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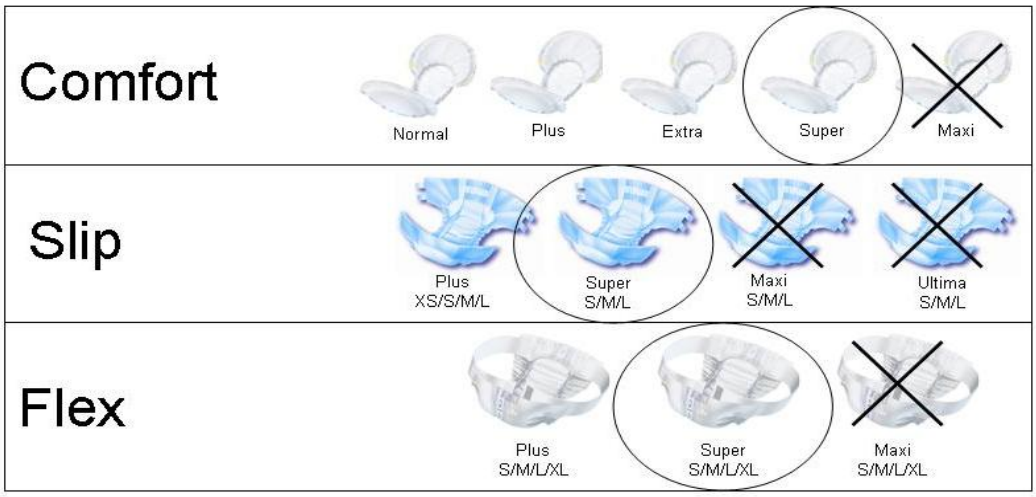

Product development and evaluation of movable inserts for the TENA assortment.

Master's Thesis in the Master Degree Programme, Product Development

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ABSTRACT

Incontinence is a very well known problem and the reasons behind it are many. There are a few treatments and exercises which could reduce the incontinence problems for certain people. Even so, effective absorbing incontinence products are a must for people with incontinence in order for them to feel secure enough to be able to live a normal life. The main goal for thesis is to investigate if it is possible to reduce the number of incontinence products in the TENA assortment by introducing movable inserts. Instead of having many bulky models with a very large absorption capacity it could be possible to have thinner base products and add inserts depending on each caretaker's individual needs.

The results and conclusions drawn in this development project is based on two dynamic Design Build Test cycles conducted with a close collaboration with experts working at SCA and the most important customers, the Professional Care Givers (PCG). The close collaboration utilized the gathering of the needed information throughout the project. The empirical information in this report is predominantly gained through in-house interviews and customer visits. The development process started with a market research, where many of the insert products on the world market was investigated, and ended with a customer oriented insert product. In addition, theoretical information has been used to guide the development process.

Summarizing, the development team has successfully developed a prototype and conducted a customer evaluation with 17 PCGs. The prototype, consisting of a base product and an insert, was developed with easy usage and individual care as the main areas of importance. The focus on these areas lead to a base product with printing used to guide the positioning of the insert. Finally the evaluation with customers was used in order to end up with a customer oriented prototype, and to elicit information about what PCGs feels about working with inserts in general. In conclusion, a market for a new insert product to facilitate caretaking during nights, for both PCGs and caretakers, was identified. Finally a further development of such a product was recommended for SCA.

Keywords: Incontinence Care, Insert, Institutions, Professional Care Givers

PREFACE

This is a technical report documenting the development and evaluation process of a system for movable inserts intended for the TENA assortment, performed as a Master's Thesis project at Chalmers University of Technology in Göteborg. The report illustrates the progression of the development project, starting with a market analysis and concluding with a prototype of the final product and the results of an evaluation about what Professional Care Givers feel about working with inserts.

We would like to extend our warmest appreciation to all the people that have been involved in the project with ideas, experience, discussions, materials, and financials. The support we received has significantly facilitated the development process.
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1. Introduction

This chapter will explain the main focus of this Master's Thesis. The background chapter will briefly explain SCA's background and give a short introduction to incontinence care. The purpose, objectives and scope will together explain exactly what this thesis will cover and what aspects that will be left out due to certain limitations.

1.1. Background

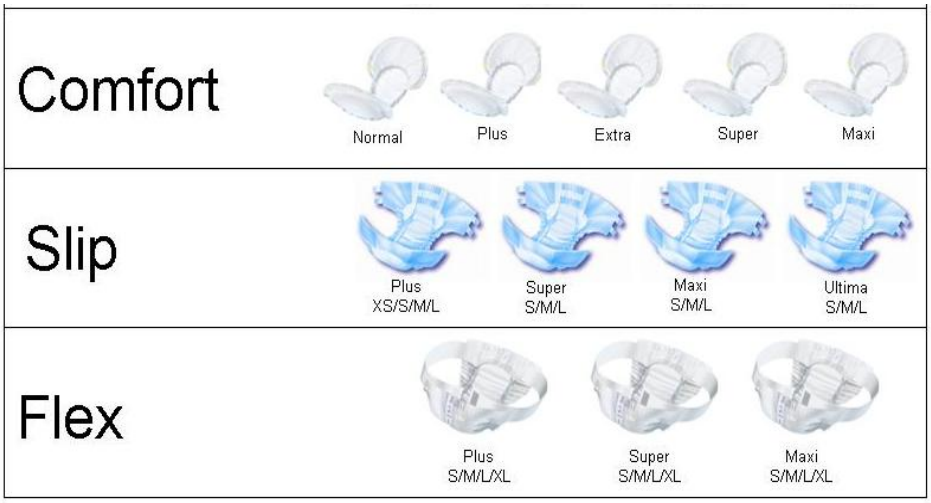
SCA is a versatile company divided into four main areas. These areas are Personal Care-, Tissue-, Packaging- and Forest products. Personal Care consists of incontinence care, baby diapers and feminine care. Tissue consists of toilet paper, kitchen rolls, handkerchiefs and napkins as well as complete hygiene solutions. Packaging offers containerboard and packaging such as transport packaging, protective packaging, consumer and point-of-sales packaging as well as services. Finally Forest products consists of publication papers, pulp and solid-wood products. (SCA, 2010)

SCA has about 52,000 employees in 60 countries. The main market is Europe but SCA also have a strong position in Australasia, Asia, North and Latin America. The five largest markets in the world for SCA are Germany, United Kingdom, France, USA and Sweden. (SCA, 2010)

SCA has many strong brands on today's market, some of them are Libero, Libresse, Tork and Edet. One of the strongest brands, which holds approximately a third of today's world market, is TENA. TENA incontinence products are sold through three different channels. In more developed countries as USA, Australia, New Zeeland and most of Europe, Institutions for elderly are the main channel. While in other parts of the world, for example in China and Latin America, Home Care and Retail are larger. (SCA, 2010)

This thesis focus on SCA's incontinence products, the assortment of incontinence products spans from small protections to be used in normal underwear to large incontinence products. Many variants of protection can be bought in sizes from XS to XL, in addition the products have different absorption capacity. The different models are categorized depending on how large the absorption capacity is. They are divided in four different areas, called Male Inco, Light Inco, Pants and Heavy Inco. This Thesis is going to focus on incontinence products with large absorption capacity (Heavy Inco), sold in Europe. The products within this area are TENA *comfort, slip and flex* which is incontinence products that are suited for caretakers with for example different mobility or incontinence. The products are shown in Table 1.1. (SCA, 2010)

Table 1.1, This table consists of Heavy Inco which is a part of SCA's incontinence product portfolio, TENA. In the table the absorption capacity increases from left to right.

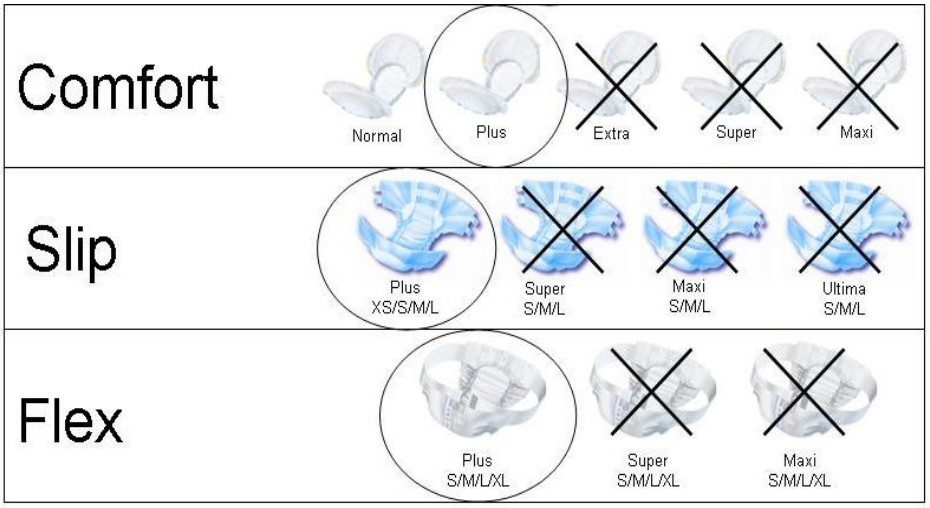


It is SCA's wish to reduce the number of articles in the assortment since this would result in savings in for example production, logistics and costs. A reduced number of articles would also lead to some environmental benefits. In addition, institutions for elderly do not use the entire assortment even if they sometimes would need it. The main reason for this is limited shelf space at local nursing homes. The large amount of shelf space needed comes from SCA's large product portfolio combined with the large packages in which the incontinence products are sold, each package containing about 20-40 products. (Vartiainen, 2010a)

SCA believes that a reduction of articles could be facilitated by developing a system with flexible absorption capacity where it is possible to add absorption capacity with insert to an incontinence base product. This system would enable the Professional Care Giver (PCG) to decide which level of absorption that is required for a specific caretaker. The result would be that someone for example using a TENA *slip* product only would need to purchase a standard level of absorption capacity and if needed add absorption capacity for each caretakers needs. The result would be that the product models with a higher absorption capacity than for example Plus could be eliminated from the assortment and a number of articles can be reduced, this is showed in Table 1.2. A new system with inserts would in theory eliminate all products with a greater absorption capacity than Plus for TENA *comfort, slip* and *flex*. (Vartiainen, 2010a)

A system like this could also enable a more individual care, since the customer can customize the incontinence product after each caretakers needs. Important to consider during this project is the customers and their feedback concerning this kind of system. The customers, who mainly will be involved during this Thesis project, are PCGs at local institutions on the west coast of Sweden. (Vartiainen, 2010a)

Table 1.2, The possible eliminations to be made are shown with X in the table.



1.2. Purpose

The purpose of this Master's Thesis is to gather the amount of information needed about adding absorption with inserts to be able to make a decision about further investments within this area.

In order to make a trustworthy decision possible, a development of a number of solutions and concepts will be conducted. These concepts will be presented to customers with the help of prototypes. The potential of this system is determined by the customers' feedback combined with calculations about possible savings within production, environment and costs. The result of this evaluation will affect the decisions about further development.

1.3. Objectives

The main objective of this Master's Thesis is to develop and evaluate the future potential of a system consisting of an incontinence product with a standard level of absorption. Where it is possible for the end user to add absorption capacity with some kind of inserts, after each caretaker's needs. To be able to reach the main objective a few interim objectives are needed.

There will be a number of technical solutions provided which will be presented during at least 15-20 evaluation meetings with PCGs. These meeting will result in an evaluation about what PCGs feel about working with inserts. This evaluation will be used in order to develop technical solutions which fulfil PCGs' and SCA's needs.

Finally, when calculating potential savings with this system, experts within different areas at SCA will be consulted in order to end up with a thorough and precise result

which can be compared to other products produced by SCA. The results are going to be presented orally and in a written report in the beginning of June 2010.

1.4. Delimitations

This Master's Thesis will only address the west coast of Sweden as a represent of other countries which use institutions for elderly globaly. This limitation in made due to limited resources and because Sweden is a very well developed country when it comes to care taking in institutions.

The evaluations made in this Thesis will only enclose Professional Care Givers (PCGs) because they are the largest users, who are working with incontinence products in Sweden on a daily basis. The evaluation study will be large enough in order to be able to support a future decision about the value of a system for adding absorption with inserts. The evaluation will also elicit needs which will be used during the development of an insert product.

The developed product will fit into all sizes of the models TENA *comfort, slip* and *flex*. The TENA *pants* model was not included in this Thesis because it was considered to be too different from the three other models. The core of TENA *pants* limits the entire possible insert shape in the crutch area to a too large extent. In addition, it was considered to be too complex to design an insert which could be easy to position in a TENA *pants* model. Therefore only TENA *comfort, slip* and *flex* will be included in this Thesis.

All technical solutions will fulfil needs from SCA and PCGs but also take production, environment and sales into consideration. All calculations made within these areas will be conducted with guidance from experts within SCA to be able to compare the result to other products within the TENA assortment.

Furthermore the absorbing function of the product, material development and lab methods are excluded because of the already well developed knowledge within these areas at SCA. Finally, all potential patent searches will be made during the next phase of development and positioned outside of the scope of this thesis because of the limited time frame.

2. Theory Framework

This Master's Thesis explains the product development and customer evaluation of an insert product. There are many commercial methods and processes which could guide the work in order to end with a product that hopefully both fulfil and exceeds the customer's expectations. This chapter will explain the theory behind the chosen process steps and methods used during this projects four phases; Pre-Study, Research and Analysis, Development and Refinements and Evaluation.

2.1. Product Development Methodology

The main literature followed during this Master's Thesis, and also the foundation for the methodology and processes explained in this chapter, is "Product design and development" 4^{ed} written by Karl T. Ulrich and Steve D. Eppinger (2008).

It is important to have a detailed product development process because a detailed process with well-defined phases and steps to follow will lead to a better final product. Not only will the product become better, an assurance of goal fulfilment is enabled along the product development process. According to Ulrich and Eppinger (2008) some advantages are enabled when using a well-defined process:

- Primarily, quality assurance is enabled to obtain if all milestones and checkpoints determined during the process are well planned in advance.
- If a well-defined process is assured both planning of the process and the coordination from management becomes easier.
- Finally the process is easy to overlook and evaluate after each development cycle, in order to eliminate waste and make it better for the following cycle.

The chosen process for this project is a combination from Ulrich and Eppingers' methodology combined with the methodology presented to the development team during the course "Product development project"- MPP126 at Chalmers University of Technology called "Integrated Product Development" (2008). Ulrich and Eppinger explain a generic development process, Figure 2.1, where a sequence of steps is conducted that aims to transform a certain input to a desired output. These ideas can be adjusted in order to fit most development processes (Ulrich & Eppinger, 2008).

The process by Ulrich and Eppinger (2008) contains six main phases, Planning, Concept Development, System-Level Design, Detailed Design, Testing and Refinements and Production Ramp-Up. The phases presented in Integrated Product Development (2008) consists of the phases, Pre-Study, Research and Conceptual Analysis, Development and Refinements and Deliverables. Even if the names of the different phases are a bit different, the content is basically the same.

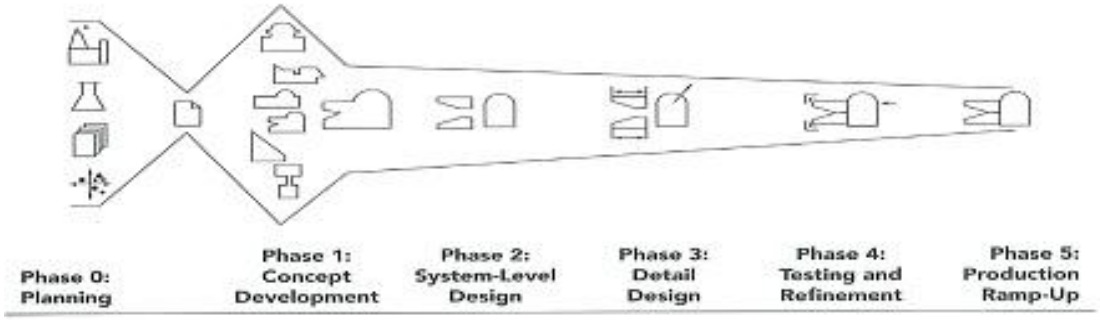


Figure 2.1, The Generic Product Development Process (Ulrich & Eppinger, 2008)

The following sub-chapter explains the phases in this thesis and resent the theory behind all methods used throughout this project.

2.1.1. Pre-Study

During the first phase of a development project the area of planning is very important in order to succeed. During the Pre-Study the gathering of the development team and its most important partners takes place. Furthermore and introduction of work norms and group goals takes place together with the planning of the project schedule and the preliminary budget. (Integrated Product Development, 2008).

Ulrich and Eppingers' (2008) first phase of their development process is called planning, but the activities during this phase are almost the same as above. The main activities are general planning of the project but also an initial investigation of market opportunities and definition of potential market segments. The output from this stage is the project mission with specifications about who the customers are; together with if it is a new product development or just minor changes to an existing product.

In order to plan the process it was divided into four phases (Pre-Study, Research and Analysis, Development and Refinements and Evaluations) where each phase contained a couple of predetermined activities. The duration of each activity was visualized with the help of a Gantt chart, which according to Ulrich and Eppinger (2008) is the traditional choice when presenting the timing of certain tasks.

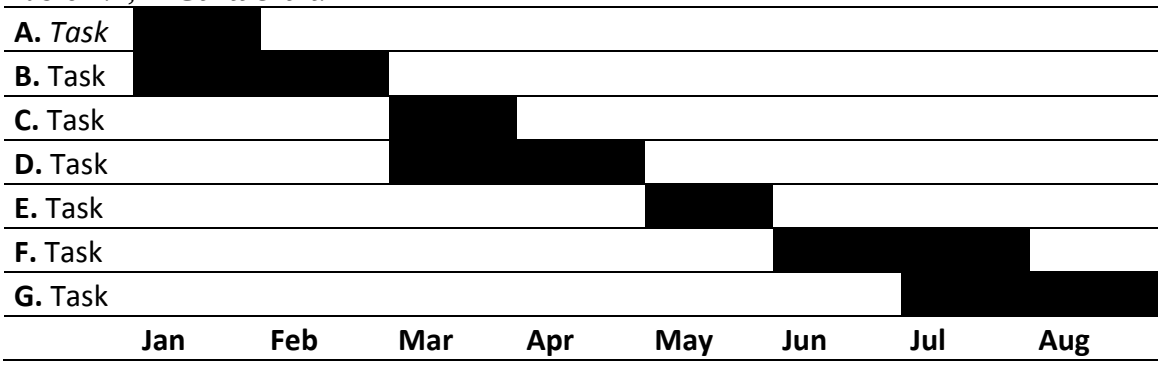
2.1.1.1. Gantt chart

The Gantt chart is used to show the duration of different tasks without presenting the actual work which needs to be done during the different phases. The chart consists of horizontal boxes which are showing when a certain activity starts and when it ends. The chart does not show dependencies among charts as for example a Design Structure Matrix where all tasks are show with dependencies of other tasks. (Ulrich & Eppinger, 2008)

When tasks overlap in a Gantt chart it can mean a number of things. Often it means that the following task is if possible started before the foregoing tasks are completely ended. Furthermore overlapping tasks can be done both in parallel, in sequence and be coupled

but this information cannot be shown in a Gantt chart, see Figure 2.1. (Ulrich & Eppinger, 2008)

Table 2.1, A Gantt chart.



2.1.2. Research & Analysis

This phase is about gathering the knowledge needed, about the product that will be developed, and the market it is going to address. After this phase, all the information needed to develop customer oriented products is gathered and analysed.

According to "Integrated Product Development" (2008) this phase should contain an action to understand the market and the user needs. This method explains the importance of having a benchmark of competing products and previous products within the company before being able to have a brainstorm. Doing so eliminates some of the risks which could be to develop something that already exists. This phase should result in a list of the specified needs and constraints for the project, both from customers and other stakeholders.

Ulrich and Eppinger (2008) have divided these tasks into two different phases, called Indentifying Customer Needs and Concept Development. In order to be able to identify customers' needs there are a few steps which need to be followed. First it is important to elicit raw data directly from the source, the customers. This can be done with several different methods; interviews, focus groups and observations of the product in use have proven to be good selections (Ulrich & Eppinger, 2008).

Griffin and Hauser (1993) have shown that at least ten interviews need to be conducted in order to elicit around 90% of customers' needs. Urban and von Hippel (1988) addresses the area of using something called Lead Users when conducting interviews. Lead Users are the users who experience needs well ahead of other users. Even if a small amount of people is used during an evaluation, the elicited needs can be representative for the entire market (Urban & von Hippel, 1988).

When a satisfactory amount of needs have been elicited it is important to find metrics for all needs, to be able to control if the needs have been fulfilled. The result of this is a need-metrics matrix where each need is linked to a certain metric; each metric should

have a accept test values to be able to verify the final product at the end. (Ulrich & Eppinger, 2008)

After customers' needs have been elicited, a five step method is very important to follow according to Ulrich and Eppinger (2008). At first, a clarification of the problem in necessary in order to get a general understanding about the problem and to be able to divide the problem into smaller manageable pieces. To ease the process of solving a complex problem, Ulrich and Eppinger (2008) suggests that the problem is decomposed into simpler sub-problems. One method for achieving such decomposition is to decompose a problem by "sequence of user action". This method is suitable for products with simple technical solutions but which consists of a lot of user interaction. Each of the actions in the series are then investigated and analysed in order to clarify what kind of areas that needs to be addressed.

Secondly it is important to focus efforts on the most critical problems, to be able to do this an external search needs to be conducted. This search should be focused at finding excising solutions for the main problem of the present project. An external search can be made with, lead users, experts, patents, literature and by benchmarking related products (Ulrich & Eppinger, 2008).

The following steps should be to search internally with brainstorming session, explore the results and finally to reflect upon the developed solutions. These actions were explored during the phase called Development.

2.1.3. Development

In order to develop concepts that will satisfy all needs, there are several methods which can be used to guide the development work. This chapter will explain methods that have been used during this project. The development process in this project consisted of two Design-Build-Test cycles. The reason and advantages with having more than one cycle is presented below.

2.1.3.1. Design Build Test cycles

According to Wheelwright and Clarke (1992) the fundamental problem when developing new products is to close the gap between design parameters determined by the designers and engineers, and the customer attributes. If there already exists a similar product on the market it is easy to compare and close the gap, but when a new product is going to be developed several iterations are necessary in order to learn the new system. The main purpose with having cycles is to generate insight and information about the customer attributes, which can be combined in the following cycle in order to come up with a better and more customer orientated final product (Wheelwright & Clark, 1992).

One Design-Build-Test cycle consists of three phases as the name tells; Design, Build and Test. During the design phase the frame for the problem is set and concepts are

generated. During the build phase the generated concepts are transformed into product representations, such as CAD-models or physical prototypes. During the last phases of testing, the prototypes is investigated differently depending on what the purpose of the evaluation is. Depending on the purpose the test can focus on a single dimension of the product or the complete system (Wheelwright & Clark, 1992).

During the design phase the most important task is to generate good ideas about solution for all problems. This can be done in many ways and one of them is explained in the next chapter.

2.1.3.2. Idea generation

Going back to the third phase of Concept Development, by Ulrich and Eppinger (2008), the following step should be to search internally. An internal search uses the knowledge within the team and company with the goal to generate creative new ideas. There are a few methods which can be used in order to come up with as many promising solutions as possible, one of them is brainstorming.

Brainstorm is a method used when many solutions needs to be generated for a specific problem. Brainstorm is a group creativity technique which has proven to be more effective than other group activities, regarding the quantity of ideas. There are a few ground rules which need to be applied in order to stimulate idea generation. They are (Osborn 1963): Focus on quantity, withhold criticism, welcome unusual ideas and combine and improve ideas. Other important areas of planning are to define the problem and carefully select the participants. Every brainstorm session need to have a facilitator and an idea collector. The facilitator keeps the idea flowing by asking questions and presenting different perspectives on the problem. One other important task for the facilitator is to let explain that everybody's ideas are equally good and make sure that everybody comes up with their own ideas. There are a few different variations of brainstorming session and one which was used during this thesis is called Suggestion Circulation. (Ottosson 1999)

Suggestion Circulation is a non-verbal and all participants should sit in a closed ring around a table. The ideas are written or sketched and after a predetermined time, all papers are sent to the neighbour to your right. The following step is to fast try to understand the ideas on the paper and try to come up with new idea connected to what you just read. The idea should be sent every five minutes, for about 40-60 minutes for the best result. This has proven to be a very powerful method when used in industry. (Ottosson, 1999)

The first action is to generate as many ideas as possible, the focus need to be on quantity and not on quality. The following action is to gather and sort all ideas. There a several methods used in order to do this and a couple of methods are going to be described in the next chapter.

2.1.3.3. Explore systematically

Explore systematically is the fourth step in Concept Development by Ulrich and Eppinger (2008) and states that it is important to use some kind of methods to be able to systematically explore the results from the external and internal searches. There are many different methods available and this chapter will explain the methods used during this project, the KJ method, Concept Classification Trees and Combination Tables.

KJ-method

Bergman and Klevsjö (2008) described the seven management tools; one of them is the Affinity diagram, also called the KJ-method after its developer Jiro Kawakita. This method is used when ideas and data are needed to be organized.

The first step is to write every idea on a post-it and put them on a wall in order to visualize all ideas together. Secondly, relations between ideas need to be found in order to group ideas into certain families. Doing so reduces the quantity from numerous ideas into some sub-groups, this makes is much easier to manage the idea process (Bergman & Klevsjö, 2008). When grouping similar ideas into sub-groups another method can be used to visualise and organise the information with the goal to form concepts. This method is called Concept Classification Tree and is explained further below.

Concept classification tree

The classification tree is a method which enables the development team to visualize the groups of solutions for a specific problem, see Figure 2.2. The previous stage could for example be the KJ-method, which organizes the idea into groups which the classification tree visualizes in an easy and understandable way (Ulrich & Eppinger 2008).

The tree makes it possible to identify less promising ideas and remove them. This makes it possible for the team to focus on the more promising ideas. Because the different solutions are divided into branches it is possible to identify independent solutions. This makes it possible to have two teams which each can focus on an independent idea, which can reduce the complexity of the concept generation.

Furthermore the tree also makes it possible to reflect on whether the team has focused an appropriate amount of time on the different branches. If a neglected branch is detected, the team can focus on this branch for a while so that no information is lost along the development process. Finally the classification tree can be used in order to visualize different problems and their sub-problems. This makes it possible to have a large amount of trees, depending how complicated the problems are. (Ulrich & Eppinger, 2008)

Combination table

This method, described by Ulrich and Eppinger (2008), is mostly used in order to think of solutions for different problems in combination. The solutions for different problems

need to be combined to form a complete concept. Not before the combination of ideas will be investigated can a complete concept successfully be developed.

In Figure 2.3 the idea of the combination table is shown. The different solutions are combined and the result is preferably developed into a drawing or textual description. This is often when not so obvious problems will appear and certain relations between solutions will become visible.

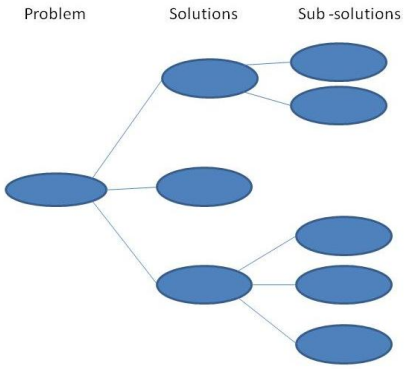


Figure 2.2, Classification tree

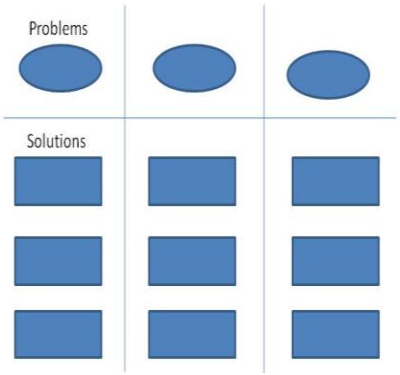


Figure 2.3, Combination table

2.1.3.4. Concept Selection

The final step of concept generation is to select which concepts to further develop and transform into prototypes. During this phase the different concepts is evaluated from customers' needs in order to find the most promising concepts. According to Ulrich and Eppinger (2008) there are several methods which can be used in order to choose concepts. One of the methods mentioned by them are External decision, where the concepts are chosen by the customer. Product champion is a method where someone with great knowledge within the area chose what he or she feels is the best solutions. Prototype and testing makes it possible to use physical prototypes to make different tests in order to decide which concepts that is best. Finally a list of pros and cons can be made for each concepts, this makes it easy to see which concepts that have the most pros and the least cons. (Ulrich and Eppinger, 2008)

When selecting a concept it is beneficial to have a structured method. This method could either be to have a customer oriented product, which fulfils everything that the customer want. It could be to have a competitive design, better product-process coordination or reduced time to introduction. The selection is made with consideration to the specific product. The selection need to be made early in order to maintain the objectives throughout the entire development, ending up with a desired product (Ulrich and Epping, 2008).

According to "Integrated Product Development" (2008) it is preferable to chose between minimum two and maximum four concepts. In addition smaller solutions and ideas, left outside could be added later as improvements. The following step is to choose a final concept which is going to be designed in detail and transformed into a prototype.

