes	No	-	-
1	2	1	1	4	1	1	1	1	1
1.a	3	3	2	4	1	2	2	2	2
1.b	2	1	1	2	1	1	1	1	1
1.c	2	1	1	3	1	1	1	1	1
Comment	Simple product but hard on the heavy person	-	Did not succeed in applying the product	Alliving person feels lighter even if it weighs the same or more	The manikin was horribly heavy, I did not manage to turn the care taker over and I got pain in my back. This lead to that I became less interested in applying it correctly and in a good way for the patient and instead focused on "just" getting the production.	-	-	-	-
2.	2	1	1	4	4	2	1	2	2
3.	attach the product	To get the protection on in under the bottom	To lift the manikin	To place the protection correctly at the back at the correct height	To turn the care taker over as the person was tremendously heavy.	To get the product in the body under the manikin to be able to reach it on the other end. Almost impossible to move the manikin	-	-	-
4.	4	3	3	4	2	3	4	3	4
5.	4	3	-	4	2	2	4	3.5	4
6.	-	-	It was not possible to get it under the manikin	-	That it was not heavy duty, it broke! That there was so much loose material. Nothing that directly showed how the product should be applied.	Low elasticity stuck in the bed and the product did not feel tough enough for one to pull it that hard.	-	-	-
7.	Simple design, how it should sit. Good without a belt	-	-	-	"No", that it was possible to tear of the hooks and use them at lastings after tearing the product	-	-	-	-

Where 1 corresponds to very hard and 5 to very easy
Where 1 corresponds to very hard and 5 to very easy
Where 1 corresponds to very hard and 5 to very easy
Where 1 corresponds to very hard and 5 to very easy
Where 1 corresponds to very hard and 5 to very easy
Where 1 corresponds to very hard and 5 to very easy

Where 1 corresponds to very low level of control and 5 corresponds to very high level of control

Where 1 corresponds to very unclear and 5 to very clear
Where 1 corresponds to very unclear and 5 to very clear

IX. LIST OF REQUIREMENTS

List of requirements	Requirement/Desire	Dark, grading			One arm, grading			Heavy, grading		
		3	2	1	3	2	1	3	2	1
Functional requirements										
1.1 The product shall provide protection	R	x								
1.2 The product shall collect urine	R	x								
1.3 The product shall absorb urine	R	x								
1.4 The product shall hinder leakage	R	x								
1.5 The product shall enable handling	R	x								
1.6 The product shall enable application	R	x								
1.7 The product shall enable adjustment	R	x								
1.8 The product shall enable removal	R	x								
1.9 The product shall enable manufacturing in different sizes	R	x								
1.10 The product shall provide instruction	D									
1.11 The product shall show status (how much has been absorbed)	D									
1.12 The product shall display brand	D									
1.13 The product shall display product name	R									
1.14 The product shall display level of absorption	R									
1.15 The product shall display size	R									
Handling and Ergonomics										
2.1 The product shall provide comfortable use for the care taker	R									
2.2 The product shall provide for good skin health	R									
2.3 The product shall facilitate positioning of the product and it's parts	D									
2.4 The product shall enable effective and efficient handling	D									
2.5 The product shall communicate procedure of application	R									
2.6 The product shall communicate achievement of task	D									
2.7 The product shall enable error detection and recovery	D									
2.8 The product shall provide for user control	D									
2.9 The product shall provide feedback	D									
2.10 The product shall provide visual clarity	D									
2.11 The product shall consider the user resources	D									
2.12 The product shall enable handling with one hand	R									
2.13 The product shall minimize needs of turning the care taker	D									
2.14 The product shall facilitate the turning of the care taker	D									
Sustainability										
3.1 The Material used shall go in line with the company's sustainability profile	D									
3.2 The product shall minimize use of material	D									
3.3 The product shall minimize waste of material	D									
Aesthetics										
4.1 The product shall have a design in line with TENAs design profile	D									
4.2 The product shall attract the target group	D									
Communicative criteria										
5.1 The product shall communicate security	D									
5.2 The product shall communicate dignity	D									
5.3 The product shall communicate simplicity	D									
5.4 The product shall communicate clarity	D									
5.5 The product shall communicate facility	D									
Economics										
6.1 The product cost should be in line with the existing assortment	D									

X. PUGH MATRIXES

Pugh matrix - Darkness						
Criteria	Grading	Reference Slip	Alt 1 Flex	Alt 2 Belt	Alt 3 Comfort	Alt 4 Pants
Hinder leakage	3	0	+	-	-	+
Application - lying	3	0	+	+	-	-
Application - standing	1	0	+	+	+	+
Adjustment	3	0	-	-	-	+
Removal	3	0	0	0	-	0
Comfortable use for the care taker	3	0	0	0	0	0
Skin health	3	0	+	+	+	0
Facilitate positioning	3	0	-	0	-	+
Enable effective and efficient handling	3	0	+	+	-	+
Communicate procedure of application	3	0	-	0	-	+
Communicate achievement of task	3	0	0	0	0	+
The product shall enable error detection and recovery	3	0	0	-	-	0
The product shall provide for user control	3	0	0	0	-	+
The product shall provide feedback	3	0	0	0	-	+
The product shall consider the user resources	3	0	0	+	-	+
Communicate security	2	0	-	-	-	+
Communicate dignity	2	0	0	0	0	+
Communicate clarity	2	0	0	0	-	+
Number of (-)		0	11	11	37	3
Number of (0)		49	25	25	8	12
Number of (+)		0	13	13	4	34
Total		0	2	2	-33	34
Rank		4	2	3	5	1

Pugh matrix - Darkness							
Criteria	Grading	Reference Slip	Alt 1 Duo	Alt 2 T-belt	Alt 3 T-flex	Alt 4 Slip-stretch	Alt 5 Brief
Hinder leakage	3	0	+	+	+	+	+
Application - lying	3	0	+	+	+	+	-
Application - standing	1	0	+	+	+	+	+
Adjustment	3	0	+	+	+	+	+
Removal	3	0	+	+	+	+	-
Comfortable use for the care taker	3	0	0	0	0	0	0
Skin health	3	0	0	+	+	0	-
Facilitate positioning	3	0	+	+	+	+	+
Enable effective and efficient handling	3	0	+	+	+	+	-
Communicate procedure of application	3	0	-	+	+	+	-
Communicate achievement of task	3	0	+	+	+	+	-
The product shall enable error detection and recovery	3	0	+	+	+	+	-
The product shall provide for user control	3	0	+	+	+	+	-
The product shall provide feedback	3	0	+	+	+	+	+
The product shall consider the user resources	3	0	+	+	+	+	-
Communicate security	2	0	+	+	+	+	+
Communicate dignity	2	0	+	0	0	0	+
Communicate clarity	2	0	+	+	+	+	-
Number of (-)		0	3	0	0	0	29
Number of (0)		49	6	5	5	8	3
Number of (+)		0	40	44	44	41	17
Total		0	37	44	44	41	-12
Rank		4	3	1	1	2	5

Pugh matrix - One arm						
Criteria	Grading	Reference Flex	Alt 1 Slip	Alt 2 Belt	Alt 3 Comfort	Alt 4 Pants
Hinder leakage	3	0	0	-	-	0
Application - lying	3	0	-	-	-	-
Application - standing	1	0	-	0	-	+
Adjustment	3	0	-	0	-	+
Removal	3	0	0	+	+	-
Comfortable use for the care taker	3	0	0	0	0	0
Skin health	3	0	-	+	+	0
Minimize needs of turning	3	0	+	+	+	+
Facilitate positioning	3	0	-	0	+	+
Enable effective and efficient handling	3	0	-	+	-	-
Communicate procedure of application	3	0	0	0	+	+
Communicate achievement of task	3	0	0	0	0	+
The product shall enable error detection and recovery	3	0	0	-	-	+
The product shall provide for user control	3	0	-	+	0	+
The product shall provide feedback	3	0	0	0	0	+
The product shall provide visual clarity	3	0	0	0	-	+
The product shall consider the user resources	3	0	-	+	0	+
Communicate security	2	0	0	0	-	+
Communicate dignity	2	0	0	0	+	+
Communicate simplicity	2	0	0	0	+	+
Number of (-)		0	22	9	21	9
Number of (0)		55	30	28	15	9
Number of (+)		0	3	18	19	37
Total		0	-19	9	2	29
Rank		4	5	2	3	1

Pugh matrix - One arm							
Criteria	Grading	Reference Flex	Alt 1 Hoop	Alt 2 Loop	Alt 3 Grab	Alt 4 Buckle	Alt 5 Brief
Hinder leakage	3	0	0	0	+	0	+
Application - lying	3	0	-	-	0	-	-
Application - standing	1	0	+	+	0	+	+
Adjustment	3	0	+	+	+	+	+
Removal	3	0	+	-	0	-	-
Comfortable use for the care taker	3	0	0	0	0	0	0
Skin health	3	0	+	+	0	0	0
Minimize needs of turning	3	0	+	+	0	+	+
Facilitate positioning	3	0	+	+	+	+	+
Enable effective and efficient handling	3	0	+	+	0	+	+
Communicate procedure of application	3	0	+	+	+	+	-
Communicate achievement of task	3	0	+	+	+	+	0
The product shall enable error detection and recovery	3	0	+	+	+	+	0
The product shall provide for user control	3	0	+	+	0	+	+
The product shall provide feedback	3	0	+	+	+	0	+
The product shall provide visual clarity	3	0	+	+	+	+	0
The product shall consider the user resources	3	0	+	+	+	+	0
Communicate security	2	0	+	+	+	+	+
Communicate dignity	2	0	0	0	+	0	+
Communicate simplicity	2	0	+	+	+	0	+
Number of (-)		0	3	6	0	6	9
Number of (0)		55	9	9	22	16	18
Number of (+)		0	43	40	33	33	28
Total		0	40	36	33	27	19
Rank		6	1	2	3	4	5