2.1.3.5. Prototypes

According to Ulrich and Eppinger (2008) a prototype could be many things. They define it as following; “an approximation of the product along on or more dimensions of interest”. Prototypes can be very useful during a development project. Depending on what the purpose of the evaluation is, the prototypes can be made in many different ways. Some of these are simulations, breadboards and mock-ups and functional prototypes. Prototypes can answer many questions according to Wheelwright and Clark (1992), some of them are about customer reactions, industrial design, fit and finish and manufacturing cost.

The prototype play a very important role in the development cycle because it tells the organisation how far the development has progressed compared to the goals set at the beginning of the project. The usage of cheap and easy prototypes effectively such as simple design models, CAD-models and simulation models can strengthen the contribution of prototypes on the development. (Wheelwright & Clarke, 2008)

2.1.3.6. Customer Evaluations

The customer evaluations are the fifth and final step from Ulrich and Eppinger (2008). When reflecting upon the generated solutions, important knowledge is obtained about the fulfilment of needs. The evaluation could lead to the identification of possible improvements. These areas could be the focus during future projects or in an additional Design-Build-Test cycle.

It is very important to define the purpose of the evaluation before starting, as well as the people which will conduct the test. The following step is to choose what tactic the survey will follow. Will it be a face-to-face interaction, by telephone or electronic mail (Ulrich & Eppinger, 2008). An interview could also be either structured or unstructured. A structured interview follows a thoroughly constructed template of questions asked in the same way at every interview. An unstructured interview consists of questions which can be changed or adapted depending on the interviewees understanding or intelligence (McQuarrie, 2006).

According to de Bont (1992) only a limited amount of information is usually presented during an early evaluation with customers. There is a rule of thumb saying that early product concepts should be presented to customer in a realistic way. Else the information elicited may not be representative for the product at hand.

2.1.3.7. Enhanced Cognitive Walkthrough

Enhanced cognitive walkthrough, ECW, is a method used together with Sequence of user action, or similar methods for dividing a problem into a handling sequence, to evaluate the usability with an interface between a product and its user. The process is often used during the development process to highlight problems that may occur during usage. The method also gives suggestions on what may cause these possible problems. (Billgård, 2007)

The ECW is divided into three phases where the first on is called Preparation, the second Analysis and the third one is called Compilation in matrixes.

Preparation
During the preparation phase the conductor of the ECW first of all decides which tasks, performed by a potential user that, that needs to be considered. Each task is also graded depending on the perceived importance of the task (a task where an error causes greater harm then another is considered to be more important). Next all the chosen tasks are specified and a template for "right usage" is set. Thereafter the user interface is specified. Finally the user and the use situation are specified. (Billgård, 2007)

Analysis
During this phase the actual test is performed. The test person performs the decided process while he or she is observed. For each task an observation is made in order to try to answer a set of questions that are divided into two different levels. The first level of questions that the observer tries to answer trough the observations are related to the interface ability to communicate with the user. These questions are:

1. Will the user know that the evaluated function is available?
2. Will the user interface give clues that show that the function is available?
3. Will the user associate the right clue with the desired function?
4. Will the user get sufficient feedback to understand that the desired function has been chosen?
5. Will the user get sufficient feedback to understand that the desired function has been performed?

The second level of questions concerns the interface ability to make the user to use the product in a correct manner. These questions are:

1. Will the user try to achieve the right effect?
2. Will the user be able to notice that the correct action is available?
3. Will the user associate the correct action with the desired effect?
4. If the correct action is performed, will the user see that progress being made towards the solution of the task?

After the questions have been asked the questions are answered with a grade together with a "failure or success" story (Billgård, 2007). The grading spans from 1, very little chance of success, to 5, very great chance of success. Thereafter problems are detected by linking a failure stories to different problem types.

Compilation of matrixes

After the test has been conducted the collected answers are divided under task number, task importance, problem severity and problem type. The information can then be combined into different matrixes where the numbers shows the distribution of the detected problems. For example problem severity can be compared to problem type to show the overall problems with the interface. Or the problem type can be compared to task importance to show which problems that are most important to rectify. (Billgård, 2007)

2.1.4. Refinements and Evaluation

The primary benefit from having a customer test is to get feedback which can be recycled and used. The team should reflect on its outcome and chose if to refine the final product and prototype (Integrated Product Development, 2008). The test can either verify that customer needs have been met or come to the conclusion that something needs to be changed for customers to accept and purchase the finished product (Ulrich and Eppinger, 2008).

The information from the prototype test needs to be interpreted into useful information. If it is just a case of comparing different concepts, then this action is straight forward. If the choice is not clear the decision can be based on calculations within for example, manufacturing costs or environmental impact. (Ulrich & Eppinger, 2008)

There are a few methods which can be used to summarize information gained during the development cycles to be able to evaluate the future potential of the product. One of these methods is a SWOT analysis.

2.1.4.1. SWOT

A SWOT analysis is a both short and long term tool which can be useful when determining the strengths (S), weaknesses (W), opportunities (O) and threats (T) a company is facing. The SWOT analysis helps collecting useful information in an easy and visual way which could facilitate a discussions and decision concerning the future potential of an entire company strategy or just a simple product or system (Redaktionen, 2010).

When performing an SWOT analysis internal and external factors that could affect the new system is considered. Internal factors such as assets, capacities and resources classifies as strengths or weaknesses, and external factors such as political, economical, social and technological factors classifies as opportunities or threats (Industry Canada 2008).

2.2. Incontinence

Problems connected with incontinence are often very taboo. What many do not know is that it is a very common problem. In Sweden about 25% of all women above 35 years have some kind of incontinence problems (TENAb, 2010). There are a few different types of incontinence for men and women, some of them are explained further in this chapter.

Women can for example experience; Stress incontinence, Urge incontinence, Mixed incontinence, Functional incontinence or Neurological Bladder Disorders. Among these, Stress incontinence is the most common. It appears when the pelvic muscles have become weakened for some reason. The consequence of this is that urine can leak when someone with these problems laughs, coughs or works with heavy lifting or similar.

Moreover, Urge incontinence is also known as over-active bladder. This problem is experienced as a sudden urge to urinate and the bladder leaks urine if a toilet not is nearby. The third incontinence type, Mixed incontinence, is simply a mix between Stress and Urge incontinence. Problems connected with Functional incontinence are connected with some kind of mental or physical illness. There are several deceases, such as; Alzheimer's, Parkinson's, Spina bifida, multiple sclerosis and accidental brain damages which can lead to incontinence problems, these are gathered under the name Neurological Bladder Disorders. There are also several medications which can lead to incontinence problem, for example diuretic medicines. (TENAa, 2010)

Men have similar problems but the reasons behind the problems are different than for women. Many of the male incontinence problems start with prostate problems. A swollen prostate can lead to Urge incontinence. If the prostate is swollen surgery might be needed, which can lead to temporarily weakened or damaged Pelvic muscles causing Stress incontinence. Just as for women; certain deceases, medications, nerve damages or overweight can also lead to incontinence. A caretaker may also suffer from double incontinence, if this is the case the caretaker have problems withholding both urine and faeces. (TENAb, 2010)

If a person is experiencing incontinence problems, there are a few things that person can do to help minimizing or eliminating the symptoms. On the TENA website (TENA, 2010) there are several tips on how to train the Pelvis muscles with pelvic floor exercises and bladder training. If training does not help there are a few medications and surgeries which can help in some cases. However, the most common medical devices used to help against incontinence are absorbent incontinence products. There are several actors on the market and one of them is TENA, which offers a large assortment from light to heavy incontinence products. (TENAa, 2010) (TENAb, 2010)

2.3. The TENA assortment

The three products in the TENA assortments which are included in this project are TENA *comfort*, *slip* and *flex*. These incontinence products are all a part of TENA heavy incontinence which means that the products are made for people with medium to large incontinence problems. The three products are explained further on this chapter.

2.3.1. TENA *flex*

Figure 2.4, TENA *flex* (SCA Global MediaBank, 2010).

TENA *flex* is the most recent developed product in the TENA heavy incontinence assortment. It can be perceived as a mix between the TENA *pants* and the TENA *slip* model. TENA *pants* is a model very similar to regular boxers. Flex has a similar protection, compared to TENA *slip*, but contains less material and therefore becomes more breathable. Flex is suitable for caretakers with medium to heavy urine loss. The Flex product is available in sizes from small to extra large. The absorption levels available are Super, Plus and Maxi. Another feature of this product is that it is new and has been perceived as hard to understand and use. Studies have shown that it can be hard to use the product properly the first time. One of the reasons for this could be that it is attached with a belt, which none of the other models are. Because of this the product is only sold to institution where the Professional Care Givers can be educated in how to use the product in a correct manner. Even so, this model is used both backwards and forwards on the caretaker. (Fylke, 2010a) (TENA, 2010c)

2.3.2. TENA *comfort*

Figure 2.5, TENA *comfort* (SCA Global MediaBank, 2010).

TENA *comfort* is the first and oldest model among these three, but still sold in many parts of the world. It is designed for medium to heavy urine loss and is best used by caretakers who can move around by themselves. For TENA *comfort* the sizes of the product is dependent of which absorption level which is used, the absorption levels available are Normal, Plus, Extra, Super and Maxi. TENA *comfort* is known as the two piece product, it consists of an absorbing part and a fixation part working as normal underwear. The absorbing part is the only model which can be bought in five different absorption levels from Normal to Maxi. The fixation part is available in three different qualities. Both are washable and the best model can be used up to six months while the absorbing part is changes several times on a daily basis. (Fylke, 2010a) (TENA, 2010c)

2.3.3. TENA *slip*

Figure 2.6, TENA *slip* (SCA Global MediaBank, 2010).

This model was created as a result of a development towards children diapers. It gives a safe protection for double incontinent caretakers and is recommended for heavy incontinent persons. TENA *slip* is also suited for caretakers who are anxious and usually picks and pulls in their incontinence product. TENA *slip* has, after it was introduced, grown on the world market to be the largest and fastest growing incontinence product. Even if the protection is perceived as very good and safe this product becomes very warm and can sometimes feel uncomfortable for the user. This is why the TENA *slip* model usually is used only if the caretaker has very heavy incontinence problems. TENA *slip* is available from extra small to large. The absorption levels available are Super, Plus, Maxi and Ultima. (Fylke, 2010a) (TENA, 2010c)

2.3.4. Parts in a TENA product

All the three products and many other products in the TENA assortment are built of similar parts and materials. This chapter will explain the most common parts and materials used in the TENA assortment. Figure 2.7 shows the different layers which most products have; Topsheet, Inlet, Small and Big Core. There is always a Backsheet at the bottom of the products as well, to protect from leakage.

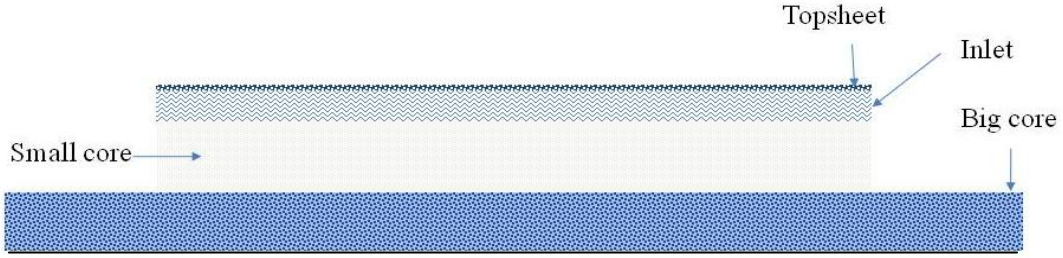


Figure 2.7, Four layers of an incontinence product plus backsheet.

The Topsheet is made of a material called Nonwoven, NW. NW is a textile like material which is not woven or knitted. It is made from fibre webs which are strengthen by thermal and mechanical bonding. NW is mainly produced from synthetic fibres like Plypropylene, Polyethylene, Polyester, Bicomponent or copolymers, Polyamid or PLA. (Vartiainen, 2010b)

The inlet, also called acquisition layer, is made from resilient films with an open structure which purpose is to let urine in and then prevent it from flowing back up on the surface again, the main principle is shown in Figure 2.8.

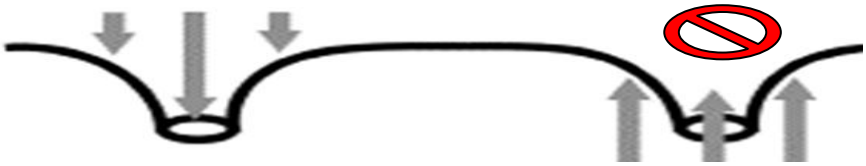


Figure 2.8, The urine can flow down through the inlet layer but is prevented to flow up again because of the shape of the hole. (Vartiainen, 2010b)

Both the small and the big core consists of pulp fibres and Super Absorbent Polymers, SAP. The pulp fibers are soft and have a good ability to spread liquid in the product. It only absorbs about 5-10 grams of water per gram pulp and the liquid is easy to squeeze out from the fibers. That is why there need to be SAP in the cores as well. SAP is a material which can absorb approximately 800 grams of water per gram SAP or 50 grams of urine per gram SAP. The SAP absorbs the urine so that it cannot be squeezed out from the product. SAP makes it possible to have very thin products with a high absorption capacity and it makes the surface against the caretaker's skin dry and leakage secure. Finally SAP works as odour control because it always holds a low PH, which is friendlier to the skin of the caretaker. (Vartiainen, 2010b)

The differences between the small and the big core are the amount of Pulp fibres, SAP and the density of the cores. Usually the small core is more "fluffy" to let water through while the big core has a higher density. This makes the capillary pressure in the material high which spreads the fluids in the product.

There is also a part in the products called Standing Gathers, SG, shown in Figure 2.9. The SG stops the urine or faeces from leaking out in the groins of the caretaker. It consists of elastics and therefore it is standing up when the rest of the products hangs down in the crotch. (Vartiainen, 2010b)

Figure 2.9, Standing Gathers stops the urine from leaking out. (SCA Global MediaBank, 2010)

2.3.5. Absorption

As the last chapter described the combination of Pulp fibres and SAP determines the level of absorption in the product. There are a few characteristics that an incontinence products needs for it to absorb fluid as effective as possible. These characteristics are Absorption rate, Absorption capacity, Retention and Spreading properties. These characteristics determine how much a product can absorb and how long it takes. (Vartiainen, 2010b)

The actual absorption capacity is not only depending on the amount of absorption materials, but also on the cooperation between the different materials. The cooperation determines how leakage secure the product will be. The theoretical capacity is the actual absorbing capacity, attained after tests. There is also a capacity which is determined by the Rothwell method. This method is conducted by lowering the entire incontinence product into Saline and letting it absorb as much as possible. After this the new weight of the product determines the Rothwell capacity. (Vartiainen, 2010b)

The absorption rate is simply the time it takes for a certain amount of liquid to be absorbed into the material. The absorption capacity is the theoretical capacity of the product to absorb liquid. The retention of the material is the ability to hold the liquid in the material upon pressure. The spreading property is depending e.g. on the density of the material and determines how fast and long the liquid will spread out in the material. With this in mind the materials of an incontinence product should either have good acquisition, distribution or storing properties. The resilient materials are best at acquisition, while the liquids spread out in the pulp and are finally stored into the SAP. Figure 2.10 shows the complete scenario. (Vartiainen, 2010b)

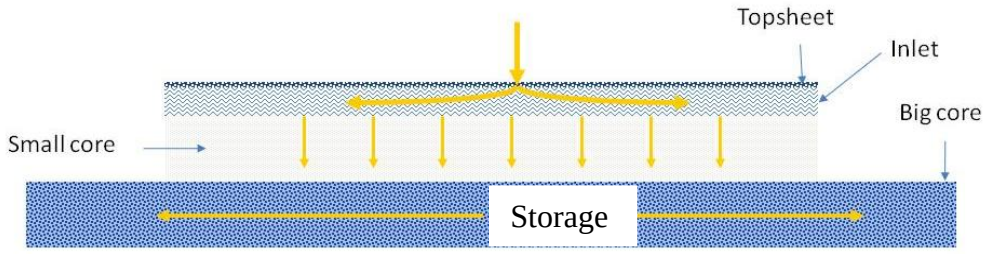


Figure 2.10, The fluids hit the topsheet and flows through the inlet material into the small and big core. The fluids are stored by the SAP of the small and the big core. (Vartiainen, 2010b)

3. Methodology

This chapter will briefly explain how all steps were conducted during the different phases in this project. For more detailed information the reader is asked to read each chapter for every phase from chapter 4, Pre-Study to chapter 8, Results. All background theory supporting the methods used in this project is presented in the chapter Theory Framework with the intention of making the methodology chapter shorter and easier to understand. The project has progressed through four major phases: Pre-Study, Research and Analysis, Development, and finally Refinements and Evaluation, see Figure 3.1. Each of these phases is briefly described in this chapter.

Figure 3.1, Process layout used for the project.

The search for knowledge in the project was performed by using a combination of several different sources, quite different depending on whether it is explicit or tacit knowledge. The collection of explicit knowledge, such as specific data, references, articles etc. was mainly conducted through searching on the Internet, using literature and quantitative interviews. The literature used mainly concerned product development. Some of the most used references throughout this project were "Product Design and Development 4^{ed}" by Ulrich and Eppinger (2008), "Revolutionizing Product Development" by Steven C. Wheelwright and Kim B. Clark and "Quality – from customer needs to customer satisfaction" by Bo Bergman and Bengt Klevsjö. Furthermore the tacit knowledge was gathered through real-life testing and observation of prototypes together with deeper more qualitative interviews and two brainstorming sessions. A qualitative interview is conducted when an in-depth understanding is needed (McQuarrie, 2006).The multitude of different sources was positive as it gave a quick understanding of the problem, and enabled to create usable ideas.

Interviews were conducted with 17 Professional Care Givers, PCG, to reach a deep understanding of the PCGs and their needs, the results from all interviews are summarized in this report and the documentation from all interviews can be given to the reader upon request. A PCG is mostly an assistant nurse working at an institution, taking care of the elderly on a day to day basis. A first round of oral interviews, using a semi structured template with questions was used to ask general questions concerning today's TENA product assortment and about incontinence care in general. The second round of interviews was conducted using both observations and a structured interview document, mainly consisting of questions about the different prototypes and about working with inserts in general.

3.1. Pre-Study

During the Pre-Study phase the project was introduced and a general understanding about the purpose of the Thesis was presented. In addition, several contacts within SCA were established. After a few meetings and discussions with the SCA supervisor (Kent Vartiainen) the initial scope of the assignment was determined. In addition to the project introduction, initial planning was performed. To support the general planning, the product development process by Ulrich and Eppinger (2008) worked as guidance for the planning, together with the knowledge and experience within the development team.

The phase ended with a planning report containing the background to this Thesis, its main purpose, objectives and scope. Finally an early approximation of a Gantt chart was presented for the entire project time. The Gantt chart is available in Appendix A.

3.2. Research & Analysis

Whereas the Pre-Study phase gave a good general understanding of the problem, the Research & Analysis phase gave the depth of knowledge that was needed to generate and develop possible solutions.

At first a market analysis, including a benchmarking of the competitors and the TENA assortment was conducted. SCA's products were introduced during three in-house meetings with SCA staff representing marketing, environment and product development. In order to get an even deeper knowledge about the product, two customer visits were conducted. Furthermore the analysis of competitors was conducted mainly with the help of competitors' web pages and product catalogues, but also with the help of knowledge within SCA. The following step was to gather all information accessible about customers' needs for incontinence products in general. Those needs and SCA's needs about the specific product were sorted and formulated into a first specification for this project, available in Table 5.1.

In order to investigate the most important areas that would be the main focus during the following Development phase, a "Sequence of user action" was conducted. The main idea of using this method is to, instead of focusing on product functions, focus on the interaction between the product and the user. This is preferable, according to Ulrich and Eppinger (2008), when the product has more simple technical functions and involves a lot of user interaction. Lack of actual technical functions affected the entire process and made it difficult and also unnecessary to use too much of the traditional product development methodology. Instead the focus would be on semantically functions such as perceptions and ease of use.

Finally a search for smart ideas from competitors' products was conducted within the areas of importance obtained from the "Sequence of user action". Parallel to the external search an internal search within the SCA idea bank IDEUM, which is a collection of internal smart ideas, was performed. A few promising solutions were selected and incorporated during the Initial Design-Build-Test cycle.

3.3. Development

The Development phase of this project consisted mainly of two areas, concept generation and evaluation. The concept generation part was a bit different compared to the traditional product development process explained in the Theory Framework. The main reason for this was that the product did not consist of technical functions; instead the areas of importance depended on the perceptions from its users.

The creative area of concept generation generated several ideas through inputs from different sources. The area of evaluation narrowed down the number of generated concepts to further develop promising solutions. The whole phase of development was performed iteratively, with two Design-Build-Test (D-B-T) cycles: Initial and Final.

The Initial D-B-T cycle contained both brainstorming sessions within the development team, as well as the result from the external and internal search of ideas. In order to further visualize the concepts which were developed during this phase, a set of prototypes were created at the SCA studio. The reason of constructing the prototypes was to give a possibility to evaluate different ideas relative each other during customer visits. In accordance with the external decision method that Ulrich and Eppinger (2008) mention, both customers and the SCA supervisor were used in order to find the concepts and areas that would be most beneficial to focus during the Final D-B-T cycle. To further evaluate the concepts an Enhanced Cognitive Walkthrough, ECW, was conducted (Billgård, 2007). An ECW is a method used to elicit what parts of a product which are most troublesome, for more information about the ECW go to the Theory Framework. The ECW and the qualitative discussion with PCG and the SCA supervisor gave needs and indications about which concepts that should be developed further and where efforts should be focused in order to improve the concepts during the Final D-B-T cycle.

During the final cycle, the concepts were further developed by inputs gained from the prior cycle. The aim with the final cycle was to find the best technical solutions and to conduct a large evaluation study about working with inserts. During this design phase a broader external brainstorming session was conducted. A total of eight people participated, the participants were chosen from different functions within SCA and with different educational backgrounds. The result of this brainstorming was combined with the results from the initial cycle and became the foundation for the final concepts. In order to further visualize the concepts, a new set of prototypes were created at the SCA studio.

The final evaluation was guided by a very thoroughly constructed plan, see 6.3.3. The idea was to both observe the PCG when handling the prototypes and ask questions about the concepts and inserts in general. During the final phase of Refinements and Evaluation the last adjustments of the final concepts was made in order to end up with a product that fulfilled all PCGs' needs.

3.4. Refinements and Evaluation

During the phase of Refinements and Evaluation the final adjustments of the concepts developed in the foregoing development phases was performed.

Both quantitative and qualitative information was taken into consideration and combined to form the final concept. Intense contact with experts within different functional areas at SCA was conducted in order to optimize the performance of the solution. Additionally, meetings were held to gain information about how to optimize the design with respect to environmental aspects, manufacturing and production cost. These meetings also resulted in calculations about potential cost savings and environmental impact.

4. Pre-Study

The Pre-Study phase mainly focused on organizing and structuring the upcoming workflow, where preparation and planning was of major importance. To support the general planning the product development process by Ulrich and Eppinger (2008), explained in the theory framework, worked as a foundation for the planning. The project started with an introductory meeting with the SCA supervisor Kent Vartiainen, Associate Scientist Applied Absorption at SCA and the tutor of this Master's Thesis. During the meeting the intentions and needs of SCA were presented. Since the project partly concerned the development of a new product, it was necessary to clarify the task definition. Important areas of clarification were, among others: Which areas should be included in the development of concepts and how large does the evaluation need to be for SCA to be able to trust the results?

The team had the opportunity to ask questions to eliminate possible issues and misunderstandings regarding the project. SCA's aim with the project was:

"Explore the potential of a system for an incontinence product based on having one base product to which it is possible for the Professional Care Giver (PCG) to add absorption capacity depending on user needs." (Kent Vartiainen, Project Proposal, 2010).

In the beginning of the project, contacts were established within SCA for the development project: Johan Fylke (International Market Research Manager), Björn Spak & Matilda Sjölin (Environmental specialist), Lars Melin (Machine Project Leader), Paula Carlsson (salesperson TENA), Maria Welke (Prototype Development), Krisina Kåren (Product Intelligence Manager Inco), Katarina Eriksson (Product Development) Mari Nordberg (Competitor Product Analyst) and Maria Bogren (Associate Scientist).

In addition to the introduction meeting, the team had the possibility to establish contact and ask the PCGs directly and gain an understanding of the products, the product change procedure and about elderly and incontinence care in general.

Finally the duration of the different tasks and project phases was illustrated in the Gantt chart, see Appendix A. The Gantt chart was chosen as the preferred tool, which according to Ulrich and Eppinger (2008) is the most traditional tool of showing how the development work is planned. To structure the documents, SCAs' project management tool consisting of windows mapping hierarchy, making it easier for the team to have a continuous overview of how the work proceeded throughout the project. This phase ended with a complete planning report, consisting of Background, Purpose, Objectives, Delimitations and the Gantt chart.

5. Research & Analysis

During the Research & Analysis all information needed to be able to understand the area of incontinence was investigated. This phase resulted in a foundation of knowledge complete enough to generate ideas and solutions into the first concepts and prototypes. The first area to be investigated was the existing market of insert products.

5.1. Market Analysis

When considering the global market for inserts the market can be divided, distinctively, into Asia and the rest of the world where Europe and USA are the two most interesting actors. In Asia they have many well developed insert solutions, to be compared with USA and Europe where almost only basic inserts can be found. These differences inherits both from the tradition of use of insert in incontinence products and from how care taking is performed. During this phase all interesting competing products found in Asia, USA and Europe were ordered. It resulted in 35 products which was investigated and can be read about in chapter 5.5 Idea inventory. Examples of competing products can be seen in Appendix B. Following is a short explanation about the different markets.

5.1.1. Asia

In Asia they are not using the same system for taking care of elderly like the ones that are common in the west. Instead younger relatives are supposed to take care of their parents and grandparents. This results in that many elderly is not taken care of in institutions as in Sweden. In Japan it is quite different since the caretaking of elderly is well developed. Great resources are spent one the elderly and a caretaker in an institution is looked after and changed on up to eight times per day, which can be compared to Sweden where the caretaker is changed on approximately three times a day. This has resulted in that inserts are much more common in Japan. Instead of changing the whole base product like it is done in Sweden, only an insert is replaced when the caretaker gets his or her incontinence product changed. (Fylke, 2010a)

Another aspect that differs when comparing the use of incontinence products is what is considered to be the most important features of the products. In Sweden and Europe the main focus is that the user shall be comfortable when using the product. In Asia the most important thing is that there is not any leakage, if a leakage would occur it is considered that the caretaker has committed a serious failure. This has resulted in bulky but leakage proof products which might not be as comfortable for the user, since the products are not breathable enough. Both these differences have resulted in that the Japanese brands like UniCharm, Hakujuji, Fuburg and Livedo all have a wide verity of well developed solutions for working with inserts, see Appendix B.

5.1.2. Europe and USA

In Europe and USA the incontinence product providers have focused on making their products suited for the users, which often results in a wide variety of variants within each model. There are often a couple of different absorption levels for each kind of protection. One of the results of this development is that the use of insert for adding

absorption is limited. SCA's policy have during many years promoted that their products should provide the users with significant protection and inserts are unnecessary in their products. There are although a couple of companies providing absorption inserts, but they usually only have one or two products in their assortment.

In USA the main manufacturers' assortment is kind of similar to SCA and other European manufacturers. When considering inserts, few products can be found, although the largest companies usually have some inserts in their assortment.

5.2. In-house & Customer Meetings

After analyzing the world market a wider knowledge about TENAs' own assortment was needed. To be able to understand the differences between the three products within this project; TENA *comfort, slip* and *flex*; three in-house meetings were conducted as open discussions. Moreover, some information from the customers was needed and therefore two customers meeting with two PCGs were conducted. The most important information from the meetings is summarized below. The first meeting was held with the SCA supervisor who explain how an incontinence products works and how it is constructed from different layers.

5.2.1. Product Development

The SCA supervisor, who is an expert in Applied Absorption, explained the basics behind absorption and he presented a specification of all materials used in TENAs' incontinence products. These materials would later be used when constructing the prototypes in order to make sure that the products not would cause any irritation on the caretakers' skin. All materials and their absorbing functions that have been used in the final products are explained in chapter 2.3.4 Parts in a TENA product and 2.3.5 Absorption.

5.2.2. Market Research

The following meeting was conducted with Johan Fylke (2010a) who is International Market Research Manager at SCA. During this meeting he explained how and why customers choose the different products in the TENA assortment and also what the differences between the products are. This meeting covered the largest differences on the world market and why the incontinence care is different in different parts of the world. This information was important because the future development would have to take consideration to only the Swedish market during the development. The information about the three products, Flex, Comfort and Slip is summarized in chapter 2.3 The TENA assortment.

5.2.3. Environment effects of incontinence products

In line with Chalmers recent development towards a more environmental focus during the development projects, a third meeting was conducted with Björn Spak and Matilda Sjölin who works as Environmental Specialists at SCA. During this meeting the different aspects of TENAs' products which affect the environment were presented. The

main goal with this meeting was to understand what parts of the entire chain for an incontinence product that affects the environment the most, and then try to minimize that part during the upcoming development.