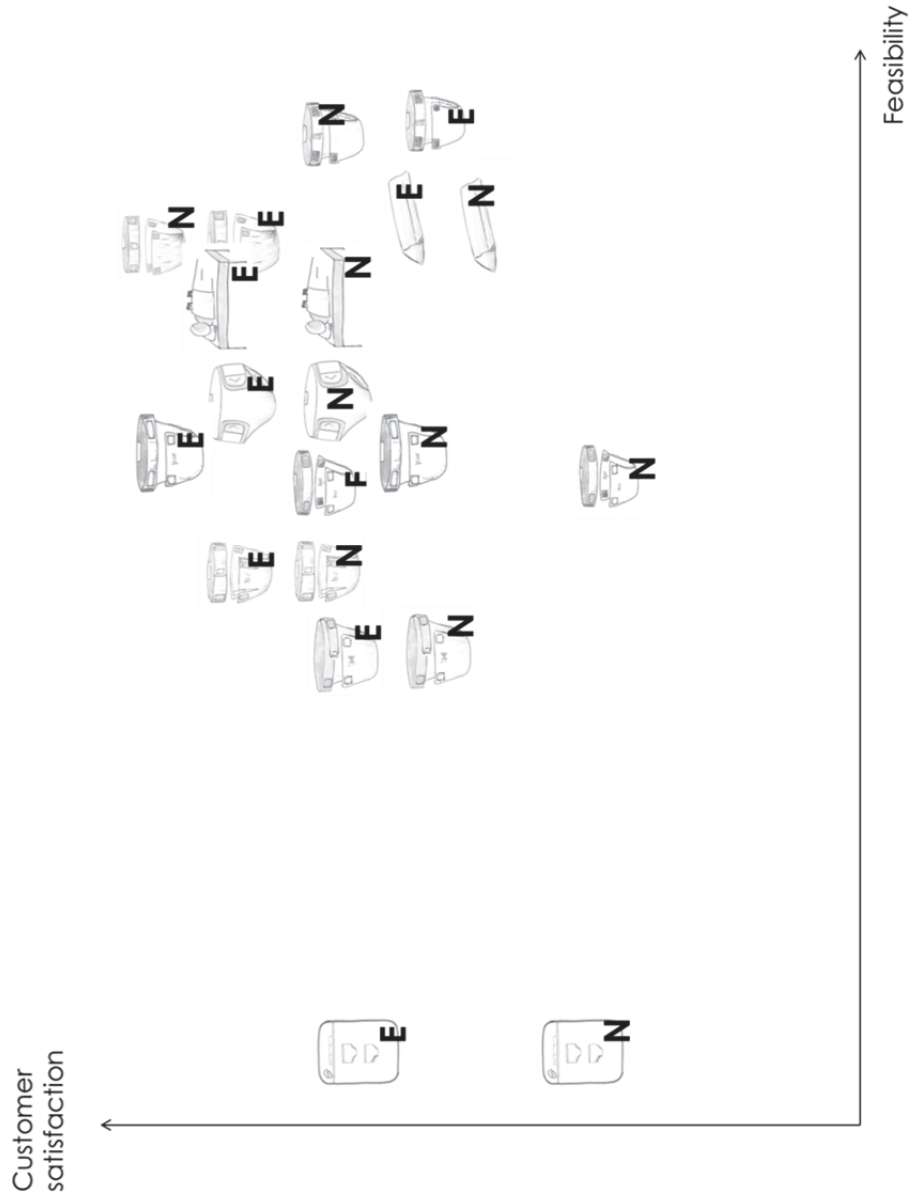
Pugh matrix - Heavy						
Criteria	Grading	Reference Slip	Alt 1 Flex	Alt 2 Belt	Alt 3 Comfort	Alt 4 Pants
Hinder leakage	3	0	-	-	-	0
Application - lying	3	0	+	+	-	-
Application - standing	1	0	+	+	-	+
Adjustment	3	0	-	-	-	+
Removal	3	0	0	0	-	-
Comfortable use for the care taker	3	0	0	0	0	0
Skin health	3	0	+	+	+	0
Minimize needs of turning	3	0	+	+	0	0
Facilitate positioning	3	0	0	0	-	+
Enable effective and efficient handling	3	0	+	+	0	-
Communicate procedure of application	3	0	0	0	0	+
Communicate achievement of task	3	0	0	0	0	+
The product shall enable error detection and recovery	3	0	-	-	-	-
The product shall provide for user control	3	0	0	0	0	-
The product shall provide feedback	3	0	0	0	0	+
The product shall provide visual clarity	3	0	0	0	-	+
The product shall consider the user resources	3	0	0	+	+	-
Communicate security	2	0	-	-	-	+
Communicate dignity	2	0	0	0	+	+
Communicate facility	2	0	0	0	+	+
Number of (-)		0	11	11	24	15
Number of (0)		55	31	28	21	15
Number of (+)		0	13	16	10	25
Total		0	2	5	-12	10
Rank		4	3	2	5	1

Pugh matrix - Heavy						
Criteria	Grading	Reference Slip	Alt 1 Slip Stretch	Alt 2 Hoop+	Alt 3 Super stretch	Alt 4 Belt stretch
Hinder leakage	3	0	+	0	0	+
Application - lying	3	0	+	-	+	+
Application - standing	1	0	+	+	+	+
Adjustment	3	0	+	+	+	+
Removal	3	0	0	0	0	0
Comfortable use for the care taker	3	0	0	0	0	+
Skin health	3	0	0	+	+	+
Minimize needs of turning	3	0	0	+	+	+
Facilitate positioning	3	0	+	+	+	+
Enable effective and efficient handling	3	0	0	0	0	+
Communicate procedure of application	3	0	0	+	+	+
Communicate achievement of task	3	0	0	+	+	+
The product shall enable error detection and recovery	3	0	+	0	0	+
The product shall provide for user control	3	0	+	0	0	0
The product shall provide feedback	3	0	+	+	+	+
The product shall provide visual clarity	3	0	+	+	+	+
The product shall consider the user resources	3	0	+	+	+	+
Communicate security	2	0	+	0	0	0
Communicate dignity	2	0	0	0	0	0
Communicate facility	2	0	+	+	+	+
Number of (-)		0	0	3	0	0
Number of (0)		55	23	22	22	10
Number of (+)		0	32	30	33	45
Total		0	32	27	33	45
Rank		5	3	4	2	1

XI. POSSIBILITY OF SOLVING IDENTIFIED ISSUES

Common problems	Slip facile	Flex facile	Light- away	Buckle	Hoop	Hoop	Hoop	Loop	Support	Super- stretch	Stretch	Turner
Fit	x	x		x	x	x	x	x		x	x	
Determination of fit	x	x	x	x	x	x	x	x		x	x	
Get the product at the correct position	x	x	x	x	x	x	x	x		x	x	
Late detection of errors	x	x		x	x	x	x	x		x	x	
Low experience of control	x	x	x	x	x	x	x	x	x	x	x	x
No indication of completion of task	x	x	x	x	x	x	x	x		x	x	
Placement of fastenings and tapes	x	x		x	x	x	x	x		x	x	
Problems concerning the heavy care taker												
Turning the care taker												x
Number of turnovers		x	x		x	x	x	x		x	x	
Problems concerning one arm interaction												
Unfold the product	x	x		x	x	x	x	x		x	x	
Tighten belt	x			x	x	x	x	x				

XII. FEASIBILITY VERSUS CUSTOMER SATISFACTION



XIII. INFORMATION NEED ANALYSIS

Information need analysis					
Information	Needed	Placement in existing product	Issues	Proposed placement	Advantages
Name of product	When picking product - verification of that the correct product has been picked, when applying and when removing as it describes way of handling	Sideways lengthwise along the product	Visual clutter	Visible from front, and when picked out of package. Proposed at fastening and crotch.	Grouped with other information at front, distinguishing the product from the flex product. Discretion
Size indication	When picking - verification of that the correct product has been picked, when applying/removing for control of fit and identification of need of size change	Sideways lengthwise along the product	Visual clutter	Visible from front, and when picked out of package. Proposed at fastening and crotch.	The information is easily findable. Discretion.
Absorption level	When picking - verification of that the correct product has been picked, when removing for identification of eventual needed increase in absorption level.	Sideways lengthwise along the product	Visual clutter	Visible from front, and when picked out of package. Proposed at fastening and crotch.	Easily findable and correlates to the colour coding of the fastenings. Discretion.
Brand	When picking - verification of that the correct product has been picked	Sideways lengthwise along the product	Visual clutter	Visible from front, and when picked out of package. Proposed at fastening and crotch.	The information is easily findable. Discretion.
Wetness indicator	During use/ when removing product	In the middle along the crotch area	Disappears in visual clutter	Stays in same place	When other information removed wetness and thereby also skin health is highlighted.
Application instruction	When applying the product.	Sideways lengthwise along the product	Irregular pattern, cut of, disappears among the other information, hard too see during the application procedure as it ends up in crotch area. Has to be read sideways.	At the belt, last place to be covered	Higher level of discretion with less readable, kept horizontally.

XIV. LIST OF REQUIREMENTS TENA TURNER

List of requirements - TENA Turner	Comment	Requirement/Desire	Heavy, grading		
			3	2	1
Functional requirements					
1.1 The product shall enable turning of the care taker		R	x		
1 The product shall enable adjustment of position in bed		R	x		
1.2 The product shall collect urine		D			x
1.3 The product shall absorb urine		D			x
1.4 The product shall hinder leakage		R	x		
1.5 The product shall enable handling		R	x		
1.6 The product shall enable application		R	x		
1.7 The product shall enable removal		R	x		
1.8 The product shall fit a common bed size	using 90 cm as a reference	R	x		
1.9 The product shall display brand		D		x	
1.10 The product shall display product name		D		x	
Handling and Ergonomics					
2.1 The product shall provide comfortable turning for the care taker	By distribution of load	D	x		
2.2 The product shall provide for good skin health		D	x		
2.3 The product shall enable effective and efficient handling		D	x		
2.4 The product shall communicate procedure of handle application	Provide for explicitness	R	x		
2.5 The product shall provide for user control		D	x		
2.6 The product shall provide visual clarity		D	x		
2.7 The product shall consider the user resources		D	x		
2.8 The product shall facilitate the turning of the care taker		R	x		
2.9 The product shall provide grip surfaces developed with regards for the 5th -95th percentile		R	x		
Sustainability					
3.1 The Material used shall go in line with the company's sustainability		D		x	
3.2 The product shall minimize use of material		D		x	
3.3 The product shall minimize waste of material		D		x	
Aesthetics					
4.1 The product shall have a design in line with TENA's design profile		D		x	
4.2 The product shall attract the target group		D	x		
Communicative criterions					
5.1 The product shall communicate security		D		x	
5.2 The product shall communicate dignity		D		x	
5.3 The product shall communicate facility		D		x	
Economics					
6.1 The product cost should be in line with the existing assortment		D		x	

XV. PUGH MATRIX HANDLES

Pugh matrix - Handles for TENA Turner						
Criteria	Grading	Reference grabbing common pull sheets	Alt 1 Slapon	Alt 2 Fold	Alt 3 Slip in	
Enable handling	3	0	+	-	+	
Enable application	3	0	0	0	0	
Provide instruction	1	0	+	-	+	
Display brand	2	0	0	0	0	
Facilitate positioning	3	0	+	-	+	
Enable effective and efficient handling	3	0	+	-	0	
Communicate procedure of application	3	0	+	-	+	
Communicate achievement of task	3	0	+	-	+	
The product shall provide for user control	3	0	+	-	+	
The product shall provide visual clarity	3	0	+	-	0	
Facilitate turning	3	0	+	+	+	
Communicate security	2	0	+	-	+	
Communicate dignity	2	0	+	-	+	
Communicate facility	2	0	+	-	0	
Number of (-)		0	0	28	0	
Number of (0)		36	5	5	11	
Number of (+)		0	31	3	23	
Total		0	31	-25	23	
Rank		3	1	4	2	

XVI. USABILITY TEST 2: TASKS

Usability test – Scenario 1

You are taking care of three elderly individuals and need to change their incontinence care protections. You are now facing three different situations in which you are to remove the used product and apply a new one. The test is not including the task of removing clothes or cleaning the care taker to keep focus on the removal and application. The test is performed to measure the usability in the product, not your personal abilities, in various situations. To manage all tests within 45 minutes each task has a time limit of 6 minutes.

You just arrive at your care takers. For the first change you just have one arm available. You can only use your right arm, please hold your left arm loosely along the side of your body. Your task is to remove the used product and apply a new one.

The next care taker is heavier than the previous, usually you are two persons providing the care but today you have to solve the situation on your own. Your task is to remove the used product and apply a new one.

You arrive at the next care taker. Your task is to remove the used product and apply a new one.

Usability test - Scenario 2

You are taking care of three elderly individuals and need to change their incontinence care protections. You are now facing three different situations in which you are to remove the used product and apply a new one. The test is not including the task of removing clothes or cleaning the care taker to keep focus on the removal and application. The test is performed to measure the usability in the product, not your personal abilities, in various situations. To manage all tests within 45 minutes each task has a time limit of 6 minutes.

You just arrive at your care takers. The first care taker is heavier than the others, usually you are two persons providing the care but today you have to solve the situation on your own. Your task is to remove the used product and apply a new one.

You walk up to the bed of the second care taker. Your task is to remove the used product and apply a new one.

For the next change you just have one arm available. You can only use your right arm, please hold your left arm loosely along the side of your body. Your task is to remove the used product and apply a new one.

XVII. USABILITY TEST 2: TEST PROTOCOL

Usability test

Achievement of task: Yes No

Time for task completion: _____

Errors: _____

Procedure: _____

Comments: _____

Level of confidence (1 is very unconfident and 5 is very confident)

1 2 3 4 5

VIII. USABILITY TEST 2: RESULT TEST PROTOCOL

Multi-armed, with one arm		Level of confidence	Time for task completion (minutes)	Errors	Comments	Notes
Test person 1	Yes	4	4.5	Minor: Initial belt high up	A real heavy person would be harder. Don't want the mold in the used product to fall out. It's not obvious what is front and back. I think that the "tag" is at the front, easy to see being change	Procedure according to HIA. Front at front
Test person 2	Yes	5	3.05	-	Would have wanted a pull sheet, use the elastic for centring.	Procedure according to HIA. Front at front
Test person 3	Yes	1	4.33	Major: Applies the very protection why, not inside markings, one fastening on the elastic	Saw that the belt was on the inside of the protection. Should the belt go on first? Cannot see what is front and what is back. Guess front and back. hard with one arm.	Rolls the core taker away from body, leading to difficulties in making it stay in place. Front at front. Applies the protection to the belt first.
Test person 4	Yes	4	4	Minor: Not inside markings	-	Centres the markings at the back. Front at front
Test person 5	Yes	4	3.866666667	Minor: belt gets stuck in flap	Its usually heavier. Ticky with the tabs fastening everywhere.	Applies the protection to the belt first.
Test person 6	Yes	3	2.833333333	-	hard to turn with one arm available. This is probably not possible with a heavy person.	Applies the protection to the belt first.