The results showed that, in Sweden, almost all used products are incinerated which leaves greenhouse gases, such as H_2O, CO_2 and NO_X. The big problem arises in other countries around the world where large incineration stations do not exist. Then the used products are stored as landfill, which covers large areas. When the products wither, they are broken down into troublesome greenhouse gases, such as CH_4, which affect the environment in a negative manner. From this the conclusion was drawn to minimize the used materials in the products. This will both have an effect on the logistics of the supply chain and less greenhouse gases will be let out in the atmosphere when stored as landfill or incinerated around the world. (SCA, 2009) (Spak, 2010)

5.2.4. Professional Care Givers

Finally a meeting with the most important customer, the people applying the products on the elderly, the Professional Care Givers, PCG, was conducted. This meeting was conducted as a semi structured interview where the team had a few open questions about how it is to work as a PCG, what they thought about working with TENA's products TENA *comfort, slip* and *flex* and about incontinence care in general. Finally the PCG showed how a incontinence product change is performed. The main purpose with these two meeting was to learn what they felt about the different products and try to find some areas that were considered more important to focus on during the development. Some needs about the products in general were elicited and are presented during the next chapter. The reader can find more information about incontinence in general in chapter 2.2 Incontinence.

5.3. Specification of needs

The first specification of needs consisted of needs from SCA and from the PCGs. The PCGs' needs about working with incontinence products in general had mainly been collected through a large evaluation done by SCA, CTC INCO (2006). The more products specific needs will be elicited first after the initial concepts of the new product have been evaluated since no similar products are available on the market today. Following are the specification of needs presented in Table 5.1.

Table 5.1, The initial specification of needs from SCAs' and the PCGs' needs concerning incontinence products in general.

1	**Possibility to provide individual care**
1.1	The insert is easy to select
1.2	The insert offers a solutions to handle faeces
1.3	The insert enables a larger range of absorptions levels.
1.4	The insert increases the possibility to have the complete assortment.
1.5	The insert supports all patients mobility
2	**Leakage secure/Fluids & Odour**
2.1	The insert does not cause an increased number of leakage problems
2.2	The insert prevents odour
3	**A comfortable product**
3.1	The insert is secured in the base product during usage.
3.2	The insert does not crumble during usage.
4	**Keeps skin dry and healthy**
4.1	The insert feels dry against the skin during usage
4.2	The insert does not cause allergic reactions
5	**Easy to handle**
5.1	The insert is easy to understand
5.2	The insert is easy to attach
5.3	The insert is easy to incinerate together with the base product
5.5	The insert is easy to position
6	**SCA**
6.1	The insert fits in both TENA *comfort*, *slip* and *flex*
6.2	The insert fits in all sizes in the TENA assortment
6.3	The insert demands less material flow
6.4	The insert acquires less shelf space at institutions
6.5	The insert is possible to detach from the base product.

When gathering the needs it was early realized that it would be valuable with several different inputs as it, according to Ulrich and Eppinger (2008), becomes easier to discover unspoken needs in this way. During the continuing parts of the project opinions of customers were gathered through several exploratory methods, such as customer visits, interviews, and observations as suggested by McQuarrie (2006).

After the customer needs have been stated the target specifications for each need must be determined. In order to do this a list of metrics should be connected to each need to be able to check the need fulfilment of the final product (Ulrich & Eppinger, 2008). The needs are each pared with a metric and visualized in a spread sheet which can be found in Appendix C.

5.4. Clarification of the Problem

When a PCG is working with a system with inserts there will be some changes in the routines considering the incontinence products. These changes will occur from the moment when a base product and a one or several inserts are taken off the shelf in the caretaker's storage room. User actions that not will be affected by the insert will not be considered within this analysis, for example the attachment of the base product on the caretaker. During the following analysis, "Sequence of user actions", all steps are carefully explained and the new working moment are implemented and shown in Figure 5.1.

Figure 5.1, The working moments elicited during the "Sequence of user actions".

5.4.1. Sequence of user action

1. During the first interaction with the insert the caretaker removes one base product and one or several inserts from the shelf located on the caretaker's storage room. The base product and the insert are then brought together by the PCG. During this encounter only one hand is used to handle the insert.

2. During the next sequence the insert is positioned relative to the base product. The insert is moved towards the base product and placed on an exact location, still only one hand is used to hold the insert. Because the new insert solution should provide a possibility to offer a more individual care, the location of the insert in the base product could vary depending on each caretaker's needs.

3. Next the insert is attached in the base product in such way that it is prevented from moving in the base product during usage. Now the two products can be considered as one, and the usage does not differ from the usage of the regular products.

4. After usage the products are inspected by the PCG who decides if a change of products is necessary.

5a. Next the used products are replaced by new ones. The base product and insert/inserts are still considered and handled as one.

5b. During the replacement there is an alternate way of handling the products. A potential advantage with this kind of system is that the caregiver has the possibility to change only the insert during a control of the products. This action results in a different usage scenario. Instead of changing both the base product and inserts, the base product is opened and only the insert/inserts is/are removed and replaced by a new one/ones. When both base product and insert/inserts are considered to be used they are detached from the user and disposed.

When considering the whole sequence of user actions a number of areas of problems that needs to be considered emerge. These problem areas are:

First the insert has to be shaped so that it is possible and easy for the caregiver to handle the product. When considering the shape of the insert it has to fit in the base product. It also needs to have size and weight that enables the care giver to handle the product properly. Solutions to these problems are further on in the report be categorised under the category **Shape**.

Further the caregiver needs to be able to correctly position the insert in the base product. This action calls for some kind of user guidance. Solutions to these problems are further on in the report be categorised under the category **Easy Usage**. Under **Easy Usage** other solutions regarding application handiness will be categorised as well.

Regarding how to provide the PCG with the possibility to give the caretaker a certain level of individual care solutions dealing with where the inserts should be placed needs to be addressed. These solutions are categorised under **Individual Care**.

Finally the insert must also be able to be attached in the base product so that the insert will not move around in the base product during usage. These concerns clarify the need of an attachment solution. Solutions to these problems are further on in the report be categorised under **Attachment**.

To conclude this chapter, the new main areas of importance from this point on during the development are Shape, Easy Usage, Individual Care and Attachment.

5.5. Idea Inventory

Before the development of concepts an idea inventory phase was conducted, with the purpose of finding good ideas within the four areas of importance; Shape, Easy Usage, Individual Care and Attachment. After a request from the SCA supervisor the area “Handle Faeces” was added as well in order to find solutions of how the insert could be

used to handle both urine and faeces. This area would, however, not be included during the development of concepts.

According to Ulrich and Eppinger (2008), finding and using an external solution is often both faster and cheaper than developing all ideas within the development team. Moreover, the use of external solutions allows the development team to focus on the more critical sub problems for which there are no documented exciting solutions.

First an external search was conducted with help of 35 competing products which were ordered throughout the market analysis. Table 5.2 is showing from which part of the world the ordered products originated. This also shows why Europe, Asia and USA are the largest and most interesting markets concerning the use of inserts. The search resulted in many interesting ideas which can be found in Appendix D.

Table 5.2, Investigation of competing products.

Number of products investigated for respective country			
USA	**Japan**	**China**	**Taiwan**
12	13	1	1

Germany	**Denmark**	**Italy**	**Spain**
1	2	2	1

The following step was to search internally for good ideas. The search mainly aimed at SCA's internal idea bank for good ideas. This search was also guided by the four areas of importance (Shape, Easy Usage, Individual Care and Attachment) and resulted in a few interesting ideas which were implemented during the development. All smart ideas were documented in an excel spreadsheet and can be found in Appendix E.

These ideas together with needs, analysis of markets, clarification of the problem and all valuable knowledge gained at SCA formed a solid base for the future development.

6. Development

The development phase was performed in an iterative manner, including two Design-Build-Test (D-B-T) cycles as illustrated in Figure 6.1 (Wheelwright and Clark, 1992). Within each cycle, certain activities were performed referred to as areas of Design (the creative area of concept generation), Build (transforming concept ideas to tangible items such as prototypes) and Test (evaluating prototypes).

Figure 6.1, shows how the information from the Research and Analysis was processed during two D-B-T cycles in order to end up as input for the following phase of Refinements and Evaluation. Before the initial cycle, a calculation of the insert shape was conducted. The determination of the shape could be performed in parallel with the D-B-T cycles, since the shape was dependent of blue-prints from TENA *comfort, slip* and *flex* together with the results from an investigation about where used products absorb most fluids.

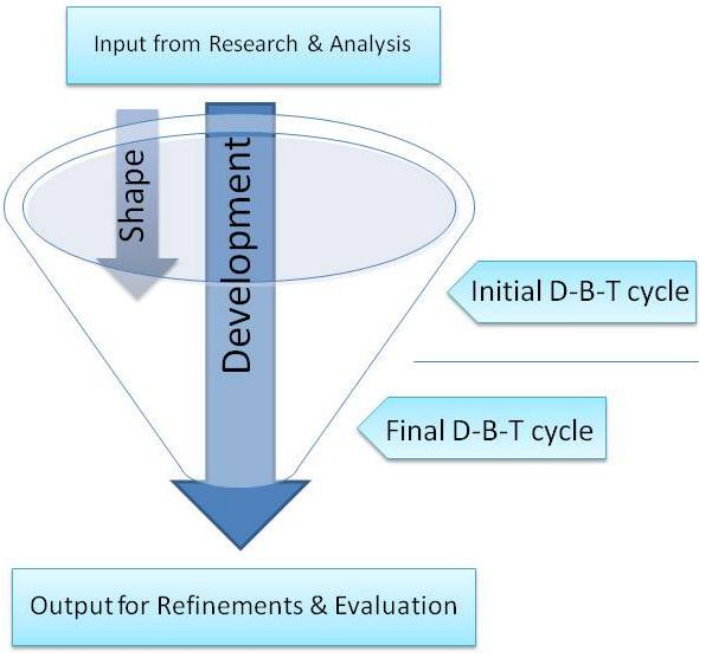


Figure 6.1, The development process used during this Master's Thesis.

The Initial D-B-T cycle mainly focused on the areas Attachment, Easy Usage and Individual Care but also investigated some general thoughts about inserts. The Final D-B-T cycle was conducted with the goal to further develop ideas from the initial cycle and to eliminate non promising ideas with the help of customer needs elicited during the initial cycle. Finally a large evaluation about the product and about working with insert was conducted.

6.1. Shape

In contrast to the development of Individual Care, Easy Usage and Attachment systems where all kinds of ideas were allowed the development of the Shape was conducted with some essential needs in consideration.

The needs that were considered were that the insert should fit in all the models and sizes of the TENA *comfort*, *slip* and *flex* products. Moreover, the insert should not increase the risk of leakage of the base products. Furthermore, the areas in the base product that according to Cobra Sum were most exposed to urine should be covered. Cobra sum is an investigation of urine patterns in approximately 10 000 used products, see Appendix M. In addition the insert should cover an area as large as possible without risking a too bulky size that would result in unnecessary use of material. The insert should also be relatively cheap to produce and appealing for the Professional Care Givers, PCG, to use.

6.1.1. Design process

The determination of the shape started with an analysis of the blueprints of all sizes of each model. Measurements of for example the width and the length of each model was taken into consideration in order to find out which product that would limit the size of the insert. When placing the blueprints, of the large core, on top of each other it could be seen that it was mainly TENA c*omfort* Plus that limited the size, in addition TENA *flex* Small would limit the length of the insert. The blueprints of TENA *comfort* Plus on top of TENA *flex* Small and TENA *slip* Small resulted in a contour that constricted the size of the insert; the two blueprints can be seen in Figure 6.2. The area to be covered by the insert could theoretically be 140mm×480mm. It was although decided that the width of the insert should not excide 120mm since some space between the standing gatherers was needed if an easy attachment of the insert in the base product would be possible. Moreover the elasticity of the product made the theoretical distance of 140mm to be smaller on the real product.

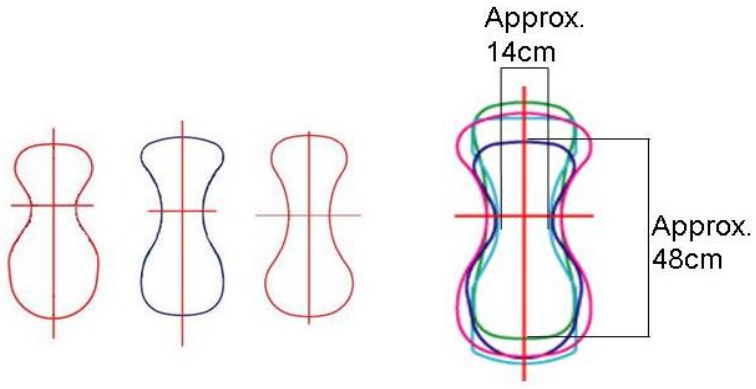


Figure 6.2, Blueprints of TENA *flex* Small (green), *slip* Small (pink) and *comfort* Plus (purple) placed on top of each other. (Petterson, 2007)

Thereafter the results from the Cobra sum investigation were taken into consideration. The printings of urine patterns for a TENA *flex* Super showed that an area of approximately 170mm×320mm had been exposed to urine in more than half of the used

products, see Figure 6.3. For TENA *slip* Super the area was 160mm×310mm, see Figure 6.4. Most important was that the areas that are exposed in a majority of the products were covered. These areas had an area of approximately 170mm×180mm for TENA *flex* Super and 150 mm×240mm for TENA *slip* Super. TENA *comfor*t was not included in the Cobra Sum investigation and could therefore not be investigated, but since the pattern in TENA *flex* and TENA *slip* were similar an insert that covered the critical areas in those products was believed to be sufficient also in Comfort.

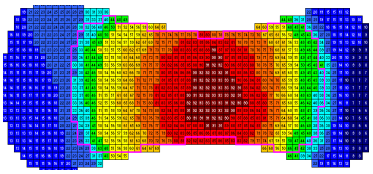


Figure 6.3, Cobra Sum investigation of TENA *flex* Super, the wine red area are the area most exposed to urine and the dark blue is least exposed. (Birring, 2007b)

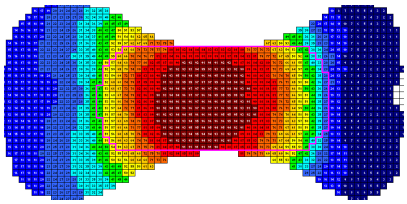


Figure 6.4, Cobra Sum investigation of TENA *slip* Super, the wine red area are the area most exposed to urine and the dark blue is least exposed. (Birring, 2007b)

Furthermore the possibility to produce the inserts was also considered. The SCA supervisor suggested that the design should be based on a rectangular shape, since such a shape would be easy to handle in current machinery and minimize cut material.

Finally the design should be appealing to the PCGs. A majority of the inserts that were available on the market had a basic rectangular shape. To distinguish the new insert from these products the corners were cropped, which resulted in that the insert appeared more ergonomic and well-worked. Another advantage of cropping the corners was that the risk of that the corner would fold during usage, and thereby chafes the caretaker's skin, was minimized. A summary of all needs are presented in Table 6.1.

Table 6.1, The four needs on the shape of the insert.

1	Fit all models and sizes and as well be easy to attach: 120mm×480mm
2	Cover the area that had shown to be heavily exposed to urine in the Cobra sum investigation: 170mm×320mm for Flex Super and 160mm×310mm for TENA *slip* Super
3	Be relatively cheap to produce: Based on a rectangular shape.
4	Be appealing for the PCGs: Cropped corners.

As can be seen need 1 and 2 contradict each other, the width was although set to 120 mm even though a wider insert would be better in some of the biggest products. The

insert would although cover a relatively large area of the most exposed parts of the base product, and since the insert could be place on the spot where it was most needed a width of 120mmm was considered sufficient. The length of the insert was set to 340mm in order to cover the areas from the Cobra Sum investigation with some additional margin. The overall shape was based on a rectangular base which would be easy to produce and cover an area as large as possible. In order to give the insert an ergonomic and appealing appearance which distinguished it from competing products the corners were cropped. All and all it resulted in a shape that can be seen in Figure 6.5.

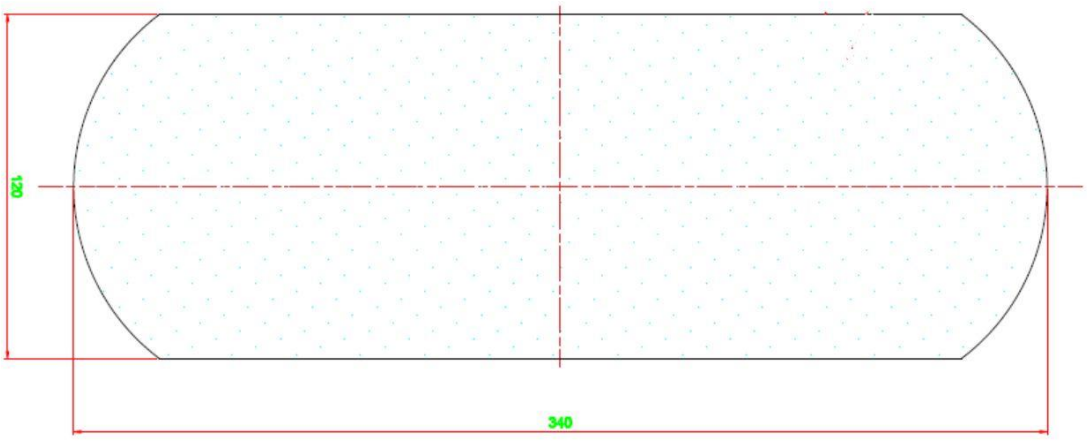


Figure 6.5, The final shape with width and length.

6.2. Initial design-build-test cycle

During this cycle a combination of ideas from the idea inventory and from an internal brainstorm created the first concepts. Throughout the concept generation phase methods were used in order to visualize and combine solutions into concepts. The first design phase started with an internal brainstorm and ended with four concepts which were built and evaluated with the goal to create feedback with customer needs for the following cycle.

6.2.1. Design

During the design phase a smaller brainstorm session within the development team was conducted. The areas investigated during the brainstorm were Attachment, Easy Usage, Individual Care and Handle Faeces. All ideas generated from this session were written on post-its and sorted with help of the KJ method. The classification tree was later used to visualize the solutions in a way similar to the “mind map” and the combination table, which is simply an easy way to combine ideas into concepts. According to Ulrich and Eppinger (2008) the idea behind combining ideas is a good way to start thinking in terms of concepts and combinations and not just about isolated ideas for sub-problems. The methods are explained further in the Theory Framework chapter. The collection of ideas from this session can be found in Appendix F.

After the internal brainstorm, all ideas needed in order to combine the first concepts were created. To be able to combine all ideas into concepts, within a limited time frame,

a combination of similar ideas into sub-groups was needed. With the help of a combination tree for each area less promising ideas could be isolated and removed. This is an important step in the development phase when the resources are limited and need to focus on the most promising ideas (Ulrich & Eppinger, 2008). At first all ideas created under the area of Attachment were investigated and divided in four main sub-groups; *Hatch, Two Component, Adhesive and Friction*. The four sub-groups can be found in the combination tree in Figure 6.6.

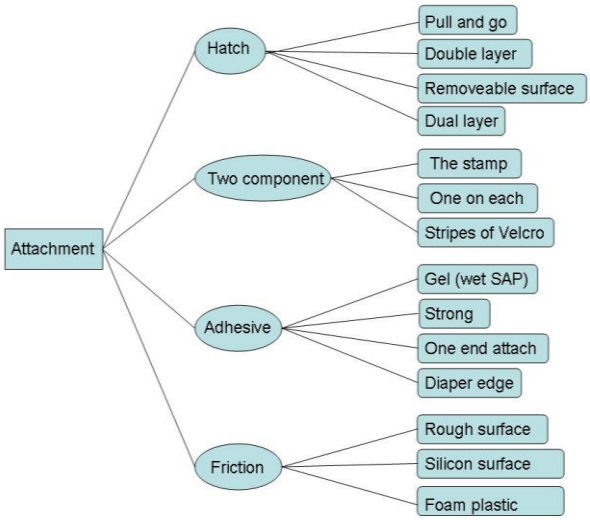


Figure 6.6, Combination tree showing the four sub-group of ideas from the area Attachment.

Moreover the ideas from Individual Care and Easy Usage were combined and sorted in sub-groups. In order to offer a more individual care, different placements of the insert in the base product was considered as important. It was also needed to be able to use many inserts in order to have an "open" range of absorption where it is possible to add one or many insert to the same base product. This makes it possible to add the amount of absorption needed exactly where the caretaker needs it.

To be able to create a system for individual care, a certain amount of information is needed in order to make it easy to understand and use for the PCGs. According to Johan Fylke (2010a), when something new it introduced for a PCG, information about how to use the product is needed. With this in mind it was considered interesting to group the solutions with consideration to how much information they carried for the end user. The solutions were sorted and divided into four sub-groups referring to where the information is presented; *Empty, Insert, Base, Base + Insert*. The ideas from Individual Care and Easy Usage were therefore combined, with the purpose to focus resources on the most critical area at this point. The combination tree is presented in Figure 6.7.

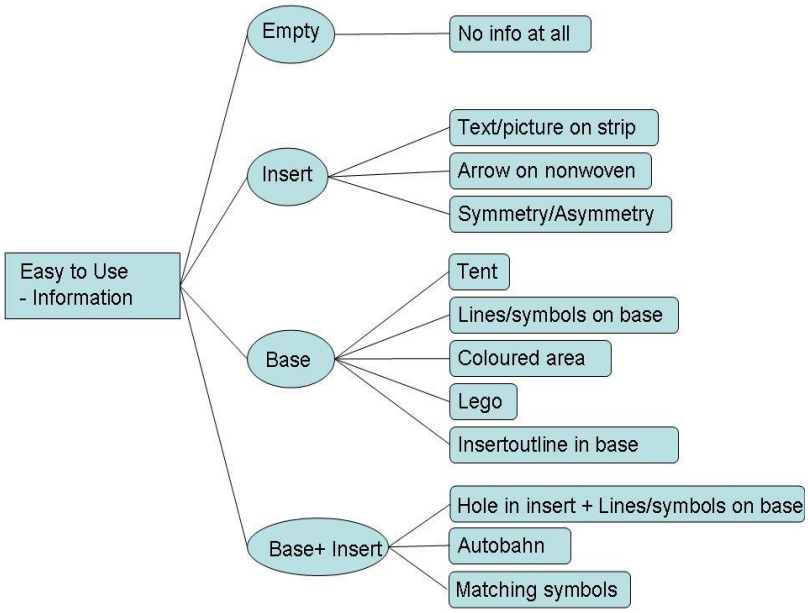


Figure 6.7, Combination tree showing the four sub-groups of ideas from the area Individual Care and Easy Usage.

All ideas chosen, at this stage, were considered interesting to further investigate with PCGs and develop after a qualitative discussion with the SCA supervisor who served as a "Product Champion" (Ulrich & Eppinger, 2008) with an insightful knowledge about developing, manufacturing and marketing incontinence products. His knowledge was combined with solutions which would be easy and fast to make into prototypes during the initial cycle. Important to highlight is that more advanced promising ideas stayed within the scope of the project even if not investigated during the Initial D-B-T cycle. One example of this is the area of Attachment called *Hatch*, which was considered interesting but too time consuming to plan and build at this point and was left out from the following concept generation.

The final step was to combine sub-solutions from Attachment and Easy Usage into concepts. This step was guided with the help of a simple combination table. A combination table visualizes the ideas in a way where it is easy to combined solutions randomly into concepts (Ulrich & Eppinger, 2008). The combination table can be found in Figure 6.8.

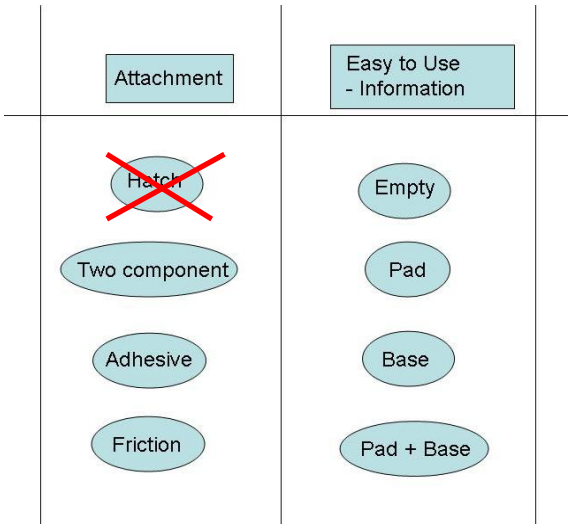


Figure 6.8, Combination table showing the areas combined in order to create the concepts for the initial cycle. The Attachment area Hatch is moved to the next cycle.

From the combination table one area from Attachment was combined with one area from the area of Easy Usage in order to create the first concepts. It was considered important to combine a number of concepts so that at least all areas from both Attachment and Easy Usage were represented in the concepts once. At the same time the number of concepts needed to be quite small in order to make the following evaluation process efficient. The evaluation process could not be too time-consuming because the evaluation meetings were going to be conducted during PCG work hours. With this in mind, five concepts were combined from four base products and four insert. The different concepts were transformed into prototypes and used as stimuli during the first evaluation in order to elicit needs as feedback for the following cycle. The main ideas of the first five concepts called; *Empty*, *Strip*, *Arcs*, *The Window and Autobahn*; can be found in Figure 6.9 and the main idea behind each concepts is explained in the following chapter

6.2.1.1. The Initial Concepts

The concept called *Empty* consisted of an empty base product and an empty insert. The concept represents the idea not to have any information at all and to have glue without a protective strip as attachment method. Moreover, concept *Strip* had an empty base product and had an attachment with glue and a protecting strip. The strip would be used to have information about how to apply the insert correctly in the base product. This concept represented a concept with information only on the insert.

The third concept, *Arcs*, had an empty insert but had guiding symbols in the base product. The arcs and gender symbols were printed in the base product with the purpose to guide the PCG to apply the insert at the correct place for each caretaker. This concept represented a solution with the information only in the base product, it also had an insert with glue without a protecting strip as attachment method. Furthermore, *The Window* had a symbol in the base which would be matched with a hole and a line on the insert so that the symbol became visible through the insert. This concept was an example of a

concept with information on both insert and base product and with small pieces of Velcro as attachment method.

The final concepts, *Autobahn*, also had information on both insert and strip but lacked different placements for gender and day and night. The blue lines had the same distances on both insert and base and when placed on top each other, they would match. This concepts hade friction foam strips as attachment method.

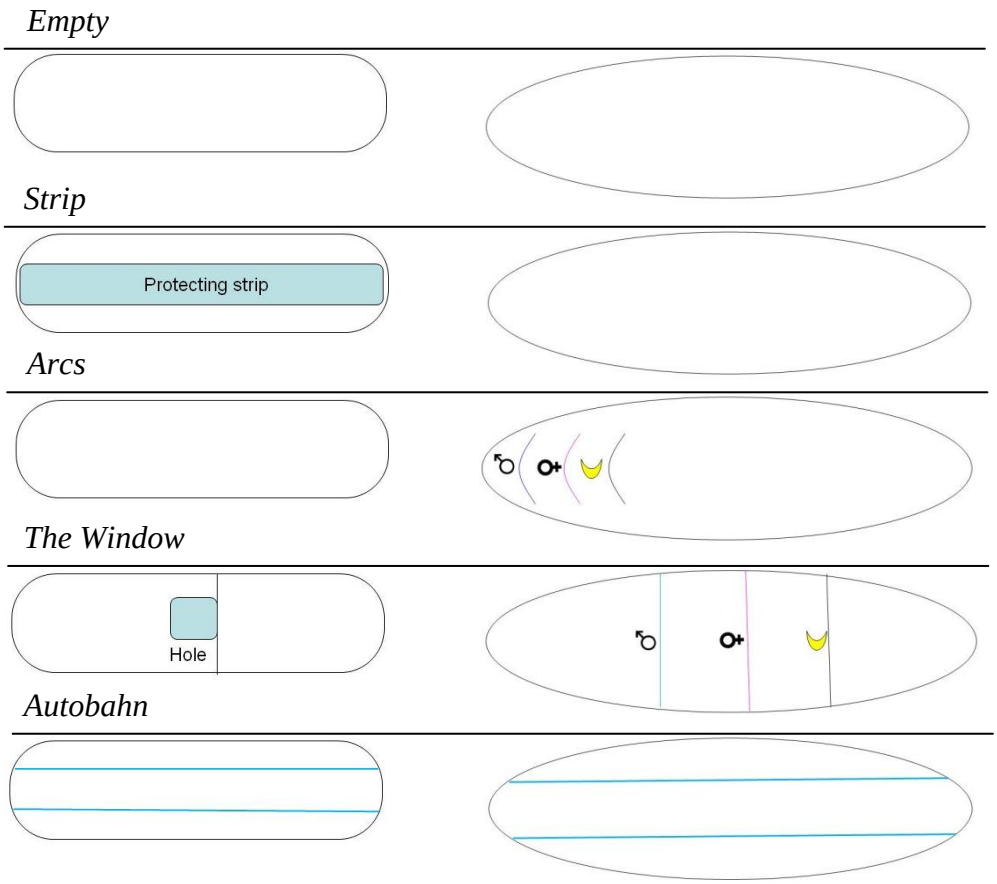


Figure 6.9, The five final concepts combined (insert + base product) from above; *Empty, Strip, Arcs, The Window* and *Autobahn.*

6.2.2. Build

From the selection of concepts, a couple of base products and inserts were built. It was very important to build prototypes in a professional matter because they later would be the main focus during customer visits. Because of this, two professional prototype builders at the SCA studio for prototyping were consulted. The build phase started with a couple of ideas and sketches and ended with four base products and four inserts combined into five prototype combinations, each consisting of a base product and an insert. Because the concepts were so easy to transform into prototypes, detailed sketches and drawings were never needed in order to make prototypes which corresponded with the ideas from the Initial D-B-T cycle. The prototypes which were built can be found in Figure 6.10.