Where 0 corresponds to that the product is not applied and its leakage security is provided and 5 corresponds to a very good quality of fit with high leakage security.

Where 1 corresponds to very unconfident and 5 corresponds to very confident

Multi changed in normal situation						
Test person	Achieved Quality	Level of confidence	Time for task	Errors	Comments	Notes
Test person 1	Yes 5	5	1,683333333	-	Easier when I have already performed the task.	Tag at front. Folds down protection, rolls belt. Pulls fastenings in correct position.
Test person 2	Yes 4	5	2,766666667	Mnor-major: Fastenings outside their landing zones. Fastening on elastics.	Folds down protection not to soil person. Rolls belt to easily remove when turned over.	Tag at front. Understand what is the purpose, to fasten in the marked areas.
Test person 3	Yes 2	3	2,33	Mnor-major: Fastenings outside their landing zones. Product low at back.	Cannot distinguish back from front. Guess.	Tag at front. Compares with used product to see how it should be fastened. Fastens protection at belt before application.
Test person 4	Yes 4	4	2,833333333	Mnor: fastenings outside of their zones.	Could have prepared the product.	Tag at front. Fastens back to belt first. Pulls to front lowers belt. The elastics are in the wrong place. The fastenings should be within the markings.
Test person 5	Yes 5	5	1,533333333	-	Easier with two hands available.	Tag at front.
Test person 6	Yes 5	4	2,75	-	Assume that there are no front and back. Markings are good but they don't really fit in the beginning.	Tag at front. Looks at the instructions.

Where 0 corresponds to that the product is not applied and no leakage security is provided and 5 corresponds to a very good quality of fit with high leakage security.

Where 1 corresponds to very unconfident and 5 corresponds to very confident

Multi changed on a heavy care taker		Level of confidence	Time for task completion	Errors	Comments	Notes
Test person 1	4. Good fit but fastenings outside of intended position	1	4.1	Minor: Fastenings outside of the landing zone	Very complicated when alone. The tag should be at the front, that is how I interpret it. Would have wanted to go to the other side.	Looks at information to place belt.
Test person 2	3. Good fit at front one slightly off at the back	3	4.5	Minor: Front at back	I would not want to do this to a normal person. How should I get the belt around the body? Don't know if I reached the belt at the back.	
Test person 3	1. Not fastened at front, too low at back	1	3.33	Minor: Not inside fastening zones. Fatal - Catastrophic: Too far down at back. Not fastened.	Poor patient. Problem in getting the product in under at first.	Uses the used product to compare and see how the new one should be attached. Applies the product to the belt first.
Test person 4	4. Ok fit, all fastenings on belt.	3	3.966666667	Minor: Fastenings outside of the landing zone	One would not do this to a normal person. Assume that the marking should be at the front.	
Test person 5	0	1	-	Fatal - catastrophic: Can not reach belt under patient as it has fastened in itself in under the patient.	"Very heavy"	Fastens the protection on the belt first.
Test person 6	0	1	-	Fatal - catastrophic: Does not apply the product	"Not possible to turn him over, too heavy"	

Where 0 corresponds to that the product is not applied and no leakage security is provided and 5 corresponds to a very good quality of fit with high leakage security. Where 1 corresponds to very unconfident and 5 corresponds to very confident

Questionnaire

Age: _____

Gender: Male Female

Have you previously applied a heavy incontinence product to yourself or another person?

Yes

No

Have you previously changed a baby diaper?

Yes

No

1. How hard/easy did you experience the performance of the overall task?

Very hard corresponds to having big difficulties performing the task and very easy corresponds to performing the task without any difficulties.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very hard	Hard	Neither easy nor hard	Easy	Very easy

1.a How hard/easy did you experience the task of removing the used protection?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very hard	Hard	Neither easy nor hard	Easy	Very easy

1.b How hard/easy did you experience the task of turning the care taker over?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very hard	Hard	Neither easy nor hard	Easy	Very easy

1.c How hard/easy did you experience the task of applying the new product?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very hard	Hard	Neither easy nor hard	Easy	Very easy

Comments _____

2. What level of control did you experience that you had when performing the task?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very low level of control				Very high level of control

3. What step of the procedure did you find the most challenging to perform and why?

4. How unclear/clear did the product communicate how it should be handled?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very unclear	Unclear	Neither unclear clear	Clear	Very clear

5. How unclear/clear did the product communicate if the task was achieved?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very unclear	Unclear	Neither unclear clear	Clear	Very clear

6. Was there anything in the product that you found hindering the progress of the task?

7. Was there anything in the product that you found helping the progress of the task?

XX. USABILITY TEST 2: RESULT QUESTIONNAIRE

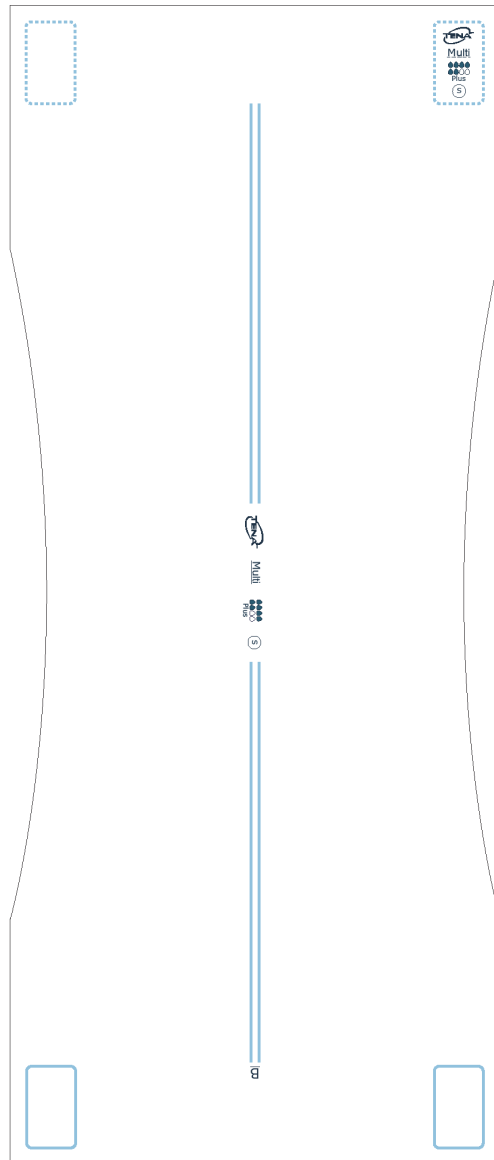
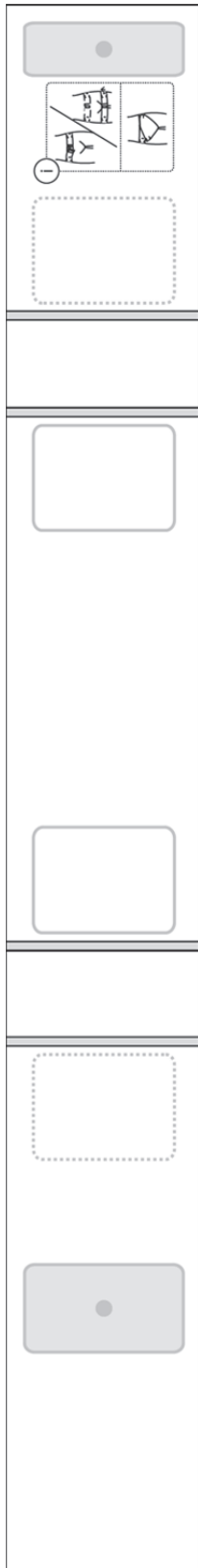
Question	Result questionnaire- Multi changed with one arm							Median not changed earlier	Median changed earlier
	1p1	1p2	1p3	1p4	1p5	1p6	1p7		
Changed product before	Yes	Yes	No	Yes	No	Yes			
Changed baby diaper before	No	Yes	Yes	Yes	No	Yes			
1	2	4	1	2	2	1	2	1,5	2
1.a	4	4	3	4	4	2	4	3,5	4
1.b	5	4	1	4	1	4	1	2,5	1
1.c	2	4	1	2	2	1	2	1,5	2
Comment	-	-	front/back	Did not manage the fastening of the protection at belt correctly.	Difficult to only use one arm, hooks attached to area so hard to get the belt on different place.	Turning product elastics made it shrink, hooks stuck in the product. Sliding belt.			
2.	4	4	1	3	4	4	2	3,5	3,5
3.	Tighten belt enough, pull the protection up.	Turn mankin around and secure position	Put belt and product under the person, pull up and fasten protection.	Make product attach properly to belt.	Get the product correct on place to fit well.	Back part of the product would probably be difficult. But I put the belt and pad together first.			
4.	2	4	1	4	4	4	2	3	2,5
5.	3	4	2	4	2	4	4	3,5	2
6.	-	-	-	-	Hooks attached all over.	Elastics and hooks sticking to the product.			
7.	The marking at the front protection, the elastics.	Markings on belt & protection, the elastics.	-	Maybe the squares, though start to hesitate on them.	Different attach areas on belt	Markings			

Result questionnaire- Multi changed in normal situation										
Question	1p1	1p2	1p3	1p4	1p5	1p6	Median	Median not changed earlier	Median changed earlier	
Changed product before	Yes	Yes	No	Yes	No	Yes				
Changed diaper before	No	Yes	Yes	Yes	No	Yes				
1	4	5	2	4	4	1	4	3	4	Where 1 corresponds to very hard and 5 to very easy
1.a	5	5	4	5	4	4	4.5	4	5	Where 1 corresponds to very hard and 5 to very easy
1.b	4	5	2	5	3	4	4	2.5	4.5	Where 1 corresponds to very hard and 5 to very easy
1.c	4	4	2	3	4	2	3.5	3	3.5	Where 1 corresponds to very hard and 5 to very easy
	-	The hook loosened so that adjustments were needed.	Placement front/back.	Was not hard to apply product but I realised that it was not correctly attached to the belt when I was finished.	Better when using two hands.	Needed several adjustments to put it right.				
Comment	5	5	2	3	4	3	3.5	3	4	Where 1 corresponds to very low level of control and 5 corresponds to very high level of control
2.	Reach the correct height of the belt.	In a real situation it would be challenging to hold the patient at the same time as applying the product. On the manikin, correct height of belt without adjusting.	Placement front back.	Attach the front. I realised that I had turned the belt too far to the left.	To set the product in the right place, to fit well to avoid leakages.	Make it fit in front to back distance. Belt did rise on the body and was not still on hips, but in waist.				
3.	3	4	2	4	4	3	3.5	3	3.5	Where 1 corresponds to very unclear and 5 to very clear
4.	4	4 (hook position)	2	4	2	3	3	2	4	Where 1 corresponds to very unclear and 5 to very clear
5.	The tags at front.	-	-	-	-	Up down, front back.				
6.	Yes the squares here one understood that the fastenings should land.	Markings on belt can help if you get information about them. Elastics in belt - Good!	-	The squares - that I missed but was good to have.	Instructions was understandable. How I saw the dot middle, easy to confuse with the fastening zones.	Squares/signs on belt & product. Worth or without a dot - was clear where to put which part.				
7.										