Figure 6.10, The five prototypes, from left to right; *Empty, Strip, Arcs, The Window and Autobahn.*

All prototypes were based on the model TENA *flex*, size medium. The inserts had the shape which had been calculated for best fit, see chapter 6.1 for more information. The symbols and lines consisted of elastic bands and paper in different colours. The Attachment methods to be evaluated were, as mentioned before, glue with and without a protecting strip, Velcro and Friction foam. These attachment methods are shown in Figure 6.11.

Figure 6.11, Attachments methods; glue with protecting strip, Friction foam, glue and Velcro.

6.2.3. Test

The prototypes were used during two initial evaluation meetings. These meeting were conducted at two institutions were four PCGs participated in total. The idea of having a qualitative discussion during the first evaluation cycle was supported by Li Wikström (2010), Senior Lecturer at Chalmers in Design and Human factors. Wikström believed that this method most certainly would give an indicator on what areas to focus on during

the following phases of development. To focus resources on the most critical areas during the first development cycle is considered to be beneficial according to Ulrich & Eppinger (2008).

During the evaluation a semi-structured interview was conducted. The purpose was to find out which of the sub-solutions that were considered to be the best and why they were considered to be best. At this stage the goal was not to find a winning complete concept, simply just to find the best solutions independently of which concept the solution was a part of.

Furthermore it was considered equally important to elicit general feelings about working with inserts and which areas the PCGs believed to be the most important about working with inserts. Below is a summary of the most important results from this evaluation. The interview documents from the two qualitative discussions can be found in Appendix G.

6.2.3.1. Attachment

After evaluating the four attachments much valuable information was gained. First of all the glue with the protective strip was considered to be the worst idea. The main reason was that it would be too time consuming to remove the strip for every insert. Furthermore the solution with glue without the protective strip was considered to be a good solution as long as there were no chemicals in the glue which could hurt the caretaker. The strength of the glue was also very important because if it was too strong, it would destroy the base product and if to weak not secure the insert enough when the products becomes wet.

The PCGs were positive to the Velcro solution and liked that it had few working moments. Few questions emerged but after testing the product a few times all PCGs expressed that they liked this solution better than the one with glue. The only concern was that the insert could be placed with the Velcro up and then the caretaker would get chafed. The last attachment was friction foam strips. This solutions both received positive and negative feedback depending on different PCGs. There was a concern about the insert not being secured enough while others liked the fact that it would be easy to adjust after attached in the base product.

6.2.3.2. Easy Usage

First concept *Empty* was discussed. The opinion was unanimous; some kind of information is needed if everyone that works with the system should understand how to use it. A PCG with a lot of experience would probably understand and put the insert where he or she believes it should be placed. But the problems emerge when a temporary employee is exposed to the product or someone else without experience and enough knowledge.

Furthermore concept *Strip*, the information on the insert was disliked mostly because of the attachment method. Because the information was presented on the protective strip, this concept failed to impress the PCGs. Concept *Arcs* with information in the base product was on the other hand given positive feedback by all PCGs. They thought it was very clear and easy to understand when there were both arcs and symbols in the base product. Concept *The Window* was not addressed with the same positive criticism. The PCGs said that the hole was unnecessary and perhaps affected the performance of the insert negatively. At the same time they all did not understand how to use this concept properly. Those who did understand perceived this concept as one of the best ones.

The last concept, *Autobahn* was a combination of the insert and the base. The information was presented on both the base and the insert as lines which needed to be matched in order to place the insert correctly. This concept did not have different placements for man and women and the PCGs did not like this at all. They understood the idea but after have seen the other solutions they liked them better.

6.2.4. Enhanced Cognitive Walkthrough

To evaluate and recognise flaws with the first generation of prototypes an Enhanced Cognitive Walkthrough, ECW, was conducted for the three concepts with guidance systems for Easy Usage (Billgård, 2007). The evaluation led to the conclusion that some kind of guidance system is necessary, but not how it should look like. The ECW analysis was therefore also conducted to clarify if there was a need for guidance that had not been foreseen when developing the prototypes. In order to conduct the ECW in the fashion that Billgård (2007) recommend the "Sequence of user action" analysis was adapted to fit a Hierarchical Task Analysis, HTA. The main conclusions from this analysis are presented below. For the complete analysis see Appendix H and for the explanation of this method, go to the Theory Framework.

This evaluation showed that some conclusions could be drawn about the different concepts. First of all, all the concepts lacked user guidance about inspecting and replacing the inserts. If this feature should be included in future concepts additional information needed to be added in the products in order to guide the PCGs when using the products. For each of the different concepts, some specific conclusions could be drawn.

The analysis shows that concept *Autobahn* first and foremost lacks information about how the inserts shall be placed in order to customise the product for men/women/night. If this concept shall be easy to use the guiding lines on the insert and in the base product is not enough. This calls for that some additional guidance has to be included in the products.

Concept *Arcs* was the concept that showed to be the one easiest to use. Only few and minor errors occurred that were related to the guidance system and the usage of a

system with guiding lines and symbols seemed natural and intuitive for all the test persons. This made further development of this concept interesting.
The results when using this concept showed some diverse results, some users found the system with a “window” intuitive and used it correct right away. Others found the system more difficult to understand and some errors occurred during usage. This shows that the concept has some potential but if it is going to be used as a complete product some improvements needs to be made in order to prevent misunderstandings.

6.2.5. Input for Final Design-Build-Test cycle

The final decisions from this cycle were to keep the attachment methods Velcro, Friction Foam Strip and Glue without a protecting strip. The attachment with glue and a protecting strip as an information carrier was eliminated after several negative comments. Also the area of attachment called *Hatch* was eliminated because of a new need that was elicited. Even if this sub-group never was tested the need said that the attachment should consist of as few working moment as possible. Because all the *Hatch* solutions had many extra working moments compared to the other solutions it was eliminated.

When considering Easy Usage it was determined that information is needed in order to guide the PCG in the correct direction. Without information or guidance the insert could easily be attached at the wrong spot and then the entire system would lose its advantages. The concepts also needed to take into consideration that it should be easy to change the insert, a subject which all PCGs expressed as very important. Furthermore the product TENA *flex* was very often used with the backside in front. With this in mind the guiding system needed to work on both ways on the caretaker.

The specific concepts that were perceived as the best ones after both the customer visits and the ECW were *Arcs* and *The Window*. They were forwarded, together with all other important information, to the following cycle. The remaining concepts *Autobahn, Strip and Empty* were not perceived as easy to understand and they did not supply the amount of information that was considered as sufficient enough. Which lead to that these concepts were eliminated during this cycle.

The opinions which were elicited during the evaluation resulted in a few new customer needs which are presented in Table 6.2. These needs were put together with the other needs from PCGs and SCA and a new, updated, specification of needs was created for the final cycle.

Table 6.2, The needs elicited during the Initial Test cycle.

	Needs from the initial cycle
1.1	The insert's attachment consists of as few working moments as possible
1.2	The insert is easy to change after usage
1.3	The insert's placement is guided for easy usage
1.4	The insert's guiding system does not cause irritation to the skin
1.5	The insert's guiding system works even if the base product is applied backwards

6.3. Final Design-Build-Test cycle

To improve the concepts developed in the Initial Design-Build-Test (D-B-T) cycle a second more thorough cycle was conducted. The methods and tests that were used during the initial cycle were reused. In addition to these methods and tests, additional brainstorming sessions and methods were used in order to guarantee a satisfactorily result.

6.3.1. Design

To be able to improve and develop the winning concepts from the Initial D-B-T cycle new ideas had to be generated, this was conducted with two brainstorming sessions. The new ideas were then sorted and implemented into a number of concepts which then were formed into the four final prototypes, used during the final customer evaluation.

6.3.1.1. External Brainstorming

The Final D-B-T cycle began with a brainstorming session that was conducted with both staff from SCA, and students from Chalmers University of Technology and Lund University. The participants from SCA contributed with deep knowledge about incontinence products while the students contributed with their knowledge about product development and design.

This brainstorming session focused on the most critical areas, elicited during the initial cycle, Easy Usage and the use of guidance systems. The main goal with this session was to generate ideas about how the PCG more easily could understand where the inserts were supposed to be placed depending on different caretakers' needs.

The brainstorming session was guided by the method Suggestion Circulation, explained in the Theory Framework chapter. In order to customise the method to the specific needs of this occasion Maria Bogren from SCA, Associate Scientist, contributed with her great experience of brainstorming sessions and workshops. Maria came with helpful tips regarding how to run the session, she also suggested that tools from a product development game, used at SCA, should be used in order to enhance creativity and make the

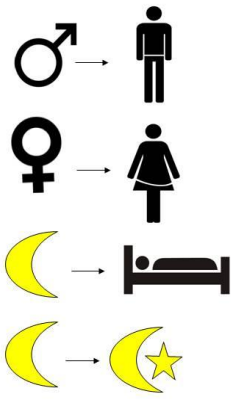


Figure 6.11, Symbols.

brainstorm more fun and creative. The idea was to let all members first generate ideas from their own point of view and after that get a character and then do the same thing. This would, according to Maria Bogren, elicit more interesting and odd ideas.

One of the most promising ideas elicited during the external brainstorm was that symbols which resembled the ones on public restrooms could be used instead of using gender symbols. Moreover, using a moon and a star instead of just using a moon as a symbol for night seemed more clear and easy to understand, see Figure 6.11. Another good idea was that the complete contour of the insert could be marked in the base product in order to guide the user of where the insert should be placed. A complete compilation of the most interesting ideas from the external brainstorming session can be found in Appendix I.

6.3.1.2. Internal Brainstorming

Following the external brainstorm was an additional internal brainstorm where the main focus was to combine and sort good ideas, elicited from the initial cycle and from the external brainstorm. This session mainly focused on guidance systems that would facilitate the use of the products, as they are used today. Problems that needed to be solved were for example the fact that Flex is used both backwards and forwards on the caretaker, a fact that was elicited during the initial cycle. Discussions with PCGs also showed that one of the greatest benefits with an insert system was that a used insert could be removed during the night and the base product would be left on the caretaker. Since this was perceived as the greatest advantage ideas that facilitated the process of removing an insert from the base product, when attached to the caretaker, had to be generated. Finally some of the most promising methods, from the Initial cycle, for how to attach the insert into base products were further developed. The most promising ideas that emerged within the different areas are explained further below.

Easy Usage

A couple of ideas that emerged were simply extensions of ideas that had been generated during the Initial D-B-T Cycle, but a few new concepts were generated from ideas elicited during the external brainstorm. These concepts had the new symbols for man, women and night and also had a full contour of the insert in the middle of the base product. The problem with that the Flex product could be worn both backwards and forwards was also solved by mirroring the guidance, making it possible to use Flex on both ways depending on the caretaker´s needs.

Another idea that emerged was that the guidance could be printed on the insert instead of the base product. A single line in the centre of the base product could be matched with lines and symbols on the insert. The insert could then be rotated 180 degrees depending on if the base product was used backwards or forwards.

Attachment

The attachment methods used was basically refinements of the attachment methods that were generated during the Initial D-B-T Cycle. For example was the placement of the small pieces of Velcro optimized and the protecting plastic stripes from the glue solution.

Removal of insert
Ideas that would facilitate the removal of a used insert from a base product attached to the caretaker were for example different solutions with handles or a fly on the insert. These would allow the PCG to get a better grip of the insert when removing it. Other solutions were to only use attachment on one side of the insert, which would limit the risk that the insert would get stuck underneath the caretaker during the removal. A complete compilation of the ideas from the internal brainstorming session can be found in Appendix J.

6.3.1.3. Concept generating

After the elimination of all non realizable ideas which fell outside the scope of this project, the concept generation part was started. All remaining ideas were divided into the sub-groups Attachment and Easy Usage with guidance.

The ideas were then combined together in order to create a number of concepts for the final evaluation. The concepts consisted of all the promising ideas put together randomly. The concepts were then discussed together with the SCA supervisor who served as a "Product Champion" (Ulrich & Eppinger, 2008) with an insightful knowledge about developing, manufacturing and marketing incontinence products. The discussions lead to that the number of concepts could be narrowed down to four, it was assured that all the most promising ideas from the brainstorming sessions and from the initial cycle at least was included. The concepts that were considered the most promising are explained below.

Arcs
Concept *Arcs,* shown in Figure 6.12, contained markings with arcs together with gender symbols that should guide the user even if the base product was used backwards. The arcs and symbols were pink for women, blue for man and black for night with a yellow moon and star. This guidance system was carried over from the initial D-B-T Cycle since the Enhanced Cognitive Walkthrough and the qualitative discussions with PCGs had shown that this guidance system was consider the easiest to understand and use.

The attachment consisted of one square piece of Velcro that was attached to one end of the insert. The advantage with only having one attachment point in one end of the insert was that it would facilitate removal of a used insert from a base product that was attached to a caretaker.

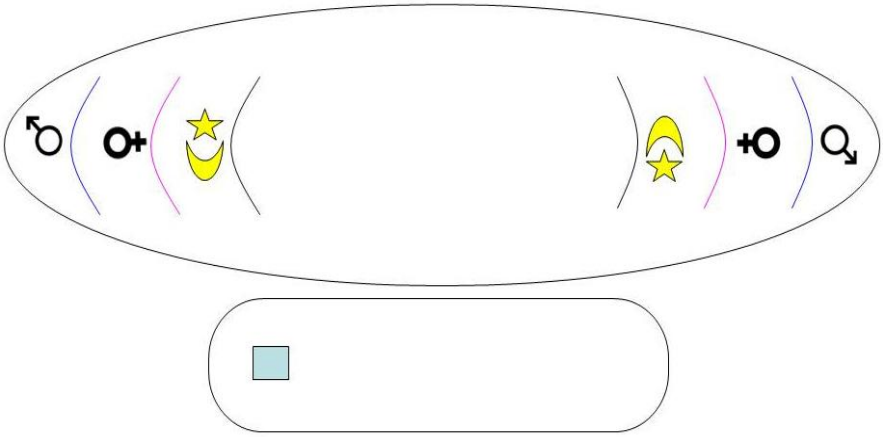


Figure 6.12, Arcs.

Contour

In concept *Contour* shown in Figure 6.13, similar markings that were used in concept *Arcs* were applied. Differences were that the lines for man and night overlapped and that a contour of an insert marked the centre and women placement of the insert, an idea that had been generated during the external brainstorming session. The possibility for overlapping the male and the night symbols came from that the day placement for male coincided with the night placement if the base product was worn backwards. The advantage with overlapping the male and night markings was that less printing would be necessary and that the markings could be mirrored which allowed both frontward and backward usage.

The same colours as in concept *Arcs* were also used, but the symbols were replaced by figures resembling the ones that can be seen on the doors of public restrooms. The symbol for night placement consisted of a person lying in a bed. These symbols emerged from the external brainstorming session and diverged from the gender symbols that were used during the Initial D-B-T Cycle. The reason for this was that some concerns had been expressed regarding the gender symbols for example during the Enhanced Cognitive walkthrough. Therefore a new set of symbols were used in order to compare which ones that was the easiest to understand.

The attachment consisted of two stripes of foam that were supposed to cause friction between the insert and the base product, which would limit the movement of the insert. This attachment method was also carried over from the Initial D-B-T Cycle since some PCGs had found this method most promising. An attachment method only using friction would also facilitate removal of a used insert since it would not stick to the base product.

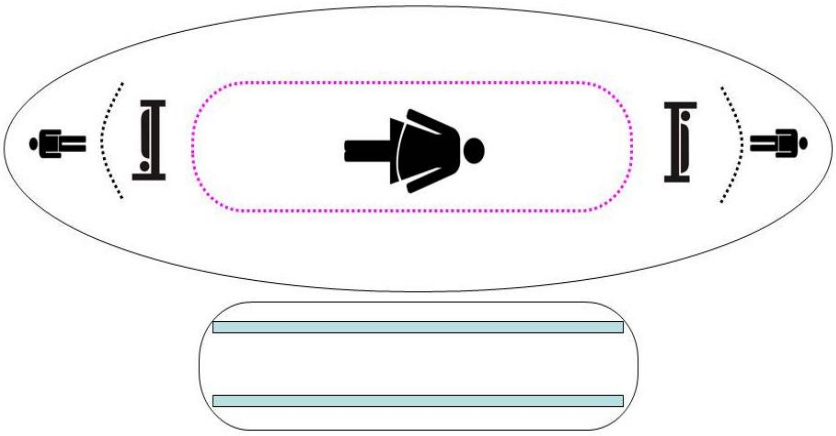


Figure 6.13, Contour.

The Window

Concept *The Window* shown in Figure 6.14, used the same symbols and almost the same placement of the symbols as the ones used in concept *Arcs*, the difference were that instead of using arcs as help when placing the insert a square hole was working as a window where the correct symbol should be matched.

The attachment method used was six small pieces of Velcro that were place in the corners and in the middle of the insert. This attachment method was also carried over from the Initial D-B-T Cycle since PCGs had found that it provided a solid attachment that was not deteriorated by urine.

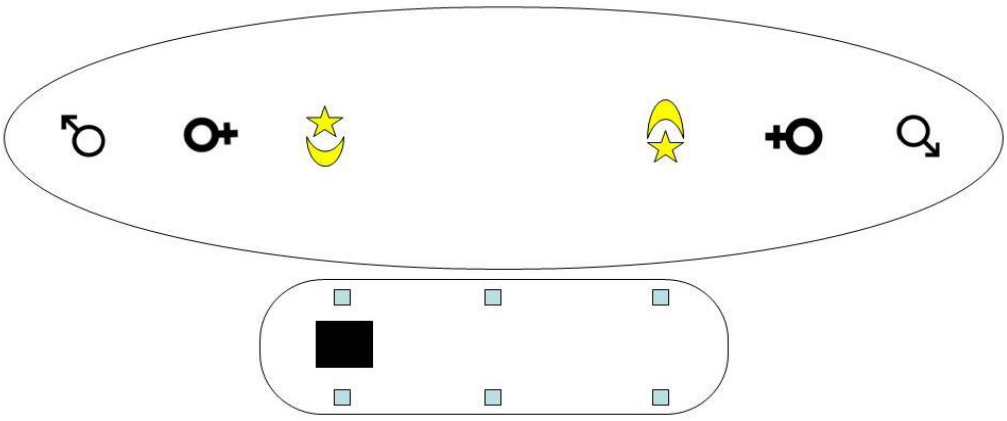


Figure 6.14, The Windo.

Insert Printing

Concept *Insert printing* shown in Figure 6.15, differed slightly from the rest of the prototypes since most of the information was displayed on the insert. The markings consisted of the same symbols that were used in concept *Arcs* and in addition the symbols were underlined with a line that was supposed to be matched with a single dotted line in the base product. The insert also was equipped with an oblong hole on the front that was supposed to be used as a handle. The handle was included since it should facilitate the removal of a used insert from a base product.

Two thin stripes of glue on the back of the insert were used as attachment. The glue stripes were brought over from the Initial D-B-T Cycle, even though some PCGs had expressed concerns regarding the glues ability to function when it was exposed to urine, since it was believed to be a cheap attachment method that was easy to produce.

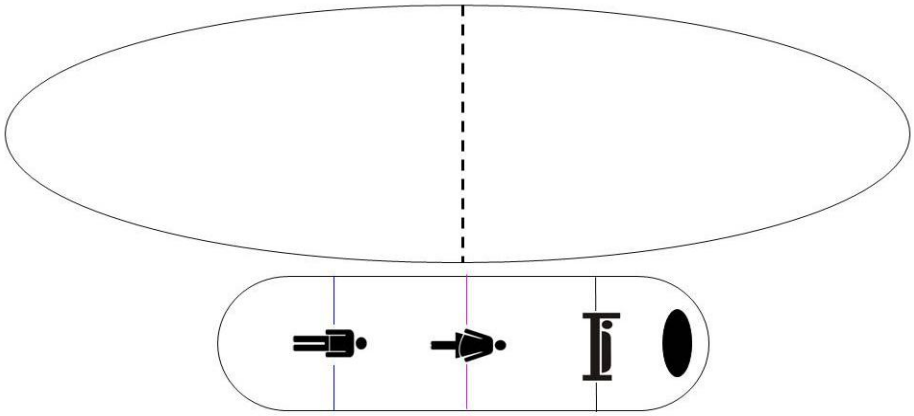


Figure 6.15, Insert printing.

Note that all the guidance systems are designed for TENA *flex* products, for TENA *slip* and *comfort* only "half" of the guidance is necessary since the products only are used in one manner.

These concepts were then presented on A4 arcs and brought to the SCA studio for prototype construction.

6.3.2. Build

In order to present and test the concepts with PCGs prototypes were built with the help of Maria Welke who work in the SCA prototype building studio. The prototypes that were built were handmade copies of the actual TENA *flex* products. TENA *flex* was chosen since those were the products that were most used by PCG in the Göteborg area and because those were the only products that could be used backwards.

The prototypes consisted of base products with different guiding systems attached under the top sheet, see Figure 6.16. Other differences from the products sold to customers were for example that the shell lacked printing and wet indication strip. Another difference was that the big absorbing core of the product was slightly flattened so that the prototypes would resemble the thinner base products that an insert system would result in. The small core was completely removed, since the insert would fill the same function as the small core used in the base products. The flattening of the big core and the removal of the small core had resulted in that the base product had crumbled unrealistically during the first generation of prototypes; therefore the tension of the leg elastics was lowered with 50% in order to gain the same tension of the product in the final result.

Figure 6.16, Base product prototypes of *Contour, The Window, Arcs and Insert Printing.*

Along with the base products four inserts were built. All the inserts had different attachment system, see Figure 6.17. One had guidance on the insert while the rest lacked printed info and one insert had a handle to facilitate removal of the insert, see Figure 6.18.

Figure 6.17, The back of the insert prototypes of *Contour, Window, Arcs and Insert Printing.*

Figure 6.18, The front of insert prototypes of *Contour, Window, Arcs and Insert Printing.*

All the prototypes were built in two copies since it was considered a risk that the prototypes would be damaged during testing.

6.3.3. Test

To be able to decide which solutions that were most appreciated and considered easiest to use and understand a number of well organized observations were conducted. In addition to the observations an interview was conducted with each participant in order to find out their opinion of the concepts as well as how they perceived working with inserts.

The first two interviews and observations were held at Bagaregården institution in Göteborg. These two meetings worked as a pilot and inconveniences and problems that occurred were corrected till the next sequence of meetings. It was Fylke (2010b) who proposed the idea of having a pilot first to see if the observation and interview went according to the plan. The next sequence was held at Patrikshill's institution in Halmstad. In total 13 interviews were held in Halmstad resulting in 15 interviews which should give an adequate result according to Wikström (2010) that recommended that at least 12 observations should be conducted. After conducting 12 independent interviews an initial result can be found according to Griffin and Hauser (1993).

6.3.3.1. Interview and Observation Procedure

The interview and observation procedure was planned after input from both Li Wikström (2010) and Johan Fylke (2010b) who helped with their knowledge and experience in conducting customer evaluations.

The meetings began with a presentation of the development team and the project. To clarify that the interviewees' competence was needed in order to clarify which guiding system and attachment method that would be most suitable for their working environment, a short presentation of the scope of the observations were also given. It was also clarified that opinions according working with insert in general were most

welcome. It was also explained that observation part would be filmed and that the interview part would be recorded.

First the test person was given one of the four prototypes together with an instruction of for whom the product would be customised. The options given were a man during the day, a man during the night, a woman during the day and a woman during the night. All positions were sequenced so that they would be repeated the same amount of times. The test person was also told to positioning the base product, with the insert attached, relative to a manikin. The reason for this task was that the TENA *flex* product can be worn backwards and in order to find out if the test person had understood the guiding system, the products positioning relative to the body had to be correct.

The handling of each prototype was filmed and the time that the test person needed to open the product, positioning and attaching the insert and positioning the base product relative the manikin was noted. It was also of importance where the insert had been positioned, if the test person used the guidance and how many errors that had occurred during the handling. For example, positioning the insert incorrectly in the base product and the base product wrongly relative to the manikin rendered in two errors. After the base product had been positioned relative to the manikin two questions were asked, one of how the attachment method was perceived and one regarding how the guidance system was perceived. This process was repeated for all the four prototypes.

The order which the test persons were given the prototypes varied randomly. Furthermore the instruction about who the product was for varied. These two actions were chosen because it was a concern from Li Wikström (2010) that the PCG could learn the way of thinking during the first observation and then be "unrealistically" better during the handling of the other prototypes.

After the four prototype tests were conducted the test person was asked to rank the prototypes. First regarding how well the interviewee thought the attachment would work and second how easy or hard the guidance was perceived. The ranking of the prototypes ended the part of the meetings that were filmed.

The meetings ended with a number of structured questions asked about working with inserts in general. First the interviewee was asked if she or he had worked with insert systems. If he or she answered yes, the test person was asked why the insert system was used. Thereafter the test person was asked which advantages and disadvantages he or she could see with an insert. Next question regarded if it could be possible to work with an insert system in their current working situations. Finally the test persons were asked if he or she could see themselves working with inserts in the future and if that was the case, what would the needs of such system be. The observation results can be found in Appendix K.

6.3.3.2. Observation Results

During the observations many interesting opinions regarding the attachment and the Easy Usage and guidance systems were expressed. The most recurring opinions are presented for each prototype in the following part of this chapter.

Arcs

The attachment method used was the one that generally was considered to be the worst one by the test persons. Many of them expressed concerns that only one attachment in one end of the insert would not be enough. They feared that the movement of a caretaker wearing the base product would cause the insert to crumble if only one attachment point was used. A crumbled insert would then cause chafe on the caretakers' delicate skin.

Moreover, the fact that there was only attachment in one end of the insert also caused confusion since the test persons had to consider which end of the insert that should be placed in the front of the base product. Only one test person realized that attachment in only one side of the product would simplify removal and change of the insert.

The guidance system was received with mixed emotions among the participants. Some found it simple to use the arcs and the symbols for guidance, while others had problems understanding the purpose of them being in both ends of the product. There were also some concerns regarding the symbols, some test persons did not seem to understand the symbols, especially the moon and the star marking the night placement.

One opinion that was common was that the amount of information, which was a result of that the product should be able to be used both backwards and forwards, was a source of confusion. Some test persons expressed that the lines and symbols were too many, which only aggravated the use of the products. One interviewee said that: "I think the markings are very obvious, but I think that the number of symbols is too great… the markings in the back of the product should be excluded."

These opinions were confirmed during the observations, since the majority of the test persons struggled to interpret all the information. This was an observation that would reoccur for the other guidance systems as well, which would indicate that less information had to be used in the products in order to enable easy usage. Still there needed to be some information in the system not to lose the advantages.

Another consistent observation was that the test persons did not agree with, or used, the night placement when they were told to place the product for a man that was supposed to use it during night. Instead they placed the insert in the front of the product where the placement for a man during the day was printed. Many did this with the argument that even during the night most absorption capacity was needed in the front of the product, when male usage was considered. As one interviewee said, "Here you got the placement for night back in the product, which I do not like. The placement for men should be

forwarded also during the night." This contradicted the information that was given to the development team by SCA.

Contour
The attachment consisted of two stripes of foam that were supposed to cause friction between the insert and the base product, which would limit the movement of the insert.

The reception of this attachment was quite mixed among the participants. Some liked it and thought that the friction was enough to keep the insert in place and that the insert would be easier to detach than the other prototypes. Others thought that the attachment would not be enough and that there was a risk that the insert would move and crumble during usage.

The guidance was quite well accepted by many of the participants. The placement for women and man seemed easy to understand. Some confusion and problems occurred when the participants was told to place the insert for man and women for night. The problems seemed to inherit from overlapping of man and night arcs and from that some participants did not seem to understand that the symbol for night was a person in a bed. Although it seemed like the "toilet symbols" were easier to interpret than the gender symbols.

The concerns with too much information that was noted for prototype *Arcs*, reoccurred for prototype *Contour*. Some also expressed that the women symbol in the middle of the product was too large.

The Window
This attachment method was the one that was considered the most promising by most of the participants. Many believed that the attachment would be a sufficient way of fixating the insert in the base product. Some also were pleased with the fact that even though the insert was attached firmly in the base product it was easy to detach and did not leave any marks in the surface of the base product. One interviewee noted that "It sticks, but it is still detachable." another said that "It seems like it should be able to stick firmly even when the patient is sitting."

The guidance used seemed to cause trouble for many of the users, very few understood how the hole in the insert was supposed to be used. Some thought the hole was a handle, while others placed the insert in the base product with little or no concern about the symbols. The ones that had problems with the night symbol in prototype *Arcs* also struggle with this prototype since the same symbols were reused.

Other concerns about the hole were that there was a risk of that the edges of the hole would chafe the skin of the caretakers and that the insert would be more expensive since an extra operation was needed when manufacturing inserts with holes. The opinions that

the base product was designed with too much information and too many symbols were yet again expressed.

Insert Printing
The participants' reactions on the glue stripes were mixed. Some thought that the glue would be sufficient enough to keep the insert in place during usage. Others feared that the glue would dissolve when it was exposed to urine, and some thought that the base product would be damage if an insert that had been glued to the surface of the product was removed. The general opinion was although that the glue probably could be sufficient. Not many of the test persons understood how to use this guidance system. Some did not seem to understand the symbols and many did not match the line on the insert with the line in the base product.

One, of few, that did understand the concept expressed the opinion that markings on the insert would be inefficient when using many inserts in the same products since you only need guidance on the top one, therefore she thought that guidance in the base product would be better. As one interviewee expressed it, "This might be unnecessarily expensive to produce for each and every one of the inserts. I you for example use three inserts, than you would only need to look at the one on top. Therefore guidance in the base product would be preferable."

Very few realized the meaning of the handle, and one expressed that they did not care about such help since they were too busy think about using handles.

6.3.3.3. Summary of Ranking and Observation Data

When summarizing the rankings that were given of the attachment methods and guiding systems in the end of the observation, the picture of which attachment method and guiding system that had grown during the observations was confirmed. The guidance system for Easy Usage of prototype *Contour* scored 29 points which can be compared to *Arcs, Insert Printing and The Window* with 38, 46 and 43 points. The score is based upon a summarization of all the rankings; hence a low score is better than a high one. This showed that this guidance system was clearly the most popular and that this kind of system with a combination of arcs, contours and "toilet symbols" should be used as a base for the final concept. The other guidance systems did all get similar scores, but the guidance system used on prototype *Insert Printing* was perceived to be the most complex to understand. The complete summarization of the concept rankings can be found in Appendix L.

To confirm that concept *Contour* guidance system, that was perceived the best by the PCGs, also was the best when actual handling was considered some data from the observations was collected. First, the time each of the PCGs used to apply the insert in the base product was timed and summarized. This was done because there should be a correlation between the time it took to insert the insert and how difficult the guidance system was to understand. The summary showed that the guidance system in prototype

Contour was clearly the fastest one to interpret. The guidance system with the hole that was going to be matched with symbols in the base product was the one that took the most time to insert, it was therefore considered to be the most difficult one to interpret.

The amount of errors that had occurred for each prototype during usage and how many that used the guidance system to place the insert were also summarized. This summarization further confirmed that prototype *Contour*'s guidance system was clearly the best one. Also among the attachment methods there was one clear winner, the small pieces of Velcro used in prototype *The Window* scored 23 points which can be compared to *Arcs, Insert Printing and Contour* with 52, 38 and 34 points. This gave an indication that an attachment method with Velcro could be used in a final solution. A complete summarization of time studies, number of errors occurred and correct placements and rankings can be found in Table 6.3.

Table 6.3, Time studies, number of errors and correct placements and rankings for the guidance and attachment method.

Prototype	Time (s)/person	Correct Actions	Error Actions	Ranking Guidance	Ranking Attachment
Contour (Foam)	45	12	8	29	34
Arcs (One Velcro)	51	9	9	38	52
The Window (Small Velcro)	53	4	20	43	23
Insert Printing (Glue)	51	7	18	46	38

6.3.3.4. Interview Results

During the interview part of the meetings many interesting thoughts about inserts solutions were presented. Also during the observation part many interesting ideas and opinions about inserts in general were expressed. The most reoccurring opinions are presented under each question that the interviewees answered.

"Have you ever worked with inserts before?"
Surprisingly all of the interviewees had worked with inserts before. Many of the test persons also told that it mostly been used by personnel working the night shift. This was also confirmed by the three persons that worked during the night that took part in the test.

"If a system has been used, why were it used and which advantages could be seen with this kind of system?"
First of all inserts had been used to minimise the disturbance of the caretakers during the night and to ease the working situations for night personnel. It was told that if an insert was used the base product could be opened during the middle of the night and the used insert could then be removed and the still dry base product could be used again.

This had a couple of major advantages compared to replacing the whole base product since it would be easier to only remove an insert. If the whole product would be changed the caretaker need to be rolled back and forth in order to insert the base product underneath the caretaker. This procedure resulted in additional work for the personnel and the caretaker was disturbed during the procedure. Waking a caretaker often leads to that he or she was unable to go back to sleep again, there was also a risk of upsetting demented patients which could cause them to be aggressive. Just opening the base product and remove the insert was considered to ease these problems vastly. One interviewee said that "There is especially an advantage with inserts during the night, you do not need to awaken and mess with the caretaker. You can simply remove the insert and keep the base product."

A second advantage was that some money possibly can be saved if the PCGs did not needed to change the whole product during the night, but instead just remove the wet insert and reuse the base product.

Furthermore, a third reason for using inserts had been to prevent leakage on caretakers who urinated heavily, during the night. This was needed when the regular products simple was not enough. By using extra absorption in the base products the cases of leakage could be decreased, which was considered beneficial both for caretakers and for the PCGs that did not have to wash as much linen. One interviewee answered the question with "It would be useful when the regular incontinence products do not provide the necessary protection. It is of course better if you do not have to clean the bed during the night and to disturb the caretaker if a leakage has occurred"

Finally, inserts had also been used on patients where their body shape had caused problems with leakage. For example caretakers with large hernia often had problems with leakage, which was prevented with inserts placed where the leakage usually else occurred.

"Can you see any disadvantages with working with inserts?"
The most common answer to this question was that there were not any major disadvantages. Although many of the PCG said that inserts only was used in exceptional cases. An agreement had been made saying that it should be forbidden to use these kinds of systems since it was not considered to be an ethical treatment of the caretakers. This agreement had been made a couple of years ago and since then very few had used inserts. Many did although express that when using inserts their workload was decreased due to less leakage problems.

"Is it possible for you to work with inserts in your current working environment?"
Most of the PCGs answered that if there had not been an agreement saying that they should not use inserts, there was not any major factors that would prevent the usage of these products.

Some expressed concerns that it would be an extra product that would require shelf space in the care takers rooms, which could be a problem since the shelf often were full with base products and urine absorbing bottom sheets.

Some also expressed that it usually takes time for some personnel to except changes, which could be a problem if a new system with inserts would be introduced. Someone gave an example with the TENA *flex* product that had been available and working well but still had not been accepted by all PCGs.

"Would you consider working with inserts in the future?"
Most of the PCGs answered yes, many had although needs that had to be fulfilled in order for the to use inserts.

"If you would consider working with these inserts, which needs would you have one the products?"
On this question many of the answers inherits from flaws that had been experienced with earlier inserts that had been used. Former used products had not had the absorption capacity and the ability to lead fluids that was required, which had resulted in that the caretakers who had used the inserts had experienced problems since their skin had been exposed to the wet inserts. Former used inserts had also been too bulky which was not comfortable for the caretakers. The bulkiness of the inserts had also caused some leakage problems since the base product could not retain when it was stuffed with thick inserts. A large group also expressed that the usage of inserts should not limit the capacity of the base products. Many of the PCGs also clarified that if this kind of system would be used it had to be easy to understand and use.

Another need was that the extra time invested when inserting the insert had to lead to that time was saved for example when performing less changes on the caretakers or when dealing with less leakage related problems. One interviewee well expressed and summarized what many of the interviewees had mentioned by saying, "The new system should make our working situation more effective, it should be nice and easy to work with and in the same time be beneficial for the caretakers"

The new needs that had been brought to surface during the interviews and observations lead to that the need specification had to be updated. The needs elicited during the final test cycle can be found in Table 6.4.

6.3.4. Input for Refinements and Evaluation

The observations and rankings clearly pointed towards a guidance system with "toilet symbols" and some arcs and contours for guidance. The amount of information in the base products were though considered to be too extensive, which pointed towards a final concept with less information.

The observation had also shown that there were some problems understanding the night symbol. There had also been some disagreements of positioning of the night markings, this was extra obvious when the participants was told to place the insert for a man during the night and most of them placed it in the front of the product anyway. This pointed to that the night markings should be removed from a final concept, since it only seemed to cause problems and disagreements.

The guidance system used for prototype *The Window* had some major disadvantages. The most troublesome one was that few participants understood how to use the window. Concerns had also been expressed about how comfortable the hole was for the user and the window had been mistaken for a handle. These disadvantages were enough to eliminate this guidance system.

The system used in prototype *Insert Printing* was also disregarded due to its complexity and the fact that guidance on every insert would be unnecessary. Moreover, prototype *Arcs* guidance system had some mixed opinions about it, some interpret it as very easy to understand while others struggled with the symbols and arcs. Some aspects about the concept were although positive, chiefly the arcs, and could be considered useful for the final concept.

Concerning the attachment methods the method that was most liked were the evenly distributed pieces of Velcro. Those were considered to supply the user with an attachment that would be sufficient for both day and night usage, and it would still be easy to detach the insert from the base product. Furthermore, the glue stripes got both positive and negative reviews. Some thought it would supply the user with adequate attachment, while others feared that the glue would release when it was exposed to wetness.

A glue solution was although regarded as a method that could be used in a final solution, if a sufficient glue could be found. The foam and the Velcro with only one attachment point were disregarded since those were not considered to attach the insert in a manner that were sufficient both during night and day usage.

When summarizing the interviews it can be seen that all the participants have been working with inserts before, but that the usage had decreased due to better incontinence products an because of agreements stating that usage of insert was not considered ethical care. A majority of the interviewees although said that inserts were missed and a solution that they thought would ease their day to day situation. First and foremost since it would facilitate caretaking during nights, as the night staff did not have to perform a tedious change of the whole incontinence product that would bother the caretaker. But also since the inserts could be used for persons with special needs.

These opinions pointed into a completely different direction then the first developed system. Instead of having a complete insert system with one base absorption level plus

inserts, a different system, specially made for use during nights, would be much more liked and required by the PCGs. With consideration to this the first goal of having one bas-product, at level plus, was discarded. In addition the idea of having a very thin base product within the small core also got discarded because of the same reason. These ideas were discarded because a new focus towards a night product was needed in order to find a solution which the PCG wanted to use. Instead a night product with inserts could work as a substitute for the thickest products which are used at night time at most in institutions in Sweden today.

All the interviewees also stated that they would consider using insert solutions if it would be available in the future. Although they required that the products should be easy to use and facilitate the use during night situation both for the PCGs and the caretakers, that the inserts were thin, had high absorption capacity and did not cause any problems for the caretakers delicate skin. Many obtained needs already existed in the specification of needs but two new needs were elicited and integrated in the final specifications of needs, see Table 6.4.

Table 6.4, Needs elicited during the Final Test cycle.

	Needs from the initial cycle
1.1	The insert's guiding system consist of as few markings as possible.
1.2	The time invested in matching and attaching the inserts leads to that the overall workload is decreased.
1.3	The base product works satisfactory as an incontinence product even without inserts.
1.4	The insert feels thinner than competing products.

7. Refinements and Evaluation

When considering the feedback that was given during the interviews and observation it was clear that some refinements were required in order to improve the concepts to secure approval from the Professional Care Givers, PCGs.

7.1. Refinements

During this chapter the feedback, elicited from the final evaluation cycle, concerning combinations and small changes of the existing concepts will be explained.

7.1.1. The complete system

Since the PCGs first and foremost saw an advantage of using the inserts during then night, the initial idea, with using only one level of absorption on the base product and replace the other models with inserts, was discarded, see Figure 7.1. In addition, the idea of eliminating the small core from the base product, and using a thin base product, was also discarded. This change affected all products and would lead to a worse absorption capacity than in today's products.

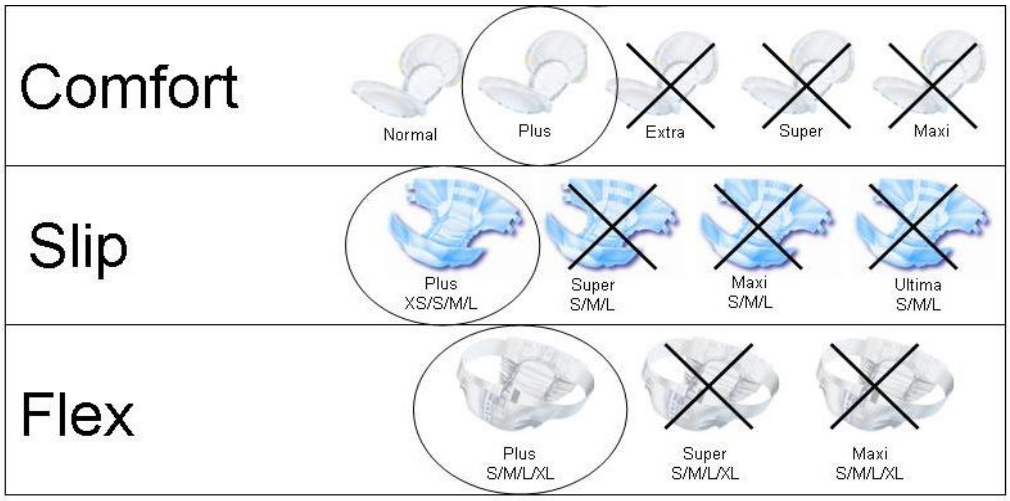


Figure 7.1, The initial idea of having one absorption level, Plus, and gain in absorption by adding inserts.

Instead the products with absorption levels up to Super were kept as day products, and only the high capacity Maxi and Ultima, which usually are used during the night, products is going to be replaced by inserts. Instead of using inserts to replace the small core of the base product, the insert system is going to be used during the night, when the need for inserts is the biggest. This change leads to a reduction of the total TENA assortment as well, but in a smaller extent than the previous idea. The reduction is from a total of 30 products down to 20, including the new insert product, see Figure 7.2.

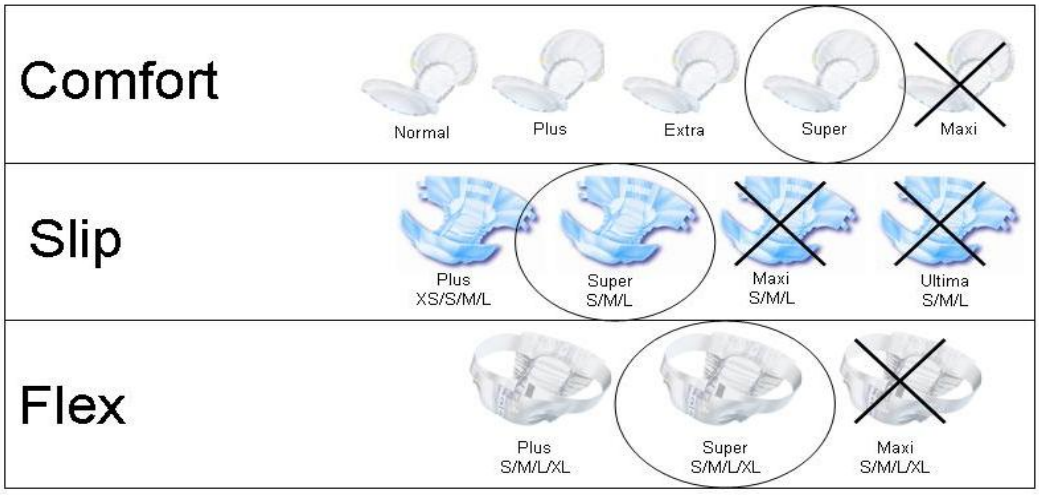


Figure 7.2, This figure visualizes the possible reduction of product when replacing the bulky night products with inserts.

7.1.2. Base Product

The interviews and observations had shown that the guidance system of concept *Contour* was the easiest to understand and use, shown in Figure 7.3. Therefore this guidance system was chosen as a base for a final concept. Some refinements were although necessary. First of all, the number of markings, which were a result of that the Flex product could be worn backwards, were too extensive. The double set of markings

only seemed to cause trouble and confusion for the PCGs, therefore half of the markings were excluded. The information showing that the insert should be moved if the product is worn backwards could instead be placed on the package of the products. This resulted in that the design of the guidance system could be the same for TENA *comfort*, *slip* and *flex*

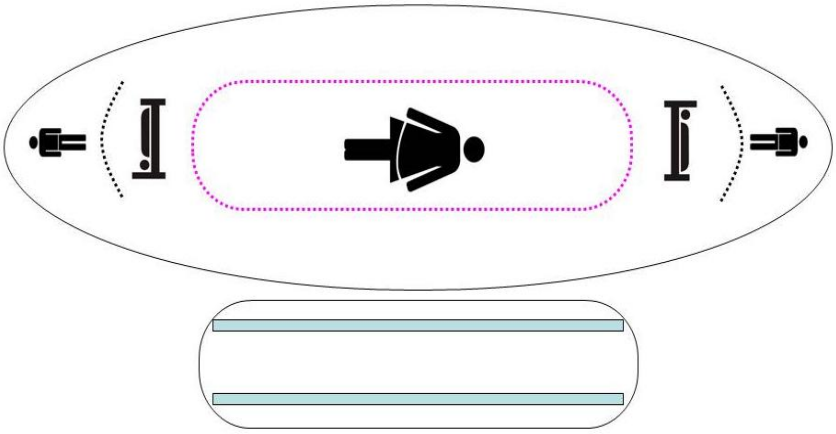


Figure 7.3, The winning concept *Contour* with an insert with glue strips as attachment method.

Another source of confusion was the bed markings that were combined with the position for male/day when the product is worn backwards. Since the double markings no longer were used, the night markings had to either be moved or excluded. Many of the PCGs expressed that the placement for night did not coincide with the actual area were the insert was needed, especially for men. This together with the belief that less information would lead to a product that was easier to understand resulted in that the night marking was excluded from the final design.

The “toilet symbols” and the colours had proven to be easy to understand and to guide the PCGs, therefore they were kept in the final concept. Some had although expressed that the women symbol was too large, which lead to that this symbol was brought down in size so that the male and female symbol were equal in size.

With help of the results from a part of the Cobra Sum investigation, were the differences between the urine patters for women and men have been investigated, could a placement of the arc and the contour be decided. This part was only based on investigations of TENA *slip* products, but since data for the other products were not available for the development team, the placement of the arc and contour had to be based on available data. In order to place the markings more exact additional data needs to be taken in consideration.

In appendix M the areas that are most exposed for respective gender be seen. In order to cover these areas, as well as possible, the marking for men should be placed 19cm from the centre, the most slender part of the product. For women the marking should be placed 14cm more towards the centre. In figure 7.1 the exact placement of the markings can be seen.

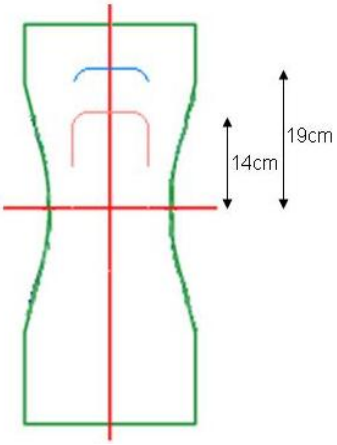


*Figure 7.3, P*ositioning of the men and women markings in a medium Flex product.

7.1.3. Insert

The attachment system with small pieces of Velcro had shown to be the most likeable among the PCGs. Lars Melin (2010) did although state that a machine for attaching and positioning the Velcro pieces would be relatively slow compared to a machine that applied glue stripes. A machine applying glue stripes would also be much more "stable" which would result in a more effective and cheaper production. Therefore the attachment system second most liked by the PCGs with two thin glue stripes was chosen. The dimensions of the two glue stripes were set to 320mm×5mm, see Figure 7.1 on the previous page.

7.1.4. Shape and Dimension

The shape, determined in chapter 6.1, was kept since the interviewees did not have any complains about this shape and size. This resulted in an insert with the measures of 120mm×340mm with cropped corners.

The investigation in the Final Design-Build-Test cycle had shown that it was a night product that was requested, which resulted in that all the models up to Super were kept and the Maxi and Ultima were eliminated from the assortment and replaced by inserts.

In Table 7.1 it can be seen that the difference in actual absorption capacity for each model and size ranges from 172ml to 804ml. In order to cover the differences for each model and size, the absorption capacity of the insert were set to 300ml. An absorption capacity of 300ml was considered to be an adequate compromise since a difference of 172ml to 335ml could be replaced with one insert and a difference of 451ml to 659ml by two. Differences in absorption, larger than 659, which would be the case for Flex XL and Ultima, would require three or more inserts.

Table 7.1, Absorption differences for all models and sizes of Super and Maxi.

	Absorption Capacity ml

TENA				
flex:	**Size**	**Super**	**Maxi**	**Abs. Dif.**
	S	735	1213	478
	M	815	1266	451
	L	930	1589	659
	XL	1153	1957	804
slip:				
	XS	444		
	S	589	761	172
	M	851	1157	306
	L	918	1406	488
***comfort*:**		793	1128	335

To be able to have an insert with the capacity of 300ml and the size 120mm×340mm that still were relatively thin a bulk density of 5.5 were chosen. The Bulk density, cm^3/g, is the inverse of the density g/cm^3 and determines how fluffy or compact the insert will be. Bulk absorption of 5.5 was considered to result in a relatively soft insert that still would be able to absorb and spread liquid satisfactorily. (Vartiainen, 2010b)

The insert should be made out of pulp and super absorbents covered with a layer of Nonwoven. Two variants of the insert, with different ratio of SAP and Pulp were considered in order to investigate how the ratio would affect price, performance etc. The first insert called, Low SAP, the level of SAP was set to 8.3g (35%) and the amount of Pulp to 15.5g (65%). For the second insert, High SAP, the amount of Sap was set to 9.7g (50%) and the amount of pulp to 9.7g (50%). This resulted in thickness of 2.3mm for Low SAP and 1.6mm for High SAP. Important to point out is that the absorption capacity still was set to 300 ml on both these inserts.

7.2. Evaluations

In order to estimate the consequences the implementation of an insert system would have, a number of different evaluations were conducted. These evaluations contained evaluations regarding environment, production and how the consumer would be affected.

In order to carry out these evaluations some assumptions regarding the PCGs habits when working with the current products and about the new insert system had to be made. These assumptions were concluded in five different user procedures. Since the consumer evaluations had shown that an insert system primarily would be used during the night the scenarios were based on night usage. The scenarios were then compared with each other in order to give an indication of which consequences an insert system would have within each area.

- Procedure 1: First it was assumed that the caretaker only needed one Maxi product during the entire night.

- Procedure 2: The caretaker needed two maxi products during one night. This scenario had shown to be very common, when talking to PCGs during the evaluation.

- Procedure 3: It was assumed that one Super product plus inserts equivalent to the gap in absorption capacity between Super and Maxi were needed. This procedure would be equal to Scenario 1 in absorption capacity.

- Procedure 4: It was assumed that two Super products were needed, one with inserts and one without.

- Procedure 5: Finally it was assumed that two Super products were needed, both with inserts.

7.2.1. Environment

In order to evaluate which consequences a system with inserts would have from an environment point of view it was calculated how much material that would be used for each procedure. The amount of material used was assumed to be a good criterion for environmental impact since the used products either are incinerated or ends up as landfill regarding of which market they are used at. In order to evaluate the environmental impact, different scenarios were stated were the current products were replaced with a scenario with the new system.

In the first scenario Procedure 1 was replaced by Procedure 3 which would be equal to that the PCGs simply replaces the Maxi product with a Super product and inserts.

In the second scenario Procedure 2 was replaced with Procedure 4 which would be equal to that the PCGs instead of using two Maxi products used two Super products were the first one were prepared with inserts.

In the third scenario Procedure 2 was replaced with Procedure 5 which would be equal to that the PCGs instead of using two Maxi products used two Super products were both ones were prepared with inserts.

In the fourth scenario Procedure 2 was replaced with Procedure 3, which would be equal to that the PCGs instead of using two Maxi products they used one Super product and inserts. During the night it was assumed that the inserts would be removed and the base product would be reused. This was a scenario that the PCGs had pictured themselves when they were asked what benefits a system with inserts would result in.

Figure 7.2, an example for how the different scenarios would affect the use of Flex products. Each comparison was made for each size for TENA *comfort*, *slip* and *flex*.

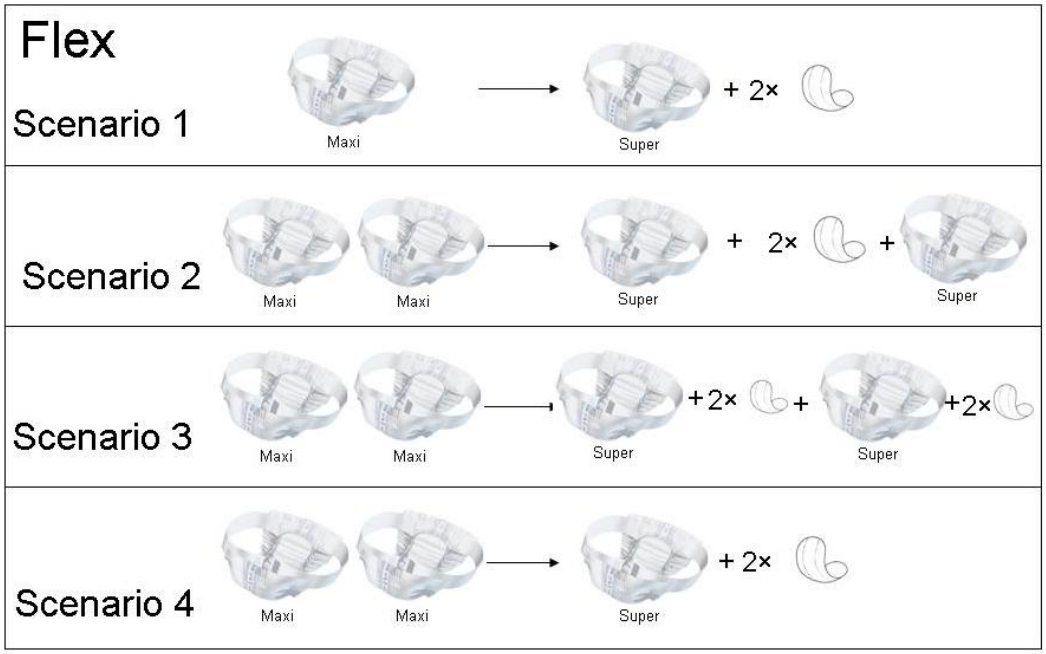


Figure 7.2, Different scenarios for working with Flex products and inserts.

In Table 7.2 it can be seen which savings in weight that can be made when considering Pulp and SAP. The savings are calculated from each scenario and product with the High SAP insert. A similar table for the Low SAP insert which shows that this insert shows slightly lower savings can be found in Appendix N. The document where the original calculations are made can be found in Appendix O.

Table 7.2, Material savings considering Pulp and SAP for each scenario and product size. Negative numbers equals an increased use of material.

High SAP, Flex:	**S**	**M**	**L**	**XL**
Scenario 1	-7%	-6%	5%	13%
Scenario 2	15%	14%	22%	25%
Scenario 3	-7%	-6%	5%	13%
Scenario 4	47%	47%	53%	56%

Slip:			
Scenario 1	-7%	4%	-1%
Scenario 2	7%	13%	13%
Scenario 3	-7%	4%	-1%
Scenario 4	47%	52%	49%

Comfort:	**No Sizes**
Scenario 1	1%
Scenario 2	10%
Scenario 3	1%
Scenario 4	51%

In the table a usage of inserts would for scenario 1, 2 or 3 would lower or raise the material usage slightly depending on which size that is used. The lack of material savings for the small sizes of Flex is a result from that the absorption capacity of two inserts, 600ml exceeds the gap between the Super and the Maxi product.

Most interesting is that if the insert system is used as the PCGs intend to use it, by removing used inserts in the middle of the night and reusing the base product, would result in a 50% reduction of the use of Pulp and SAP.

7.2.2. Costs

With the use of less material there is also some cost savings to be made, these savings could for example lead to cheaper products for the consumer or greater revenues on sold products for SCA. To calculate which cost savings that can be made the same procedure was performed as for the material savings, the calculations can be seen in Appendix P.

Table 7.3 shows which cost savings that can be made for an insert system with a High SAP insert when considering the Pulp and SAP content in the products. Same calculations for the Low SAP insert shows that the savings for this insert is slightly less than for the High SAP insert, the calculations can be found in Appendix O. Since the High SAP insert appears to be the better alternative both when considering material and cost savings, therefore this insert was considered as the best one. Further tests of for example inlet capacity are although needed before a final decision can be taken. Such

tests will not be conducted within this project, these test are although recommended in if the system would be further developed.

Table 7.3, Cost savings regarding Pulp and SAP with the usage of a High SAP insert. Negative numbers equals an increased cost.

	Size			
Flex, High SAP:	**S**	**M**	**L**	**XL**
Scenario 1	7%	3%	15%	18%
Scenario 2	23%	20%	28%	29%
Scenario 3	7%	3%	15%	18%
Scenario 4	53%	52%	57%	59%
Slip:				
Scenario 1	-3%	7%	0%	
Scenario 2	10%	15%	15%	
Scenario 3	-3%	7%	0%	
Scenario 4	49%	53%	50%	
Comfort:	**No Sizes**			
Scenario 1	8%			
Scenario 2	17%			
Scenario 3	8%			
Scenario 4	54%			

In contrast to the material savings a usage of an insert system would result in cost savings for all the products except for TENA *slip* small. As well as for the material savings the largest cost savings can be made for scenario 4, where used inserts are removed and the base product reused.