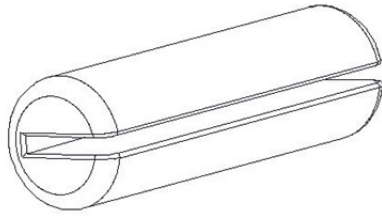
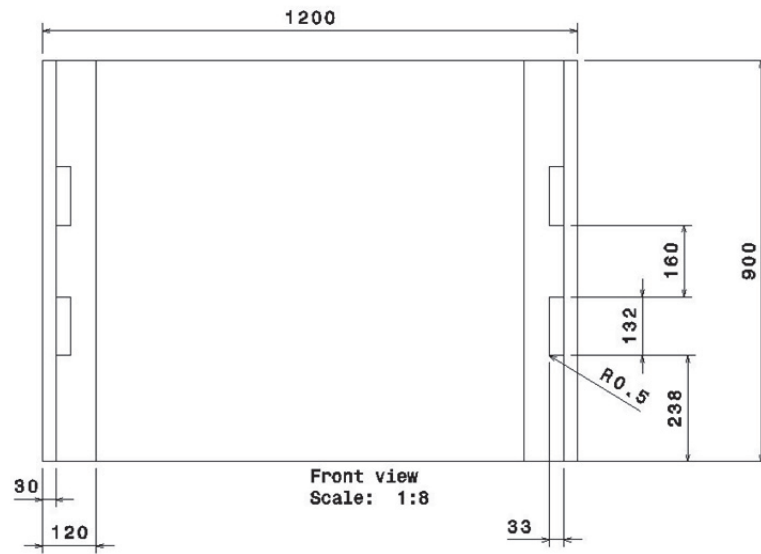
8. In questionnaire, have changed with one arm									
Question	TP1	TP2	TP3	TP4	TP5	TP6	TP7	TP8	TP9
Change product before	Yes	No	Yes	Yes	No	Yes		Yes	
Change product before	Yes	Yes	Yes	Yes	No	Yes		Yes	
1.a	1	2	1	2	1	1		1	1.5
1.b	3	4	3	3	3	3		1	3
1.c	1	1	1	1	1	1		1	1
1.d	1	2	1	2	1	1		1	1.5
Comment	Could not secure positioning of product on belt at back, as I could not turn the monitor, but the core was placed correctly.							Did not manage to take off or apply due to heavy patient.	
2	3	3	1	2	1	1		1	2.5
3	Adjust to back, get the belt removal, turner to apply the new product with appropriate security.	Turn the monitor for secure and comfortable removal, turner to apply the new product with appropriate security.	Turn the monitor for secure and comfortable removal, turner to apply the new product with appropriate security.	Apply the product at the back and see if it is properly applied or not.	Apply the product at the back and see if it is properly applied or not.	Apply the product at the back and see if it is properly applied or not.		Turn the patient	
4	2	4	1	4	4	4		4	2.5
5	2	3	2	4	3	3		3	2.5
6	At the beginning I started with the problem of back as it is too placed with one place the core forward.	Had with problem of back as it is too placed with one place the core forward.						Had a problem of the product to turn the patient, but I did not manage to turn the patient, so I did not finish the product but remember from first test.	
7	Monitors on belt, what was front	Good with the print for new users.		Believed that the forerights would land in the blue squares but they did not fit there. Maybe they should help but I applied the product wrong.					

XXI. DRAWINGS

TENA Multi, illustration of the outlining on the belt and the absorbing part.



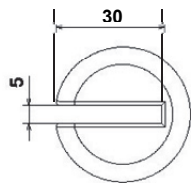
TENA Turner (all measures in mm)



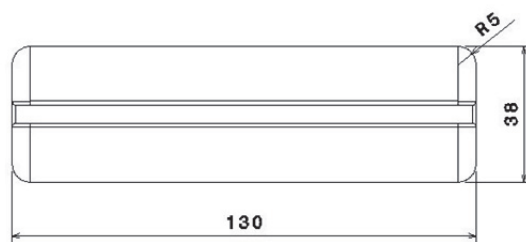
Isometric view
Scale: 1:1



Top view
Scale: 1:1



Right view
Scale: 1:1



Front view
Scale: 1:1

XXII. FULFILMENT OF REQUIREMENTS

List of requirements - TENA Multi	Comment	Requirement	One arm, grading			Fulfillment during change with one arm and normal situation			Verification method
			Not fulfilled	Partly fulfilled	Fulfilled	Not fulfilled	Partly fulfilled	Fulfilled	
Functional requirements									
1.1 The product shall provide protection		R	3		x				Quality assurance
1.2 The product shall collect urine		R	3		x				Quality assurance
1.3 The product shall absorb urine		R	3		x				Quality assurance
1.4 The product shall hinder leakage		R	3		x				Quality assurance
1.5 The product shall enable handling		R	3		x				Usability test
1.6 The product shall enable application		R	3		x				Usability test
1.7 The product shall enable adjustment		R	3		x				Usability test
1.8 The product shall enable removal		R	3		x				Usability test
1.9 The product shall enable manufacturing in different sizes		R	3		x				Quality assurance
1.10 The product shall provide instruction		D	3		x				Usability test
1.11 The product shall show status (how much has been absorbed)		D	2		x				Quality assurance
1.12 The product shall display brand		R	2		x				Quality assurance
1.13 The product shall display product name		R	2		x				Quality assurance
1.14 The product shall display level of absorption		R	2		x				Quality assurance
1.15 The product shall display size		R	2		x				Quality assurance
Handling and Ergonomics									
2.1 The product shall provide comfortable use for the care taker		R	3				x		
2.2 The product shall provide for good skin health		R	3			x			Quality assurance
2.3 The product shall facilitate positioning of the product and it's parts	Compared to existing product	D	3		x				Usability test
2.4 The product shall enable effective and efficient handling		D	3		x				Usability test
2.5 The product shall communicate procedure of application	Provide for explicitness	R	3		x				Usability test
2.6 The product shall communicate achievement of task		D	3		x				Usability test
2.7 The product shall enable error detection and recovery		D	3		x				Usability test
2.8 The product shall provide for user control		D	3		x				Usability test
2.9 The product shall provide feedback		D	3		x				Usability test
2.10 The product shall provide visual clarity		D	3		x				Usability test
2.11 The product shall consider the user resources		D	3		x				Usability test
2.12 The product shall enable handling with one hand		R	3		x				Usability test
2.13 The product shall minimize needs of turning the care taker		D	2		x				Quality assurance
2.14 The product shall facilitate the turning of the care taker		D	2			x			Usability test
Sustainability									
3.1 The Material used shall go in line with the company's sustainability profile		D	2						Quality assurance
3.2 The product shall minimize use of material		D	2		x				Quality assurance
3.3 The product shall minimize waste of material		D	2				x		
Aesthetics									
4.1 The product shall have a design in line with TENAs design profile		D	2		x				Comparison with existing assortment
4.2 The product shall attract the target group		D	3				x		
Communicative criterions									
5.1 The product shall communicate security		D	2		x				Evaluated towards expression board
5.2 The product shall communicate dignity		D	2		x				Evaluated towards expression board
5.3 The product shall communicate simplicity		D	2		x				Evaluated towards expression board
5.4 The product shall communicate clarity		-	-						
5.5 The product shall communicate facility		-	-						
Economics									
6.1 The product cost should be in line with the existing assortment		D	2		x				Cost estimation