Table 7.4, savings that can be made when the whole product is considered, the table only displays the savings for the Comfort product since enough data considering the TENA *flex* and *slip* products could not be acquired. The complete calculations are found in Appendix O.

Table 7.4, Cost savings considering the whole comfort product

Scenario 1	1,7%
Scenario 2	8,3%
Scenario 3	1,7%
Scenario 4	20,4%

In addition the increase of cost of the base products due to a more expensive top sheet with markings needs to be considered. Since no good estimations of how much more expensive these top sheets would be could be given, when consulting experts, this extra cost was excluded from the calculations. It was although noted that it would result in

additional costs that should be considered if more resources would be spent on evaluating a system with inserts further.

The decision to go with a glue solution as the attachment method is based on the fact that glue stripes is a cheaper solution also material wise than Velcro. The material for making the attachment method out of Velcro would be significantly more expensive than the material for making the glue solution, which would make the whole insert slightly more expensive. The calculations can be found in Appendix O.

7.2.3. Production and logistics

In order to establish how the new system should be manufactured, to estimate which investments that were necessary and which savings that could be made Lars Melin (2010), Technology Development Manager for incontinence products were consulted.

7.2.3.1. Production procedure

Lars Melin (2010) suggested that the inserts could be made in a machine similar to the ones making TENA-pads. A machine that would apply the glue stripes on the back of the insert also needed to be added to the main machine. He suggested that the markings in the base products should be printed on the top sheets. The top sheets would then be correctly matched against the base products when it was attached. This would result in that the current machinery would need to be slightly adapted in order to correctly match and attach the top sheets against the base products. Lars Melin (2010) also clarified that an insert with cropped corners would not result in a more complicated production or result in more spill. Therefore the shape stayed unchanged.

7.2.3.2. Cost estimating

A new system with insert products would require some investment in machinery in order to produce the new products. The new system would also result in some saving opportunities since the current number of articles would decrease, which would result in that there would be less transpositioning of the machinery. This would result in fewer spills and a more effective production.

In order to calculate if the investment of new machinery could be financed by savings Lars Melin (2010) suggested that a model that showed how much the effectivity should increase and how much the spill should decrease in order to outweigh the necessary investments.

Lars Melin (2010) also provided the necessary data to create such a model. He estimated that investments needed, would be: one new machine for making the insert costing approximately 1.5M€; a machine for adding the glue stripes on the inserts costing approximately 100K€, a ultrasound weld costing approximately 200K€, a machine applying the NW glue costing approximately 100K€ and adjustments to

current machinery in order to apply markings in the base product which would cost approximately 50K€/machine.

He suggested that these investments should be weighed against that an increase of effectivity and a decrease of spill, as a result of less models in production, would result in significant savings. In order to calculate the savings, information about which saving that can be made when reducing spill and increasing effectivety are needed. This information was given by SCA. The information is although classified and can not be presented in this thesis.

When calculating how many inserts that needs to be produced it can be seen that approximately 450M inserts are needed per year if each model and size is replaced by a Super product and inserts equivalent to the absorption capacity. If 450M inserts are going to be produced one new machines is needed. In addition an extension of the machine where the glue is applied, a machine for gluing the NW and a machine for welding the NW are needed. Together with the adjustments of current machinery the total cost would be approximately 3.1M€.

To outweigh this investment in one year the effectivety, for example, have to increase by 0.6% and the spill has to be reduced by 0.025%. The complete calculations can be found in Appendix Q.

Whether these improvements are possible and realistic to achieve will not be considered within this project due to the complexity of such estimation, instead these investigations are left as recommended efforts if further development will be conducted.

7.2.3.3. Logistics

An area of interest that also needs to be considered is which consequences a new system with insert products would have from a logistic point of view. Thorough calculations of which benefits that can be made by reducing the product assortment by removing Maxi and Ultima products and replacing them with inserts have not been made within this projects. Although expertise within SCA has suggested that there are significant benefits to be made from reducing the product assortment, both when considering products in stock and for transportation.

8. Results

The main objectives in this project have been to develop a system with movable inserts and to conduct an evaluation of how Professional Care Givers (PCG) perceives working with such products. In this chapter the final products is presented along with evaluations of these products. A summary what PCGs require from such system and how they perceive working with it will also be presented.

The information that has been acquired, in addition to the knowledge gained during interviews, observations and meetings, has been gained during day to day experiences at SCA and in institutions.

8.1. The complete system

During the evaluations it became clear that a system with inserts first and foremost is required to facilitate care taking during the night. Therefore the system is primarily designed to be a product suited for night usage. In total the final insert system consists of a base product with a new system aimed to guide PCGs with different levels of experience and a new insert specially designed to fit in all Flex, Slip and Comfort products.

8.2. The base product

Pictures of the final base product can be seen in Figure 8.1 and Figure 8.2. Figure 8.1 is a sketch of the final prototype and Figure 8.2 displays a picture of the final base product.

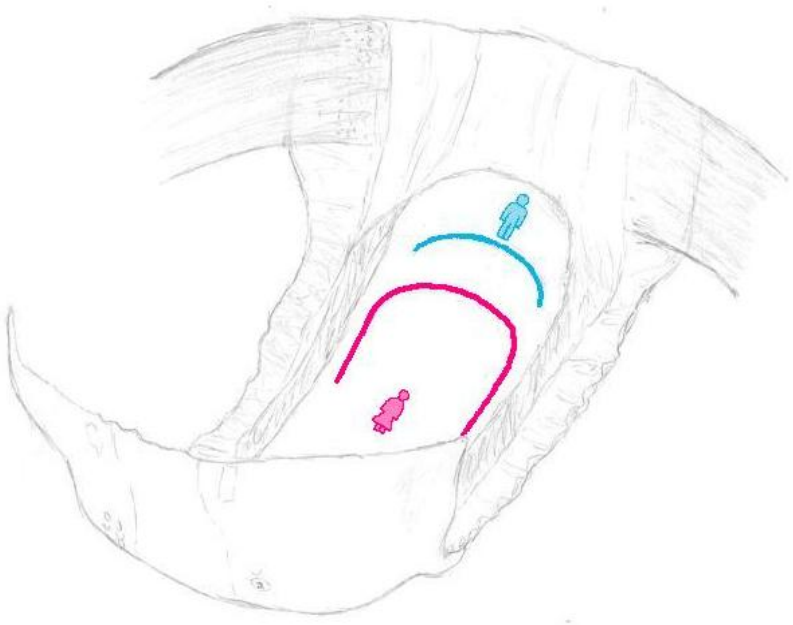


Figure 8.1, Sketch of the final base product.

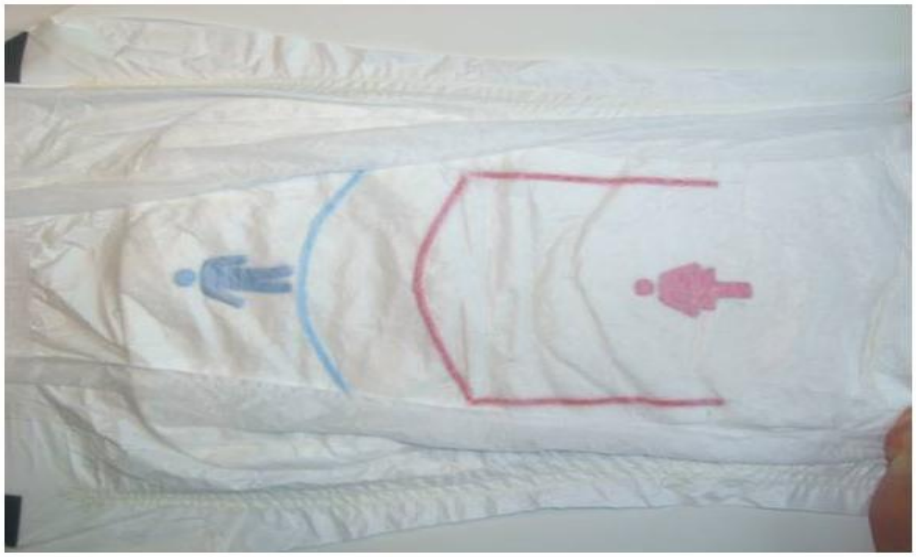


Figure 8.2, Photo of the final base product prototype.

The guidance system consists of one arc marking the placement for male users and a half contour, of the complete insert, marking the placement for women. Two symbols are also printed on the top sheet displaying which marking that considers which user. The male symbol and arc is printed in blue and the women symbol and the contour are printed in pink, in order to further clarify which markings that belong to which user. The arc representing men are placed 190mm from the centre of the product and the women contour is placed 140mm. The measurements are for a medium Flex product and they will vary depending of which size and model their printed in. If the insert is place by these markings the areas that are most exposed for the respective user group will be covered.

8.3. The insert

After two Design-Build-Test cycles and some final refinements the final shape was set to 120mm×340mm with cropped corners. The absorption capacity was set to 300ml which required a core consisting of 9.7g SAP and 9.7g pulp. The core would also be covered with two sheets of Nonwoven that would be glued onto the core giving a total thickness of 1,6mm and a total weight of 23,4gram. It is possible to capsulate the core in NW in two different ways. One procedure is to glue one sheet of NW on the top of the insert and one sheet one the bottom, then the two sheets are welded together with ultrasound around the core. In the other procedure, which is used in the specification below, one sheet of NW is wrapped around the core and sealed on the backside with a string of glue. The two ends of the inserts are sealed with ultrasound welds. The latter method looks better and is easier to produce, while the first one does not require glue. The insert specification is presented in Figure 8.3 and 8.4. (Melin, 2010)

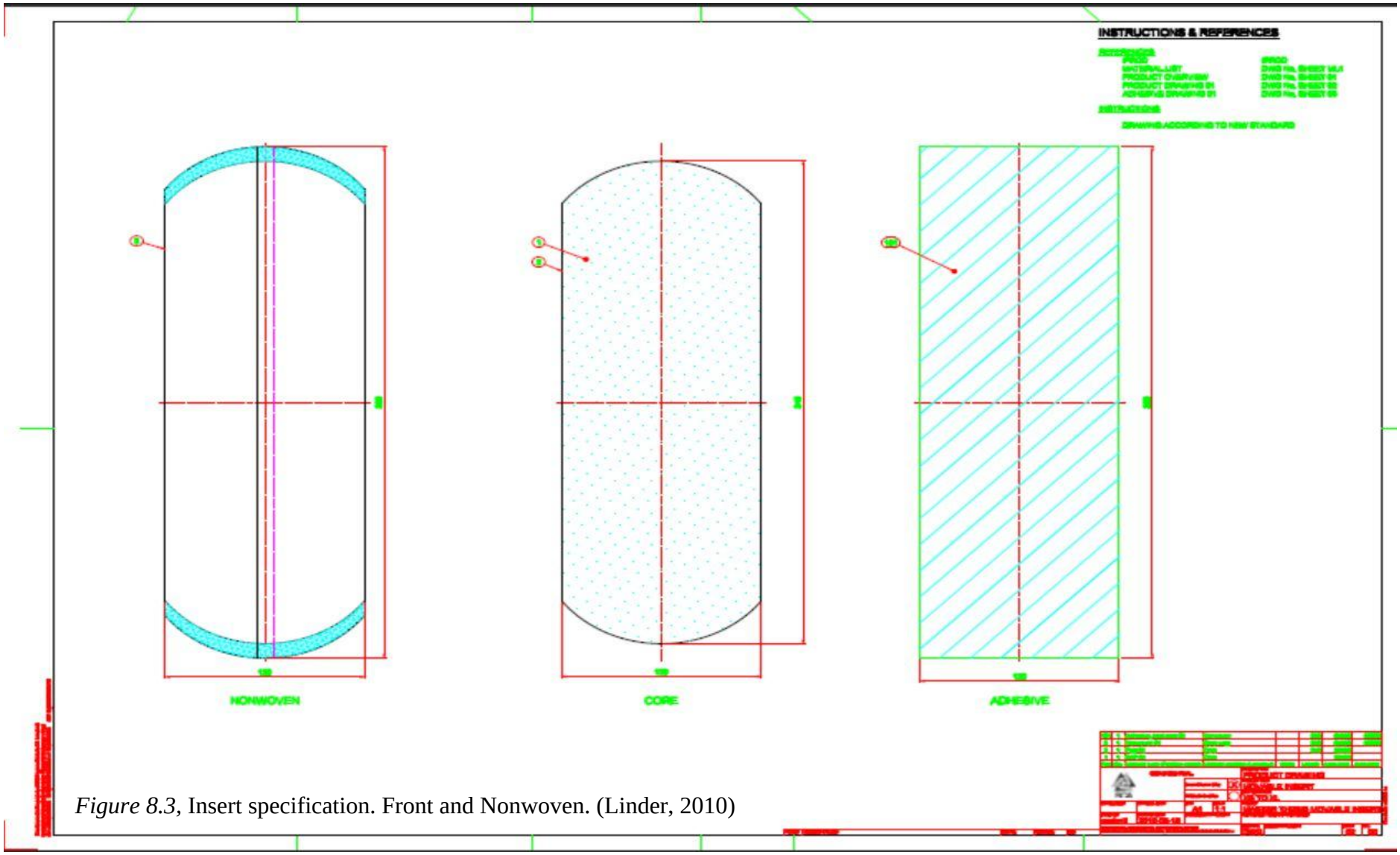


Figure 8.3, Insert specification. Front and Nonwoven. (Linder, 2010)

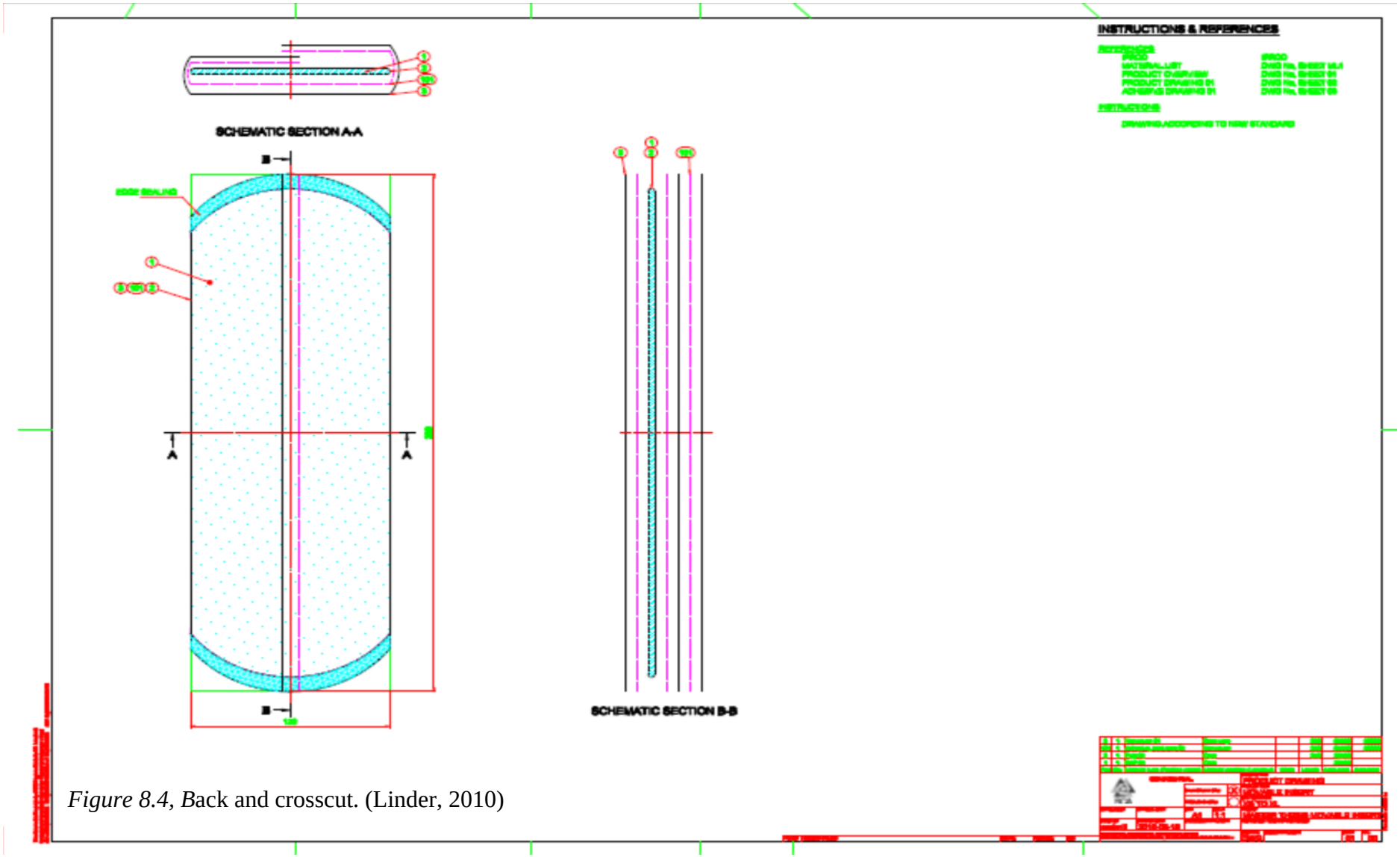


*Figure 8.4, B*ack and crosscut. (Linder, 2010)

8.4. Evaluations of the insert system

In order to evaluate what kind of opportunities a new system with inserts could result in, evaluations regarding environment, production and costs were conducted.

8.4.1. Environment

When considering the environment the fact that the new system would make it possible for the PCGs to remove used inserts and reuse base products would result in less usage of material. The movable insert system would also enable a more effective use of absorption capacity. This is possible because the inserts gives the same total absorption capacity to the whole product but with less material. These two possibilities will lead to less use of material, which is going to be beneficial from an environmental perspective because less material in total will be incinerated and stored as landfill.

A system with inserts should also be possible to package more effectively than the bulky Maxi and Ultima products, which would result in less transports and less environmental impact. In addition, a removal of all sizes of the Maxi and Ultima products would result in fewer adjustments to the machinery and less spill, which also would result in a more efficient production and less environmental impact.

8.4.2. Production

As previous mentioned an elimination of the Maxi and Ultima products would reduce the number of models within Flex, Slip and Comfort from 30 to 20 products. This would result in that the machinery can run more effectively because of fewer adjustments and that it would result in less spill. In order to finance the investment in new machinery that a new insert system would require the production would have to become 0.6% more effective and the spill will have to decrease with 0.025%, for more information about this, go back to chapter 7.2.3.2.

8.4.3. Cost

As production gets more effective, less material is needed to manufacture the products and the logistics will be improved. A result of this is that costs are going to decrease and so could also the price of the products. In addition a new system with inserts would enable the PCGs to change their routines and use fewer products, which would also lower the costs for the institutions. In summary, an insert system would enable SCA to lower prices as a try to gain customers in low price markets or keep the current prices and, if keeping the same level in sales, increase the profit.

8.5. Professional Care Givers opinion about inserts

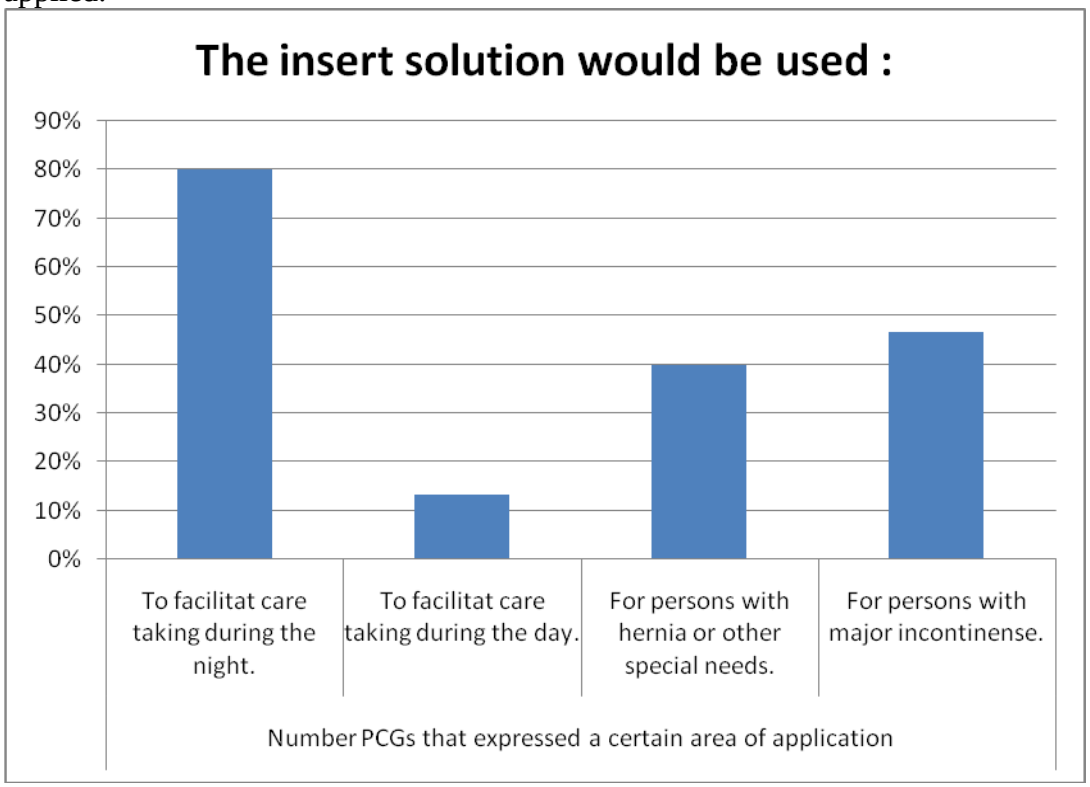
In addition to the design and evaluation of the movable insert system an investigation about PCGs opinion about inserts in general was conducted. This investigation showed that all of the PCGs had some or great experience of working with inserts. They stated that the inserts which had been used before had been of different quality and they often worked unsatisfactorily. The inserts had for example crumbled during usage and failed

to store urine exposing the caretakers' skin to urine. The inserts were even though used for some caretakers, especially during the night for patients with major incontinence problems, or for patients with other special needs like hernia. The insert products had been withdrawn and were only used in rare occasions for a few patients. One reasons given for why inserts was not widely used any longer was that the usage of inserts was not considered as ethical care taking. Another reason was that the sales persons from SCA had promoted that insert products were something that should not be used with the TENA assortment.

All PCGs did express that inserts was requested and that they would start using inserts again if it was approved and became available. The only real obstacle to start using inserts again was that no suppliers of incontinence products offered any good solutions to the problem. If good insert products became accessible they would primarily be used as an extra help for certain caretakers to facilitate care taking during nights. The inserts would give the PCGs the opportunity to just open the base products and remove the inserts and close and keep using the base product for the rest of the night. This scenario would be less disturbing for caretakers compared to an exchange of the entire product. This is also where the largest potential for a future product was found. Many caretakers have deceases and take medicines which make them aggressive and unwilling to cooperate when disturbed in the middle of the night. In addition PCGs felt sorry for some of the caretakers when needing to wake them for a change of product every night. This is the case on certain caretaker when they are using Flex, which is troublesome to change when the caretaker is sleeping or lying down.

PCGs also liked the fact that an insert solution would facilitate a customisation of the products, both because the amount of inserts could be chosen depending of the caretaker's incontinence type and because the inserts could be placed differently for women and men. The guidance system would give feedback to the PCGs if they felt uncertain where to place the insert for a certain caretaker. It would also be possible to ignore the guiding system and place the insert in a more individual way if there is a certain need. For example, caretaking men have very large differences in penis sizes and then the urine could, in some cases, be absorbed more similar to women in the centre of the base product. In table 8.1 the number of PCGs who believed a new insert system could be used within certain areas of usage is presented.

Table 8.1, Compilation of areas were the PCGs believed the insert system would be applied.



Along with their opinions on insert products the PCGs also expressed some needs that needed to be fulfilled if they were to use these kinds of products in the future. Primarily, if an insert would be used it should improve the working situation for the PCGs and be beneficial for the caretakers. The extra time invested in positioning and attaching inserts in the base product must to lead to advantages, as for example less leakage, less change of linen, less changes of products, lower costs or more individual care. Preferably the new system should grant most of these wishes. In addition the insert should be so thin that the insert combined with the base product is not perceived as bulky for the caretaker. The inserts should also distribute and absorb fluids well so that the caretaker's skin is not exposed to urine during a long period. The insert should also be soft enough to prevent chafing the delicate skin of the caretakers. In addition the insert should stay fixed in the base product during usage. Crumbling of the insert could damage the skin of the caretaker and lower the absorption capacity. Furthermore the PCGs also expressed that the insert should not in any way decrease the performance of the base products when added.

Since the PCGs mainly would use the inserts to facilitate caretaking during the night there are some needs which need to be take into extra consideration. For example should the inserts be easy to attach and not be attached to tough, so that a removal of used inserts could be performed during the night without disturbing the caretaker. The complete need specification can be seen in chapter 8.6, were also the fulfilment of all the needs are discussed.

8.6. *Fulfilment of needs*

In order to evaluate how well the new system fulfilled the needs given by PCGs and SCA the finished system was compared to the final need specification.

Table 8.2, The Final need specification

Specification of PCG and SCA needs	
1	**Possibility to provide individual care**
1.1	The insert is easy to select.
1.2	The insert facilitates a customized absorption capacity of the base product.
1.3	The insert enables a larger range of absorptions levels.
1.4	The insert increases the possibility to have the complete assortment.
1.5	The insert supports all caretakers' mobility.
1.6	The insert's guiding system works even if the base product is applied backwards.
2	**Leakage secure/Fluids & Odour**
2.1	The insert does not cause an increased number of leakage problems.
2.2	The insert prevents odor.
3	**A comfortable product**
3.1	The insert is secured in the base product during usage.
3.2	The insert does not crumble during usage.
3.3	The insert feels soft against the skin.
3.4	The base product works satisfactory as an incontinence product even without inserts.
3.5	The insert feels thinner than competing products.
4	**Keeps skin dry and healthy**
4.1	The insert feels dry against the skin during usage.
4.2	The insert does not cause allergic reactions.
4.3	The insert's guiding system does not cause irritation to the skin.
5	**Easy to handle**
5.1	The insert is easy to understand.
5.2	The insert is easy to position.
5.3	The insert is easy to attach.
5.4	The insert is easy to incinerate together with the base product.
5.5	The insert's attachment consists of as few working moments as possible.
5.6	The insert is easy to change after usage.
5.7	The insert is possible to detach from the base product.
5.8	The insert's guiding system consist of as few makings as possible.
6	**SCA**

6.1	The insert fits in both TENA slip, flex and comfort.
6.2	The insert fits in all sizes in the TENA assortment.
6.3	The insert solution decreases the complete TENA assortment.
6.4	The insert acquires less shelf space at institutions.
6.5	The insert is economically defensible to produce.
7	Overall
7.1	The time invested in matching and attaching the inserts leads to that the overall workload is decreased.

Each need was consider either to be fulfilled, unfulfilled or undecided. The last two would call for additional efforts in development and testing in the future. All needs were connected with a metric in order to have a method to check its fulfilments. The updated need-metric table and the fulfilment are summarized below and the complete fulfilment can be found in its final version in Appendix R.

To summarize it can be seen that a majority of the needs given by SCA and the ones elicited during interactions with PCGs were fulfilled, but there is also a couple of needs which have not been tested enough to say if they are fulfilled or not. In general the function of the insert system needs to be tested much more extensively in order to clarify how well it fulfils the given needs that are valid for all incontinence products. Especially tests were the function of the inserts system is tested on actual caretakers is needed.

The only need that for certain will not be fulfilled by the current insert system is the one saying that the guidance system should work even if the base product is worn backwards (will only be a concern for Flex). This need first elicited and then dropped since it required plenty of markings in the base product which contradicted the need saying that the guidance system should consist of as few markings as possible. If the base products should be able to be worn backwards and still be supported by the guidance system additional efforts are required in order to re-design the guidance system.

8.7. SWOT

To summarise and clarify which kind of effects an introduction of a system with could have a SWOT analysis was conducted.

When performing an SWOT analysis internal and external factors that could affect the new system is considered. Internal factors such as assets, capacities and resources classifies as strengths (S) or weaknesses (W), and external factors such as political, economical, social and technological factors classifies as opportunities (O) or threats (T) (Industry Canada 2008).

Table 8.1, SWOT-analysis for a system with movable inserts

8.7.1. Strengths

The possible strengths with a new system of inserts are explained further in this chapter. The subchapters logistics, production and less use of material are the three areas which are perceived as the ones were the largest changes will be made.

Logistics

As mentioned in the evaluation chapter, one of the strengths of a system were inserts replaces the Maxi and Ultima models is that it would facilitate logistics. The Maxi and Ultima models are made in sizes from XS to XL for Slip, from S to XL for Flex and one size for Comfort. If these products could be replaced by a single one the number of main articles could be reduced from 30 to 20. In addition each model and size can vary slightly depending of which market it is sold at, the differences can both be in the actual products and one the package. Therefore a reduction of main article from 30 to 20 would result in an even greater reduction of sub articles. A reduction of articles of this magnitude would facilitate the logistics since there are fewer articles to control and keep in stock (Melin, 2010).

Production

Fewer articles also results in a more effective production, since fewer time-consuming adaptation of machinery is needed. A more effective production would lead to that more articles could be produced and money could be saved. According to Lars Melin (2010),

a reduced amount of articles will also result in a more effective production with less spill.

Less use of material
In chapter 7.2.1 Environment, it is explained that a system with inserts would lead to that the total amount of material could be reduced. This is a result from that the absorption used in the products can be used more effectively, with less material in total, and the possibility to reuse base products after removing used inserts.

If the total flow of material can be reduced it is also likely that the number of transports is reduced. In addition there is a possibility that a solution with Super products and inserts could be more effectively packaged than the Maxi and Ultima products, which also would result in less transports. This will in total give less transporting of incontinence products, which will both result in less costs, less environmental impact and less products in the local storages facilities at institutions.

8.7.2. Opportunities

The possible opportunities with a new system of inserts are explained further in this chapter. The subchapters less landfill, less articles and broader assortment and facilitate for PCGs and caretakers are the three areas which are perceived as the ones were the largest opportunities for improvements are.

Less landfill
A positive effect of that less material is used is that there will be less material which needs to be incinerated or end up as landfill at the end of the lifecycle of the incontinence products. Even is Sweden does not need to store incontinence products as landfill, many countries in Europe does not have as well developed incineration stations as Sweden and most incontinence products end up as landfill. A reduction of material will result in less environmental hostile greenhouse gases such as CH_4, this development would be positive from an environmental and sustainable development point of view.

Less articles and broader assortment
A system with inserts would broaden the assortment by only adding one item to the product portfolio and removing nine. This is possible since the PCGs now would have the possibility to add exact the amount of absorption they want and not be restricted to the specific absorptions levels as before

Adding an insert product to the assortment could also be positive when competing with competitors since some of the other largest manufacturers of incontinence products has insert solutions in their assortment. Even if they have inserts they do not fulfil the needs elicited during this project. This shown that there is a potential for expansion into larger markets where inserts are used today.

Facilitate for PCGs and caretakers
A system with inserts would also facilitate for the PCGs in their day to day work. A system were the absorption level can be customised and were the inserts can be placed where they are needed could result in less leakage. Less leakage would decrease the amount of time spent on changing linen. Less leakage would also benefit the caretaker that would not be exposed to urine in the same extent.

A system were used inserts could be removed and the base product be reused would also facilitate caretaking during the night since a removal of the inserts could be performed more smoothly than changing the whole product. This would make the PCGs work easier and result in a reduction of the risk of awakening sleeping caretakers.

8.7.3. Weaknesses

The possible weaknesses with a new system of inserts are explained further in this chapter. The sub-chapters investment and adjustment of machinery, more expensive material in the base product, reluctance from SCA personnel and lower profits are the four areas which are perceived as the ones were the largest weaknesses could appear.

Investment and adjustments of machinery
One weakness of implementing a new system with insert products would be that the current machinery cannot produce the amount of inserts that could compensate for the exclusion of the Maxi and Ultima models. This would call for investments in new machinery. Adjustments and extensions would also be needed to current machinery in order to match and attach a new top sheet with markings.

More expensive material in the base products
Since the new system calls for additional markings in the base products there is a need for more expensive material in the base products. The part of the base products that would be affected is the top sheet that now needs to come with pre-printed markings. This would result in a more expensive top sheet which needs to be produced by a sub contractor.

Reluctance from SCA sales personnel
Sales personnel within SCA may be reluctant to promote insert products since they for many years have been opposed by SCA. The sales personnel have for a long period of time tried to convince the PCGs that insert products should not be used in modern and ethical caretaking. It might be a problem to convince these persons to totally revaluate their arguments, and to make them start to promote inserts.

Lower profits
If the insert system would lead to that fewer products are needed to maintain the same level of care taking it would lead to that SCA will sell fewer products and therefore lower their profits. It could possibly also lead to that a broader market is introduced to

the TENA assortment. The current market where inserts are sold today is a quite large market that could be introduced and then the profit may increase instead.

8.7.4. Threats

The possible threats with a new system of inserts are explained further in this chapter. The subchapters patent issues, easy to copy, non ethical caretaking and reluctance of usage of new products by PCGs are the four areas which are perceived as the ones were the largest threats are

Patent issues
One threat towards the new system with inserts products is that no thorough investigations of patents have been made. A patent application regarding the guidance systems and the idea to have movable inserts have been sent in, but the result of this application has yet not been received. There is a risk that the ideas are already patented which would obstruct a launch of the products. There is also a risk that there are competing products that are to similar to the insert which have not been detected during the market analysis.

Easy to copy
There is also a risk that the new system could be copied by competitors. The guidance system and the insert are both produced with well known technology and competitors could start produce similar products. If the patent would be approved there is a risk that a competitor would do minor changes to de system and thereby go round the patent and start to produce their own products. This scenario has happened before with products invented by SCA.

Non ethical caretaking
A consequence with the new insert system is that it would probably lead to that the base products are used longer and that only the inserts are removed or changed. This scenario might be a threat against the system since it among some PCGs is considered as non ethical care taking. At some nursing homes they have also decided to ban insert products based on the same reason. This might obstruct a launch of the new products.

Reluctance of usage of new products by PCGs
Another threat against a new system is that the products and the way of working with them might be unknown to some PCGs. They might therefore be reluctant to start using them which would obstruct a launch of the products. An example of this reluctance is that the Flex product has not yet been accepted at some institutions even though it has been around for over a decade.

9. Discussion

In this chapter strengths and weaknesses within the project will be discussed. The chapter will be structured in the same way as the report as a whole beginning with Introduction and end with Results. The initial chapters that consider areas within the project where there is not as much room for improvement will only be mentioned briefly.

Introduction

Within the Introduction the projects Background, Purpose, Objective and Delimitations are considered, in retrospect these four guidelines showed to be adequate for the project and helped keeping the project on a straight path. The Objective and Scope were slightly modified trough the project, which seems natural when considering the lack of knowledge that was possessed by the project group in the beginning of the project. The scope was set after a meeting with the Master's Thesis supervisor at SCA. The Swedish market was set as an objective that could represent the European market. With this in mind there is a risk that Sweden is not a good representative for entire Europe, since the Swedish market is so well developed within institutionalised care for elderly. This was although the choice because of other limitations, such as economy and time. All in all the guidelines stated in the beginning of the project were followed and the Purpose of the project was fulfilled.

Theory Framework

This chapter was created to ensure that a reader who possessed limited knowledge about the product development process, SCA, incontinence etc. should be able to understand the report as a whole. Since the project group had to bury themselves within this theory it was also ensured that proper methods and procedures were used in order to end up with a satisfactorily result. All in all the Theory Framework is a well structured document based on well known literature that gives a solid knowledge base for someone who wishes to repeat the process of this project.

Method

The Method chapter generally sums up the line of actions that were taken during the project. It provides the reader with a brief introduction of what can be expected in the rest of the report and of what has been conducted within the project. When it comes to the specific methods chosen for this project it can always be discussed if other methods would have given a different result. Because the developed product did not contain any technical functions and was based on customer perceptions, the general product development methodology could not be applied exactly as it was found in literature. Instead the literature was adapted to the specific project and together with all knowledge within SCA the specific development process was chosen. Looking back there could be information which was never introduced into the project and therefore could not be evaluated by customers. This risk is always present when a new system is developed, where needs cannot be solicited before the first round of prototypes.

Pre-Study
During the Pre-study, all pre-work to the actual Master's Thesis was conducted. Having this in a separate phase gives the opportunity to explain in which areas where the most uncertainty was present, what knowledge that was given to the development team and what additional information that was needed before the development could start.

Research and Analysis
The goal with this phase was to gain all information needed in order to start the development phase. The information needed was extensive because the development team did not have any experience or knowledge about the area of interest. During the market analysis, experts within SCA presented a list of competitors. When conducting the search for competing products all these companies WebPages were investigated. There is a risk that some product could have been overlooked, which would result in that they never were ordered and implemented during the idea inventory. Furthermore, during the early customer interviews the Professional Care Givers (PCGs) were chosen after a recommendation from SCA sales personnel. The PCGs chosen were looked upon as leading customer who had a willingness to cooperate and develop new products. There is a risk that these PCGs are not representative for the general PCG, which might have affected the view of PCGs that was gained during these meetings. In addition the PCG interviews were conducted during their work hours and some information could therefore have been lost due to these circumstances.

During the in-house meetings, the knowledge from certain staff within SCA worked as a base for the upcoming development. There is always a risk when conducting an interview, that some knowledge never is gained. This fact was minimised after complementing the research with internal PowerPoint slides and reports from meetings within certain areas of interest.

Because of the nature of the developed product, specific needs were hard to elicit before developing the first prototypes. The more general needs had although been elicited by SCA already through a very broad research and together with SCA's needs they formed the initial specification of needs. Because of this there could be a risk that some ideas did not follow into the first prototypes and which could not be evaluated by the PCGs. The evaluation conducted showed which of the developed prototypes the PCG liked the best and that was why the final Design Build Test cycle was so important in order to form a final prototype which fulfilled all needs.

Finally the areas of importance elicited during the sequence of user action did guide the following development. The sequence of user action is a method adapted for products which consists of much user interaction and few technical functions. The actual analysis results can be discussed but the obtained areas were perceived as interesting for further development since no direct knowledge existed within these areas at SCA. It was necessary to divide these interesting areas into smaller sub-areas in order to focus the

development work on the more crucial and important sub-areas which would facilitate the work for the PCGs.

Development

The development phase started with the calculation of the shape of the insert. There were a few needs and a lot of material which made it possible to decide the shape without the PCG's opinions.

The decision to have two Design-Build-Test (D-B-T) cycles resulted in a better product than if just one cycle had been used. Looking back there will probably need for at least one additional D-B-T cycle in order to able to secure undecided needs concerning the absorbing functions of the insert system. During the initial D-B-T cycle the foundation for the following cycle was built. The internal brainstorm was complemented with ideas from the idea inventory. Together they constructed a large idea base which after elimination and integration formed the first classification trees of ideas. The elimination at this stage was made together with the project supervisor since no customer needs existed. Therefore it was of a crucial importance to gain knowledge and experience to try to find the most promising ideas to form concept of. There is a risk that an elimination process conducted in this fashion may have resulted in that a few ideas were eliminated which could have shown to be better solutions at the end.

The final D-B-T cycle handled the feedback from the first cycle and focused on the area of easy usage and guidance. This area was also the area of importance during the external brainstorm. The brainstorming session resulted in many ideas. Because the development had come so far, many of the ideas was outside of the updated scope and could not be implemented. It would perhaps have been better to have the large brainstorm in the beginning of the project in order to find all the crazy and innovative ideas before narrowing the scope.

Finally the evaluation was conducted in a well planned and structured manner. The number of interviews conducted gives a trustworthy result. The last interviews elicited similar information as the first ones. This is an indicator that the most important information has been elicited since no new information is given even if the number of interviews increases. The chosen procedure worked very well and all PCGs could both handle the inserts and answer the questions.

Results

When considering the final results of this thesis there are a few areas which are important to discuss. These areas will results in recommendations to SCA. First of all the guidance system is presented in a TENA *flex* medium and the distance between the arcs are applied specific for this model. The placement of the guidance system needs to be calculated for each model and sizes independently because they are applied and look different from each other. In addition the guidance system may not be needed in the smallest incontinence products while it is more important in the largest products.

The developed guidance system was perceived as necessary by the PCG, but still a majority did not use the system when placing their inserts for specific users. The need for guidance was mainly for more inexperience users but because no inexperience users were interviewed the guidance system still needs to be evaluated further, in order to find the correct amount of information that is needed for this kind of system.

The specific absorption capacity of the insert was set to 300 ml for the material mixture of SAP and Pulp. The specific mixture and density of the insert was chosen in collaboration with the project supervisor who is an expert within absorption. Even if the insert's function needs to be tested further the experienced expert predicts that the insert should work satisfactory in its present shape and material combination.

The main needs and advantage gained from the evaluation was to be able to remove a part of the incontinence product easily during the night. This was perceived as important to not disturb the caretaker. This action could be solved by using inserts, but also by using some sort of incontinence product with a removable layer which could be removed during the night and still could be able to absorb fluids until the morning.

Finally, all calculation about savings and costs within production has been based on assumptions made by expert working at SCA. If these assumptions would be wrong then the calculations, in some cases, would give a false final result. Therefore the assumptions would need to be controlled further.

10. Recommendations

The result of this thesis has a few loose ends which need to be investigated before or during, further development of movable inserts. The recommendations both cover areas that have been elicited during the project and some areas that have been investigated throughout the project, but still needs further investigations. The most important recommendations for SCA are presented in this chapter.

First of all it needs to be investigated how large the amount of information that is necessary for a system of inserts to work satisfactory in institutions. Preferably the information could be divided between being in the base product, on the package and perhaps also being presented by sales personnel during customer visits or thrue the SCA homepage. The information may also need to be different for different models in the TENA assortment. For this to work in reality it is crucial to gain the trust and interest from SCAs' sales personnel. Today, the sales personnel are promoting how bad inserts are for the caretaker. The new system should not be promoted in this fashion since the inserts and the base product are developed to work together as an even more secure product.

The PCGs requires that a system with movable inserts is absorbing fluids at least as efficient as the TENA products are doing today. The actual absorbing function of the inserts, when applied in the base product, need to be further tested. Preferably the tests should be preformed both in a lab environment and in institutions. Furthermore, glue is a well known attachment method when it comes to pads, which are attached in panties. There still need to be an investigation to see if the same glue satisfies all needs elicited for inserts products which are exposed to much more fluids. If the attached insert is attached enough to be secured during usage but still is easy to change without disturbing the caretaker during the night also need to be tested.

In addition is it crucial to further examine how a change or removal of an insert can be facilitated. One of the most important problems elicited for the *Flex* model is when a change of insert is required and the caretaker is lying down. One idea is to have more elastic materials in the waiste are, like in the *Pants* model, in the *Flex* model. This would facilitate a change of insert without opening the product by just expand it in the front or back, resulting in less need to turn and wake the caretaker.

The design of the base product and insert could also be optimized so that the inserts fits better in TENA products than in competing ones, which would enable SCA to sell more products and prevent that the PCGs uses competing inserts in the TENA products.

Finally the needs of being able to remove the insert in the middle of the night could possibly be addressed by some other, today not existing, product. The product could be based one of the TENA products that exists today, but constructed with a removable top

layer which is easy to take off and leaves an unused part in the base product. There has also been a need from SCA saying that the insert should facilitate a change when faeces are involved. This area was left out of this project and still needs to be further investigated before the full potential of a movable inserts can be determined.

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TENA (2010b) Informationscenter Kvinnor (Electronic) Available: <http://www.tena.nu/Kvinnor/Informationscenter/> (2010-05-12)

TENA (2010c) Produkt sortiment (Electronic) Available: <http://www.tena.nu/Kvinnor/produkter/produktsortiment/> (2010-03-15)

Personal Communication

Brogren, M., (2010) (Associate Scientist) Meeting 2010-03-26 at SCA

Fylke, J., (2010a) (International Marketing Manager) Meeting 2010-01-26 at SCA

Fylke, J., (2010b) (International Marketing Manager) Meeting 2010-03-17 at SCA

Melin, L., (2010a) (Technology Development Manager) Meeting 2010-04-29 at SCA

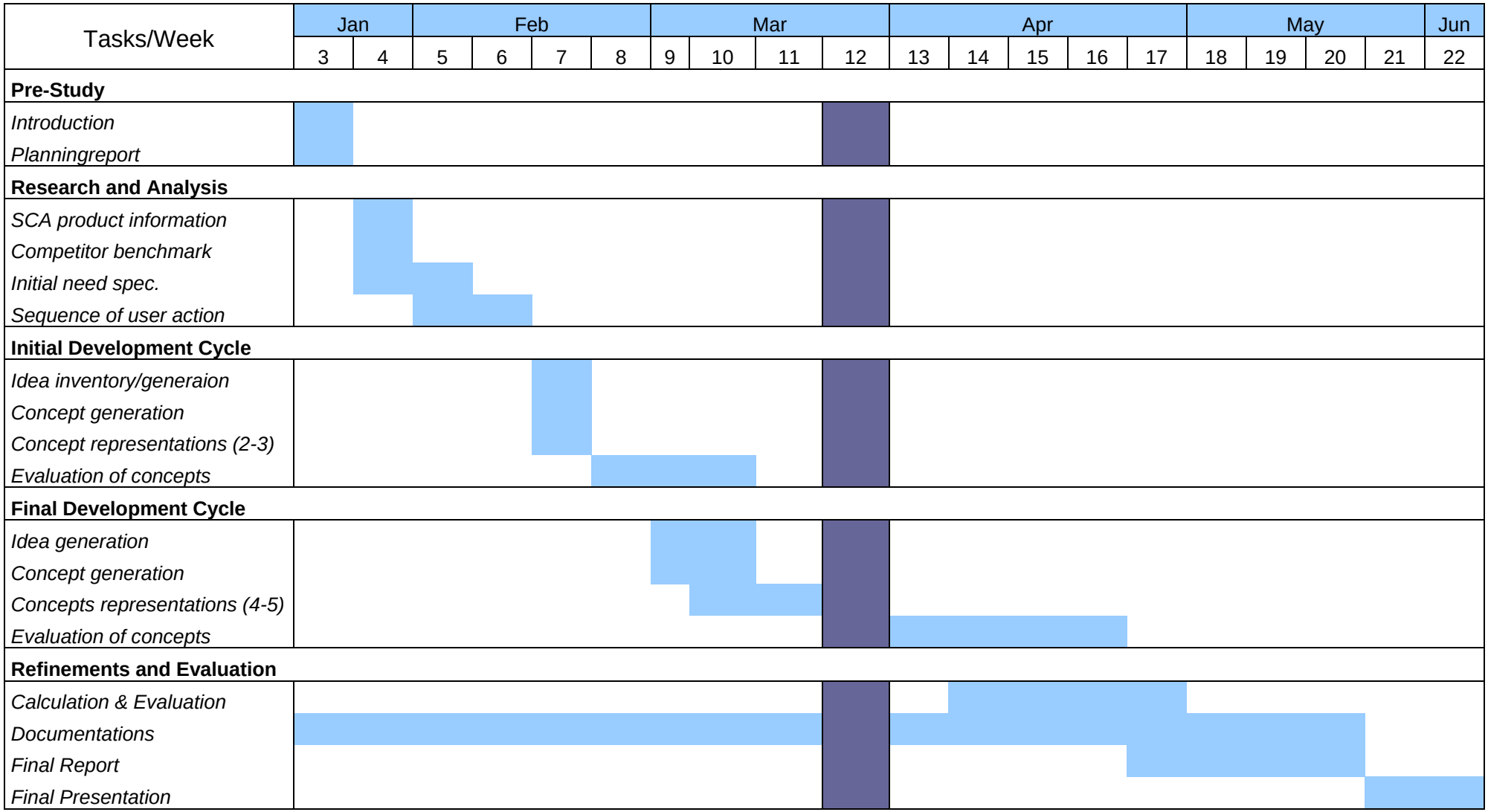
Melin, L., (2010b) (Technology Development Manager) Meeting 2010-05-24 at SCA

Spak, B., (2010) (Environmental Specialist) Meeting 2010-02-16 at SCA

Vartiainen, K., (2010) (Associate Scientist Applied Absorption) Meeting 2010-01-21 at SCA

Wikström, L., (2010) (Senior Lecturer at Chalmers in Design and Human factors) Meeting 2010-02-23 at Chalmers

Appendix A – Gantt chart



Appendix B –Competing insert products

Asia

Hakujuji, Available: http://www.hakujuji.co.jp/products/diaper/diaper03.html, (2010-02-18)

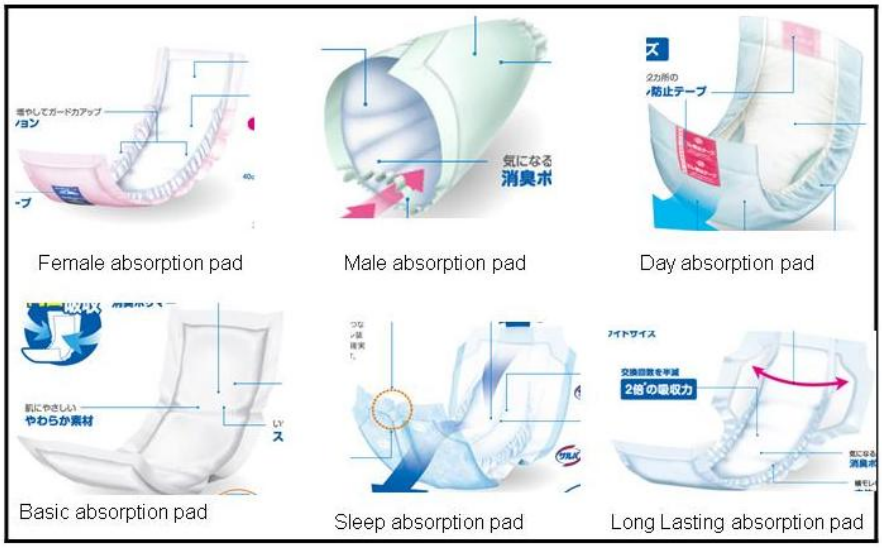


Figure B1, Examples of Hakujuji's insert products

Unicharm, Available: http://www.unicharm.co.jp/english/corp/profile/, (2010-02-18)

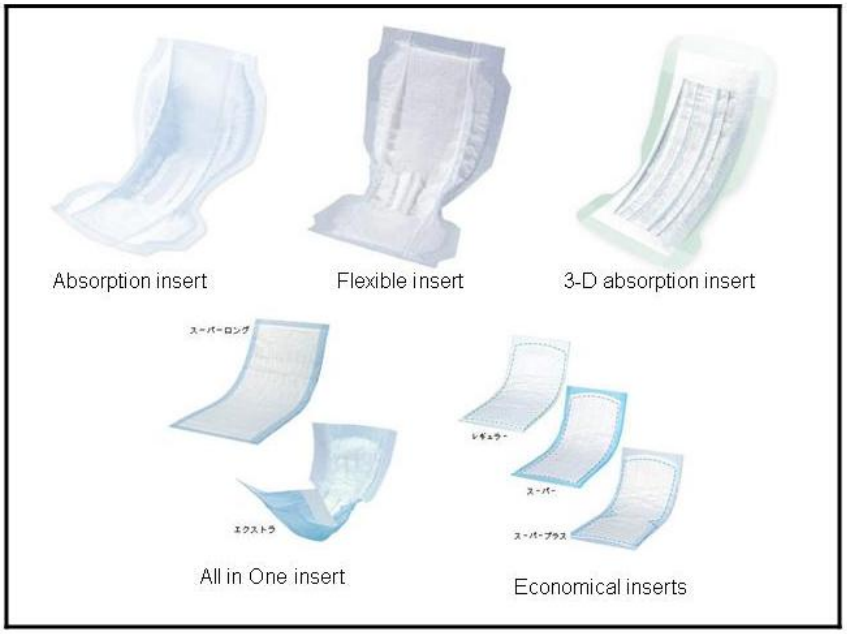


Figure B2, Examples of Unicharm's insert products

Europe

Abena, Available: http://www.abena.dk/Om%20Abena/Historien.aspx , (2010-02-18)

Figure B3, Abena's insert products

Hartmann, http://en.hartmann.info/, (2010-02-18)

Figure B4, Hartmann's insert product Strampelpeter

TZMO, Available: http://seni-global.com/content/ff_home, (2010-02-18)

Figure B5, TZMO's insert product

Usa

Attends,
Availabel:http://www.kendallhealthcare.com/kendallhealthcare/pageBuilder.aspx?topicID=81041&breadcrumbs=0:121623 (2010-02-18)

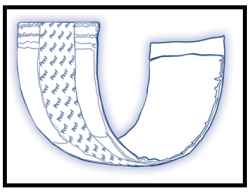


Figure B6, Attends insert product

K-C, Available: http://www.us.depend.com/Female/Incontinence-Products/ProductDetailBoostInsertsForWomen.aspx, (2010-02-18)

Figure B7, K-C's insert products Depend Booster insert

Appendix C – Need-Metric

Table C.1, Needs sorted (Ulrich & Eppinger, 2008).

No.		Need	Imp.	Owner
1	The insert	does not cause an increased number of leakage problems.	4	PCG
2	The insert	feels dry aginst the skin during usage.	4	PCG
3	The insert	is economically defenceable to produce.	3	SCA
4	The insert	does not cause allergic reactions.	5	PCG
5	The insert	feels soft aginst the skin.	4	PCG
6	The insert	prevents odour.	3	PCG
7	The insert	is able to incinerate together with the base product.	4	PCG
8	The insert	is easy to select.	4	PCG
9	The insert	is easy to understand.	5	PCG
10	The insert	is easy to position.	4	PCG
11	The insert	is easy to attach.	4	PCG
12	The insert	fits in both Slip, Flex and Comfort.	5	SCA
13	The insert	fits in all sizes in the Tena assortment.	5	SCA
14	The insert	solution decreases the complete TENA ssortment	4	SCA
15	The insert	aquires less shelfspace at local nursing homes.	3	SCA
16	The insert	is secured in base product during usage.	5	PCG
17	The insert	enalbes a larger range of absorbtion levels.	5	SCA
18	The insert	increases the possibility to have the complete assortment.	5	SCA
19	The insert	facilitates a customized absorbtion capacity of the base product.	5	PCG
20	The insert	is possible to detach from the base product.	4	SCA
21	The insert	does not crumble during usage.	4	PCG
22	The insert	supports all patients mobility	4	PCG

Table C.2, Each need connected (Ulrich & Eppinger, 2008).

Metric No.	Need Nos.	Metric	Imp.	Units
1	8, 9,10,11	Time for assembly	5	s
2	1, 2, 3	SCA test	4	Result
3	17, 19	Absorbtion capacity	5	ml
4	14, 18	The TENA assortment	3	Binary
5	15	Shelfspace aquired	3	m3
6	12, 13	Test of fit	5	Binary
7	20	Attachment strength	5	N
8	1, 16, 21, 22	Usage test	5	Binary
9	4, 5, 6, 7, 14	Incontinence materials used by SCA	5	List
10	8 , 9, 10, 11	Failures during assembly	5	Nr.

Table C.3 Need-Metric table (Ulrich & Eppinger, 2008).

		1 SCA test	2 Incontinence materials used by SCA	3 Time for assembly	4 Failures during assembly	5 Test of fit	6 The TENA assortment	7 Shelfspace required	8 Absorbtion capacity	9 Usage test	10 Attachment strength
1	Does not cause an increased number of leakage problems.	●								●	
2	Feels dry aginst the skin after usage.	●									
3	Is economically defenceable to produce.	●									
4	Does not cause allergic reactions.		●								
5	Feels soft aginst the skin.		●								
6	Prevents odour.		●								
7	Is able to incinerate together with the base product.		●								
8	Is easy to select			●	●						
9	Is easy to understand.			●	●						
10	Is easy to position.			●	●						
11	Is easy to attacht.			●	●						
12	Fits in both Slip, Flex and Comfort.					●					
13	Fits in all sizes in the Tena assortment.					●					
14	Solutions decreases the complete TENA assortment		●				●				
15	Aquires less shelfspace at local nursing homes.							●			
16	Is secured in base product during usage.									●	
17	Enalbes a larger range of absorbtion levels.								●		

18	Increases the possibility to offer individual care.	●
19	Facilitates a customized absorbtion capacity of the base product	●
20	Is possible to detach from the base product.	●
21	Does not crumble during usage.	●
22	Supports all patients mobility	●

Appendix D – Idea inventory, Competitors

Table D.1, Smart ideas found during the idea inventory of competing products.