List of requirements - TENA Multi	Requirement/Desire	Heavy grading	Fulfillment during change on a heavy care taker	Verification method
Functional requirements	Comment		Fulfilled/Partly fulfilled/Not fulfilled	
1.1 The product shall provide protection		3	x	Quality assurance
1.2 The product shall collect urine		3	x	Quality assurance
1.3 The product shall absorb urine		3	x	Quality assurance
1.4 The product shall hinder leakage		3	x	Quality assurance
1.5 The product shall enable handling		3	x	Usability test
1.6 The product shall enable application		3	x	Usability test
1.7 The product shall enable adjustment		3	x	Usability test
1.8 The product shall enable removal		3	x	Usability test
1.9 The product shall enable manufacturing in different sizes		3	x	Quality assurance
1.10 The product shall provide instruction		3	x	Usability test
1.11 The product shall show status (how much has been absorbed)		2	x	Quality assurance
1.12 The product shall display brand		2	x	Quality assurance
1.13 The product shall display product name		2	x	Quality assurance
1.14 The product shall display level of absorption		2	x	Quality assurance
1.15 The product shall display size		2	x	Quality assurance
Handling and Ergonomics				
2.1 The product shall provide comfortable use for the care taker		3		Quality assurance
2.2 The product shall provide for good skin health		3	x	Usability test
2.3 The product shall facilitate positioning of the product and it's parts	Compared to existing product	3	x	Usability test
2.4 The product shall enable effective and efficient handling		3	x	Usability test
2.5 The product shall communicate procedure of application	Provide for explicitness	3	x	Usability test
2.6 The product shall communicate achievement of task		3	x	Usability test
2.7 The product shall enable error detection and recovery		3	x	Usability test
2.8 The product shall provide for user control		3	x	Usability test
2.9 The product shall provide feedback		3	x	Usability test
2.10 The product shall provide visual clarity		3	x	Usability test
2.11 The product shall consider the user resources		3	x	Usability test, quality assurance
2.12 The product shall enable handling with one hand		1		
2.13 The product shall minimize needs of turning the care taker		3	x	Quality assurance
2.14 The product shall facilitate the turning of the care taker		3	x	Usability test
Sustainability				
3.1 The product shall minimize use of material		2	x	Quality assurance
3.2 The product shall minimize waste of material		2	x	Quality assurance
3.3 The product shall minimize waste of material		2		
Aesthetics				
4.1 The product shall have a design in line with TENAs design profile		2	x	Comparison with existing assortment
4.2 The product shall attract the target group		3		
Communicative criteria				
5.1 The product shall communicate security		2	x	Evaluated towards expression board
5.2 The product shall communicate dignity		2	x	Evaluated towards expression board
5.3 The product shall communicate simplicity		-		
5.4 The product shall communicate clarity		-		
5.5 The product shall communicate facility		2	x	Evaluated towards expression board
Economics				
6.1 The product cost should be in line with the existing assortment		2	x	Cost estimation

List of requirements - TENA Turner Functional requirements	Comment	Requirement/Desire	Heavy grip			Verification method
			Fulfilled	Partly fulfilled	Not fulfilled	
1.1. The product shall enable turning of the care taker		R	X			Test
1.2 The product shall enable adjustment of position in bed		R	3	X		Test
1.3 The product shall collect urine		D	1	X		Quality assurance
1.4 The product shall absorb urine		D	1	X		Quality assurance
1.5 The product shall hinder leakage		R	3	X		Quality assurance
1.6 The product shall enable handling		R	3	X		Usability test
1.7 The product shall enable application		R	3	X		Quality assurance
1.8 The product shall enable removal		R	3	X		Quality assurance
1.9 The product shall fit a common bed size		R	3	X		Quality assurance
1.10 The product shall display brand	using 90 cm as a reference	D	2	X		Quality assurance
1.1.1 The product shall display product name		D	2	X		Quality assurance
Handling and Ergonomics						
2.1 The product shall provide comfortable turning for the care taker	By distribution of load, compared to gripping the skin	D	3	X		Test
2.2 The product shall provide for good skin health		D	3		X	
2.3 The product shall enable effective and efficient handling		D	3	X		Test
2.4 The product shall communicate procedure of handle application	Provide for explicitness	R	3	X		Test
2.5 The product shall provide for user control		D	3		X	
2.6 The product shall provide visual clarity		D	3	X		Test
2.7 The product shall consider the user resources		D	3	X		Test
2.8 The product shall facilitate the turning of the care taker	compared conventional turning	R	3	X		Test + quality assurance
2.9. The product shall provide grip surfaces developed with regards for the 5th -95th percentile		R	3	X		Quality assurance
Sustainability						
3.1 The Material used shall go in line with the company's sustainability		D	2	X		Quality assurance
3.2 The product shall minimize use of material		D	2		X	
3.3 The product shall minimize waste of material		D	2		X	
Aesthetics						
4.1 The product shall have a design in line with TENAs design profile		D	2	X		Compared to the existing assortment
4.2 The product shall attract the target group		D	3		X	
Communicative criterions						
5.1 The product shall communicate security		D	2	X		Evaluated towards expression board
5.2 The product shall communicate dignity		D	2	X		Evaluated towards expression board
5.3 The product shall communicate facility		D	2	X		Evaluated towards expression board
Economics						
6.1 The product cost should be in line with the existing assortment		D	2	X		Cost estimation