Area of interest	Re. no.	Name	Company	Country	Description
Attachments	*32314*	*Ufree long lasting*	*Unicharm*	*Japan*	*Velcro. Very small attachment in one end of product. Enables multiple attachments on base product.*
	32547	*Day*	*Hakujuji*	*Japan*	*Two adhesive areas, one in each end. Good for attachment in Pants and other closed products. Edges are shaped to extend standing gather on base product.*
	32548	*Urine salva*	*Hakujuji*	*Japan*	*Centered strip with strong adhesive area which allows pad to be used in both Pants and regular underwear.*
	26437	*Booster pads*	*Attends*	*USA*	*Centered strip with adhesive area and protecting paper which is removed when used. Enables multiple attachments on base product.*
	32316	*Dr. P insert pad*	*Ever Beauty*	*Taiwan*	*Small adhesive area in front of product with protecting paper. Enables multiple attachments on base product.*
	-	*Diginity*	*Stackables*	*USA*	*Very strong centered adhesive area. Peel protective paper, patented solution?*
	-	*High capacity pads*	*Tranquility*	*USA*	*Extra material around pad in NW which is used to attach product into protective pants.*
Easy usage	*31029*	*Serenity*	*Artsana*	*Italien*	*Symmetry. Rectangle shape makes it easy to use product. Does not matter which way it is applied.*
	32284	*Ufree absorbing pad*	*Unicharm*	*Japan*	*Asymmetry. Makes it easy to undestand which way it suppose to be used, back/front etc.*

	26437	*Booster pads*	*Attends*	*USA*	*Allows for several pads to be mounted on top of each other. Easy to use and the protecting paper is easy to remove and product easy to handle and use (small).*
	32548	*Urine salva*	*Hakujuji*	*Japan*	*Protecting paper, for adhesive area, has guiding marks for easy use.*
	32547	*Day*	*Hakujuji*	*Japan*	*Two adhesive areas, one in each end. Good when folding product for disposal. Adhesive areas can be used to fold product into itself.*
	31733	*Urine relieve pad*	*Attent*	*Japan*	*Large guiding pictures showing who to apply product in base product.*
	32545	*Night Long*	*Hakujuji*	*Japan*	*Packed folded so that the "Tena viket" is not necessary before usage. The product is glued together in front making a "hole" for securing leakage and creates a good way to grab the product when changed.*
	-	*Topliner booster contour pad*	*Tranquility*	*USA*	*Coloured inside abs. Area. Makes it easy to understand which way to use.*
	-	*Extra duty abs. Pads*	*Dignity*	*USA*	*Two pads which are attached together, makes it easy to stack on eachother and easy to cut and use as singels.*
Customised protection	*70150*	*Abri-let Super*	*Abena*	*Danmark*	*Able to add multiple pads for adjustable absorption, non-plastic backcover.*
	32285	*Ufree absorbing pad*	*Unicharm*	*Japan*	*Separate product for men/women, the super abs. Area on the product is moved according to who the user is. Specific shape to fit men/womens' bodies better. Also got different products for day and night.*
	32547	*Day*	*Hakujuji*	*Japan*	*Pad is easy to move in base product and can be added further forward for men where more absorbtion is needed.*

	32320	*Ufree long lasting*	*Unicharm*	*Japan*	*Special solution for men, wrapping product around the penis. Making a package.*
	32548	*Urine salva*	*Hakujuji*	*Japan*	*Shaped so that when reversed it works better for men and women.180 degree turn.*
	32545	*Night Long*	*Hakujuji*	*Japan*	*A pee channel leads fluid back into a super absorbing area in front of product. Consists of a Day-long product aswell, with less absorbing area for day use.*
Communicate premium	*31043*	*Lindor rectangle*	*Ausonia*	*Spanien*	*Indicates when it is time to change product.*
	32277	*Ufree absorbing pad*	*Unicharm*	*Japan*	*Technically advanced solution, man different materials used in same product. Also many different colours used, blue, geen and white.*
	-	*Booster liner*	*Depend*	*USA*	*Packed in separate small NW bags. Makes the product seem more exclusive and new, bad enviromental solution.*
	32284	*Ufree absorbing pad*	*Unicharm*	*Japan*	*When looked upon into the light a specific absorbing area appears. When tested alot of fluid (water) is absorbed in this area. Colours white and pink.*
	32545	*Night Long*	*Hakujuji*	*Japan*	*All edges are folded in instead of just sticking out, looks comfortable and more professional.*
Handle faeces	*32545*	*Night Long*	*Hakujuji*	*Japan*	*The product is glued together in middle, in front. This makes the edges stand up and catch leaking fluids. The standing gathers, edges, are ended with a pocket, front/end, which stops leakage.*
	32277	*Ufree absorbing pad*	*Unicharm*	*Japan*	*Mechanical storage of faeces. Several threads making a 3D pattern with walls going across the absorbing area.*

	32314	*Ufree long lasting*	*Unicharm*	*Japan*	*Very high sidewalls which create a feeling of a bag which will store faeces in a good way.*
	31733	*Urine relieve pad*	*Attent*	*Japan*	*Large holes in top sheet allows for faeces to go through?*
Feel comfortable	*32284*	*Ufree absorbing pad*	*Unicharm*	*Japan*	*Body-shape. Enales a wider protection for men in one end and a more narrow for women in other. Designed to fit the body better.*
	-	*Briefmates*	*Dignity*	*USA*	*Small insert pad which is shapable for better fit and protection. Stays shaped when released*
	32313	*Ufree regular insert pad*	*Unicharm*	*Japan*	*Shaped as a bowl with high walls protecting against leakage. Give impression of a bowl.*

Appendix E – Idea inventory, IDEUM.

This appendix can not be displayed due to SCA's secrecy policy.

Appendix F – Initial internal Brainstorming

This appendix can not be displayed due to SCA's secrecy policy.

Appendix G – Interview documents, Initial Test Cycle

Evaluering 1- Loop 1, Bagaregården 5A 2010-03-09 klockan: 14.00 – 15.30

Annelie Utbildning: Undersköterska Erfarenhet: 25 år	**Ulla-Karin** Utbildning: Undersköterska Erfarenhet: 23-24 år

Huvudfokus idag:
Utvärdera dellösningar inom fastsättning samt informationsbärare. Testa koncept och uttryck spontana reaktioner om enkel användning.

Delfokus idag:
Utvärdera hela konceptet med att arbeta med ilägg.

1. Förklara vad vårt arbete går ut på.
”Detta måste vara så enkelt som möjligt om det ska fungera” – UK
”Tyngre personer, skönt att slippa byta allt varje gång” – A
”På natten kan detta vara bra” - A

2. Fastsättning
”Måste ju sitta bra även om det blir blött” – UK

- **Adhesive (Limremsa) Tunn vs. Bred**

”Finns det kemikalier i limmet som kan skada användaren?” – UK
”Håller det om det blir vått?” – UK
”Det blir ett moment extra med skyddstejp, jag vill ha så få moment som möjligt” – A
”Först dra av, sen placera, sen trycka till – Nej, detta blir för många moment extra” – A
”Om förlimmade – Svårt om de ligger högt upp på hyllan, då måste man ha den bra placerad från början.” – A

- **Two component (Kardborre)**

”Positivt att det ej är ett extra moment, bara att sätta dig – Enkelt!” – A
”Det fungerar ju bra, men hur blir det när ytan är blöt?” – UK
”Det går ju ej att dra ur vid byte, fastnar!” – UK
”Kan funka bra när blöjan öppnas vid byte vid toaletten” – A
”Funkar bra slipper trycka till så mycket” – A

- **Friction (Skumgummi)**

”Bara den ligger still där man lägger den.” – UK
”Vid toalettbesök kan detta ilägg lossna och trilla av.” – A
”Får inte flytta och vecka sig, veck kan skada äldres känsliga hud” – UK

3. Informationsbärare

”Vi behöver en person som kommer hit och förklarar hur man skall använda systemet, annars lyssnar vissa inte” – A
”Räcker inte med information på förpackningen, på natten kan det ju vara mörkt” - A
”Produkterna ligger ju lösa på hylla vid vårdtagarna” - A

- **Empty (Ingen)**

”Vi som arbetar med det dagligen hade nog fattat, men det kommer ju nya ibland och på sommaren, de vet ju inte hur det fungerar.”-UK
”Är ju käckt om man kan se var den ska ligga.” – A
”Det ska ju vara så enkelt å smidigt som möjligt, ska inte behöva leta upp informationen”- UK
”Info kan ju glömmas bort på vägen.” – UK

- **Pad (Skyddstejpen)**

”Det känns inte bra med skyddstejpen, extra moment” – UK
”Denna tycker vi inte om” – A
”Det ska vara smidigt, det är denna inte” – UK
”Hur blir detta med 3 ilägg eller kanske 5, dra bort skyddstejpen på alla? – Då kommer man kanske glömma/eller strunta i att dra bort på alla och då kan det kanske bli vått å instängt, bildas svamp kanske – Inte bra” – A
”Drar man bort en skyddstejp, blir det extra skräp som skulle kunna hamna i sängen!” – A

- **Base**

”*Väldigt tydligt och enkelt” – A*
”Bara alla känner till vad det är bra för” – UK
”Bra idé att ha olika positioner!” – A
”Fanns ju barnblöjor förr med denna funktion, för pojkar å flickor” – A
”Då vred vi bara på blöjan när de skulle sitta upp” – A
”Bra med tre olika nivåer, det behövs en speciell för natt” – A

- **Pad + Base**

”Här ska vi lägga den eftersom det är blå tråd – det är ju för man” - A
”Det kan vara väldigt obehagligt att sitta på denna hårda linjen” – UK
”Förlorar ju absorption i hålet, kan ju inte vara bra” – A
”Bättre utan hålet tycker jag, enklare på många sätt, måste ju vara billigare att tillverka också, slippa göra ett hål och måla en linje!” – A
”Många äldre har mycket skör hy, kan får inte vara något hål eller text på paden, kommer skada deras hy” - UK

4. Vad känner ni för att arbeta med ilägg?

- **Har ni arbetat med ilägg någon gång**? *”Vissa har även om man inte borde.” A*

”Ilägg med plastbaksida har använt, har funkat dåligt och orsakat läckage istället.” – A

”Förr gjorde man egna ilägg för männen med sängunderläggen, man klippte ett hål i underlägget och gjorde ett paket runt snoppen” – A

- **Vad har ni hört om ilägg**? *”Det är inte bra, de är våta som disktrasor mot hyn.” - UK*

”Bra att slippa jobba med ilägg – Men bra då någon har ett extra stort urinläckage” – UK
”Det blir ju ett extra moment, det kommer vi inte ifrån” – A
”Plats för iläggen, då behöver vi ju en extra hylla inne på toaletterna” - A

- **Vad ser ni för fördelar?**

”Behöver inte byta lika ofta” – A
”Tunnare och smidigare basprodukt, kan ju användas för dem med litet läckage- UK
”Bra att kunna anpassa efter den nivå som behövs och bra att ha olika placering”- A
”Bra med placering speciellt för män där har vi haft problem innan med att det har läckt ut på sidorna där framme” – A

”Bra på natten då endast ett ilägg kan tas bort, detta skulle inte störa den gamle lika mycket som ett helt byte” – A
”Bra får såna med extra mycket inkontinens” – UK

- **Vad ser ni för nackdelar?**

”Extra moment” – A
”Fler delar – hur många ilägg ska jag ta, 3 eller 5?” – UK
”Inte bra med skyddstejpen en kardborre fungerade ju bra.” – A
”Man kan slippa ett fullt byte kanske, bara att dra ut ilägg och fortsätta ha basprodukten?” - UK
”Kan vara lite krångligt och leda till problem när olika vårdgivare använder produkterna på olika sätt” – UK

5. Skulle ni kunna tänka er att arbeta med ilägg i framtiden?

A – ”Ja”
UK – ”Kanske”

- **Vad skulle kunna motivera det där extra arbetsmomentet?**

”Om det fungerar BÄTTRE än idag.” – UK
”Måste finns en klar fördel med att byta, för oss och vårdtagaren.” – A / UK
”Bättre än idag måste det ju bli, annars ingen idé att byta” – A
”Färre byten.” – A
”Inte störa vårdtagaren på natten, bara ta ur ilägget är en bra idé.” – A

”Det kan ju påverka flera saker, kanske kan byta lakan färre ggr och byta underlägget färre ggr, då kan det vara värt det” – A

- **Kan ni se det användas i er nuvarande miljö?**

”Det finns inte plats på hyllorna i nuläget” – A
”Man kan kanske ha en automat på väggen där man trycker ut sina ilägg?” – UK
”om måste finnas på hyllorna och dessutom ska de vara lätta att nå” – A

6. Om ni tänker tillbaka på de koncept ni fått titta på, vilken lösning kan ni tänka er att arbeta med?

”Inga trådar, det kommer skada vårdtagarnas köra hy.” – A
”Vi gillar den med kardorre.” A
”Ja den med kardborre och den med linjerna, den va lätt att förstå.” – UK
”En med kardborre, utan hål och linjer som kan skava” – UK
”Vore bra om iläggen fanns i flera tjocklekar, så slapp man ta massa ilägg för de med stort urinläckage.” – UK
”Ja flera tjocklekar vore bättre än en tjocklek” - A
”Lim utan tejp eller kardborre är ju bäst, man slipper ett till extra moment” – A

ÖVRIGT

”Hur kommer ert ilägg bli när det blir blött?” – UK
”Jag vill inte få tag i ett ilägg som känns sladdrigt, får inte gå sönder i min hand” – UK
”En idé – kunna ta bort ilägget på natten och ha kvar endast basprodukten, håller absorptionen för det?” – UK
”Det är trångt med hyllor redan idag, vissa har fler hyllor och det är trångt och hemskt.” - A
”Det är ju fullt idag efter att jag har beställt.” – UK
”Ligger iläggen högt upp kommer det vara svårt att ta rätt antal.” – A
”Allt ska vara så lättarbetat som möjligt, det är bra både för personal och de äldre.” – UK
”Man ska inte behöva komma på egna lösningar, det är viktigt med bra information.” – UK
”Saker ligger på lagret som inte används, det e ju inte bra men man vill ju inte slänga något” – A
”Blöjan måste kunna klara sig bra utan ilägg, så man kan ta ut ilägget på natten och fortsätta använd blöjan” – UK
”Det går ju ej att dra ur vid byte, fastnar!” – UK
”Viktigt att blöjan sitter bra även när man använder ilägg.” -A

Kan det finnas en fördel med att ha hela sortimentet?

Kan det vara ett problem att ha mans- och kvinnosymboler samt bara en nattsymbol?

”Nattsymbolen är ju för alla, det förstår man ju” – A

Vad betyder smidigt för er?

”Lättarbetat för oss och boende – Så att de kan sova utan att bli störda” – UK

Evaluering 2 - Loop 1, Bagaregården 5B 2010-03-16 klockan: 12.00 – 13.30

Nanna Utbildning: Undersköterska/Vårdbiträde Erfarenhet: 10 år	**Mia** Utbildning: Undersköterska Erfarenhet: 23 år

Huvudfokus idag:
Utvärdera dellösningar inom fastsättning samt informationsbärare. Testa koncept och uttryck spontana reaktioner om enkel användning.

Delfokus idag:
Utvärdera hela konceptet med att arbeta med ilägg.

1. Förklara vad vårt arbete går ut på.
   - Utvärdera iläggsprodukter
   - Förenkla produktsortimentet
   - Enkel användning – därför vi behöver er!
   - Vad vi ska göra idag: Diskutera kring olika dellösningar samt uttrycka åsikter om iläggsprodukter i allmänhet.Vad är dåligt, kan något vara bra?

”Kommer att bli knöligt och tjockt” – N
”Kanske för varmt och för tätt också” - M

2. Fastsättning *”Det är viktigt att den fäster ordentligt”* -N

   - Adhesive (Limremsa) Tunn vs. Bred

   Med skyddstejp:
   ”Blöjan får inte gå sönder, inte bra med starkt lim” – N
   ”Kan fungera sämre när blöjan är blöt, ännu större risk att blöjan går sönder” – N
   ”Kan bli problem med väta och tryck” – M
   ”Blöjan får inte gå sönder, inte bra med starkt lim” – N

   Med skyddstejp:
   ”Limmet tar ändå” – M
   ”Hugget som stucket, men utan skyddstejp är nog smidigare” – M

   - Two component (Kardborre)

   ”Ytan släpper lite grann(i basprodukten) och blöjan kan bli sliten” – N
   ”Funkar nog bättre än tejpen” – N

   - Friction (Skumgummi)

   ”Tjäck och smidig”- M

”Mer lätthanterlig. Sitter inte fast och lossnar lättare” – M
”Skulle funka bäst. Flyttar sig inte, lätt att kasta ut. Lätthanterlig och smidig” – M
”Bättre än klisterremsa” – N

3. Informationsbärare
   - Empty (Ingen)

”Kan funka. Man gör det av bara farten, men markering skulle kunna underlätta” – N
”Funkar nog inte med alla vikarier, alla har inte samma erfarenhet” – M

   - Pad (Skyddtejpen)

   - Base

(Nanna förstod hur bågarna skulle användas)

”Funkar bra. Känns lättare än hålet -N
”Lättare att se och så slipper man hålet” – N

   - Pad + Base

Ränderna:
”Den kommer i mitten. Naturligt med den placeringen. -M
”Kan vara bra i kombination med böjen (bågarna)” – N

Hålet:
(Nanna förstod hålet direkt)

”Känns konstigt med ett hål -N

4. Vad känner ni för att arbeta med ilägg?
   - Har ni arbetat med ilägg någon gång?
   - Vad har ni hört om ilägg?

”Det används ofta av nattpersonalen” – N
”Vi använder det inte” – N
”Bökigt, produkten skall vara bra som den är” - M

   - Vad ser ni för fördelar?

”Smart med olika placeringar för olika användare. -N
”Man kan placera där det behövs, man vet var de pinkar” – M
”Man kan ta ur illägget och fortsätta använda basprodukten bara, så gjorde vi förr” - N

Enklare produktsortiment
Individuell vård
Flexibel absorption
Miljövänlig
Ekonomi

   - Vad ser ni för nackdelar?
     - Vad baseras nackdelarna på, erfarenhet/rykte?

Extra arbetsmoment
Delad produkt
Jobbig hantering
Svårt att förstå
Dåligt rykte

”Kan bli kaka på kaka, känns inte bra med för många. Kan bli för tjockt, för varmt och för tätt. –M&N
”Bökigt och ska inte behövas. Blir extra krångligt, basprodukterna är bra som de är” – N&M
”Vi som jobbar här inne tycker inte om inlägg” N

5. Skulle ni kunna tänka er att arbeta med ilägg i framtiden?
   - Om JA / NEJ, varför?

   Nej/Nej

   - Vad skulle kunna motivera det där extra arbetsmomentet?
     - Sparar material – Miljö?
     - Mer individuell vård

     De är inte intresserade av extra arbetsmoment
     ”Vi vill ha så få arbetsmoment som möjligt” -N

   - Kan ni se det användas i er nuvarande miljö?
     Nej/Nej

     - Testa i verklig miljö, kommer det att gå?

     ”Förvaringsutrymme finns men inte tid.” -N

     - Utveckling mot mindre tid/vårdtagare?

6. Om ni tänker tillbaka på de koncept ni fått titta på, vilken lösning kan ni tänka er att arbeta med?
   - Vilken dellösning är enklast/bäst att använda enligt er?

   ”Bågarna plus skummet” - M

Övrigt:
Idag händer det att dom vänder på flexprodukten när den ska användas till män, detta då de upplever att den skyddar bättre då.

Flex används idag för att den sparar tid p.g.a. att man inte behöver byta så ofta.
Dessutom är den läckagesäker och smidig.

Förr så användes ilägg och då kunde ilägget tas ut och den relativt tomma blöjan kunde användas vidare.

Appendix H – Enhanced Congitive Worktrough

To evaluate and recognise flaws with the first generation of prototypes an Enhanced cognitive walkthrough (ECW) was conducted. The analysis was also conducted to clarify if there was a need for guidance that had not been foreseen when developing the prototypes.

In order to conduct the ECW in the fashion that Billgård (2009) recommend the Sequence of user action analysis where adapted to fit a Hierarchical Task Analysis (HTA).

1. HTA
In order to form a basis for an ECW a HTA must be conducted. The HTA (see figure H1) was conducted by extending the Sequence of User Action and breaking down each user actions into sub-tasks. Each blue square represents a *function* that the test person needs to succeed with in order to successfully perform the sequence of user actions. Each *function* is divided into *operations* (the green squares) that needs to be correctly performed in order to succeed with each *function*. The red dot marks where an effort to visually guide the users has been implemented in the first generation of prototypes.

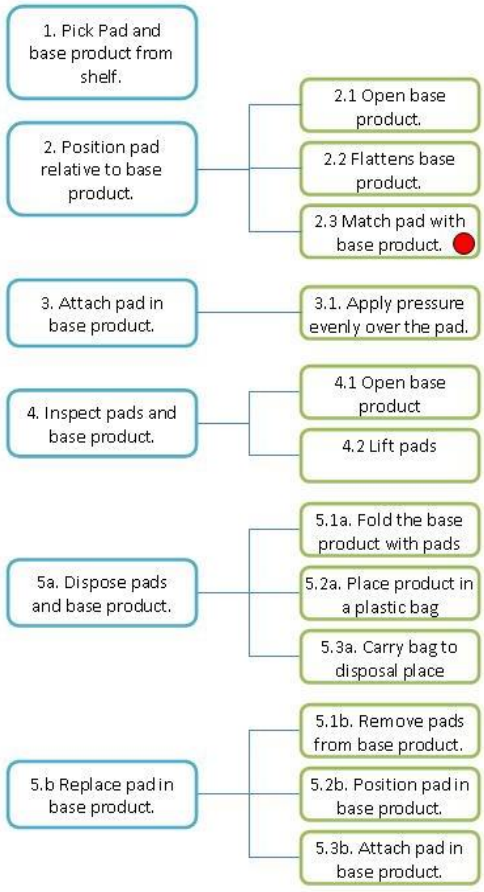


Figure H.1, HTA

2. Preparation

To enable an implementation of an ECW some initial preparations were conducted.

2.1 Selection and grading of tasks

For the ECW all the user actions except for the first action *"Pick Pad and base product from shelf."* where chosen. This action was excluded in the ECW analysis since it was considered a simple task with an insignificant risk of failure. "*Dispose pad and base product* " was also excluded in the analysis since this task should not differ from the usage of the regular products.

When grading the importance of the tasks *"Position pad relative to base product."* and *"Attach pad in base product."* where considered most important. *"Attach pad in base product."* was graded 1, where 1 is very important and 5 is not so important, since the function of the pad depends on that the pad is properly attached in the base product. "*Position pad relative to base product"* was also graded 1 since the individual care feature with insert pads depends on that the pads are placed in the correct area of the base product. *"Inspect pads and base product"* was graded 3 since it is an important task, but if the user would remove an un-used pad or fail to detect if a product was slightly used the consequences would not be that serious "*Replace pad in base product."* where considered less important, and graded 4, because this tasks inherits from a feature (the possibility to replace a used pad with a new one) of insert pads that was not included in the initial scope of this project. It was however included in the analysis since to clarify what needed to be done in order to implement this feature in later concepts.

2.2 Specification of tasks

By specifying the tasks it is clarified how each task shall be performed in order to succeed with the whole sequence of tasks. This specification acts as a template for how the test person's actions shall be graded later on in the analysis phase.

The test person shall open the base product so that the big core is exposed.	2.1 Open base product.
The test person flattens the base product so that an attachment of the pad is possible.	2.2 Flattens base product.
The test person matches the pad with the base product so that they are positioned correctly.	2.3 Match pad with base product.
The test person attaches the pad in the base product by evenly pressing the edges of the pad towards the surface of the base product.	3.1. Apply pressure evenly over the pad.

The test person opens the base product in such way that it is possible to lift the pads to control if a change of products is necessary.

4.1 Open base product

The test person lifts the pads and controls if a change is necessary.

4.2 Lift pads

The test person inspects the used product and determines if only the pad/pads needs to be changed or if both pad and base product should be changed. If the products need to be changed they are folded together.

5.1a. Fold the base product with pads

The test person places the used products in a plastic bag.

5.2a. Place product in a plastic bag

The test person carries the bag to the disposal room.

5.3a. Carry bag to disposal place

Or

The test person detaches on ore several pads from the base product without causing any damage to the base product.

5.1b. Remove pads from base product.

The test person positions the new pad over the old, still functional pads, or in the area where it is supposed to be attached.

5.2b. Position pad in base product.

The test person attaches the new pad on top of the old, still functional, pad or in the area where it is supposed to be attached.

5.3b. Attach pad in base product.

During the actual test the user track 5a was not tested since these actions do not differ from the actions the PCG would perform with a regular product.

2.3 Specification of user interface

The pads of the prototypes chosen for the ECW all had different variants of interfaces, the size of the pads were similar but the guidance systems used differed. The base products also had different types of guidance, but the shell (Flex) were the same for all base products. Flex was chosen because it was the product series that was considered to be the most complicated one to insert and attach a pad in. If a user could manage to insert a pad in a Flex-product the chance was significant that he or she also would be able to insert a pad in the other products (Slip and Comfort).

2.4 Specification of user and user situation

The users that were chosen for this test of the first generation of prototypes were non savvy users. These were chosen since the addable absorption system should be designed so that people without any experience from care giving could use the products. If an interface could be designed so that even the most unaccustomed users could use the products in a correct way the chance of that a PCG would succeed using the products could be considered significant.

The user situation and venue were chosen to assimilate the room and usage situation in a retirement home. The test person was given one pad and one base product with the orders to attach the pad in the base product. The test person also had the possibility to place the base product on a surface and flatten the base product, in the same way that a PCG would use the care takers bed. The incontinence product was then attached to the observer's body and opened in the same way that a PCG would open it when inspecting the product. The test person was the given the directives to detach one pad and replace it with a new one. There after the test was ended.

3. Analysis

During the analysis four persons where given one base product and on insert pad. First they where instructed to insert the pad in the base product while they where being observed. Then the base product was attached on an assistant and the test person was instructed to remove one pad. This process was repeated for all three prototypes. The sequence that the prototypes were tested in was randomly selected so that this would affect the results as little as possible.

3.1 Questions

During the observation the observer noted how each function and operation were performed and answered a number of questions regarding the performance of each *function* and *operation*. Each question was answered with a grade that depended on how great the chance of that the test person succeeded with each task was. If the test person in some way failed with the task a *short failure* story was written. The questions answered for each task were divided under two levels the first one regarded *functions* and were:

Will the user know that the evaluated function is available?
Will the user interface give clues that show that the function is available?
Will the user associate the right clue with the desired function?
Will the user get sufficient feedback to understand that the desired function has been chosen?
Will the user get sufficient feedback to understand that the desired function has been performed?

The second level of questions concerned the *operations* and tested the interface ability to make the user to use the product in a correct manner. These questions are:

Will the user try to achieve the right effect?
Will the user be able to notice that the correct action is available?
Will the user associate the correct action with the desired effect?
If the correct action is performed, will the user see that progress being made towards the solution of the task?

The analysis where conducted on four different test persons and the summary of their answers can be found at the end of this appendix and in the report.

3.2 Graded answers

Each answer was graded depending on how great the chance is that the test person will succeed with the task. The grading spans from 1 (very little chance of success) to 5 (very great chance of success). Table H.1 shows an explanation for each grade. If a grade can not be given that question where left blank.

Table H.1, grading of answers

Grade	Grade in words	Explanation
5	Yes	Very great chance of success
4	Yes, probably	Great chance of success
3	Don't know	Impossible to tell success or not.
2	No, insecure	Small chance of success
1	No	Very small chance of success

3.3 Problem categories

The problems were also categories under different types of problem families.

Table H.2, Problem categories

Problem type	Explanation
Hidden (H)	The interface does not give any clues if the function exists or of how to use it.
Text, Symbols etc. (T)	Text and symbols can be misinterpret
Sequence (S)	The tasks are performed in the wrong sequence.

4. Matrixes and results

To compare the different concepts and to clarify the pros and cons with the different systems the results from the observations where compiled into different matrixes.

4.1 Problem Importance against Problem Grade

To investigate the general condition of a products interface the problem importance can be compared to the problem grade. The number of errors that occur for each Task Importance and *Problem Grade* are summarised into a matrix, if the matrix shows a large number in the top left corner it can be concluded that there are serious flaws in the user interface when considering important tasks and needs to be improved. If there are large numbers in the bottom right in the matrix there is an indication that the interface results in minor problems for the user for less important tasks. The results for the different prototypes can be seen in Table H.3.

Table H.3, Task Importance/ Problem Grade. The maximum amount of errors for any Task Importance is 60.

Concept 2

Task Importance	Problem Grade 1	2	3	4
1	7	1	18	1
2				
3	20			
4	20		3	
5				

Concept 3

Task Importance	Problem Grade 1	2	3	4
1				1
2				
3	21			
4	10	2		
5				

Concept 4

Task Importance	Problem Grade 1	2	3	4
1	9		5	1
2				
3	20			
4	25		3	
5				

The table shows that Concept 2 has some major flaws when considering important tasks such as *Position the pad,* this inherits from the fact that this prototype does not have any

guidance regarding individual placement for men/women/night. If this concept would be further developed improvements needs to be made in the user interface.

The concept with the least amount of errors were Concept 2, the concept also did not show any errors when considering the most important tasks. Therefore the guidance system used in this concept was interesting to develop further.

Concept 4 did show some flaws regarding important tasks, these errors occurred when the test person was trying to figure out how to use the "window" on the pad. These results indicate that improvements need to be made, regarding this type of user guidance, if this concept shall be developed further.

All three concepts show some serious problems regarding *Inspecting the pad* and *Replace pad in base product.* In the concepts there was nothing in the user interface that gave the test persons any clues about that the pads could be replaced with new ones. Instead these instructions were given by the observer. If the future user of the products shall realize the opportunity to change used pads there needs to be some kind of information about this feature. If the instructions cannot be fitted on the pads or in the base product, the information should be placed on the bags and/or the boxes of the products.

When considering *Replace pad in base product* the errors can be related from the same problems as the tasks with the highest importance. If the test person had initial problems placing the pad in the base product these problems reoccur when replacing the pads. Some additional problems occurred due to the problems resulted from that the base product now was attached to a body. During further development the fact that it can be tricky to change the pads when the base product is attached on a body needs to be considered.

4.2 Problem Importance against Problem Grade

To clarify where the different problems inherits from Problem Type was compared to Task Importance.

Table. H.4, Problem Type/Task Importance. H= Hidden or lack of usage information, S= Sequence related errors, T=Text, Symbols etc. related errors

Concept 2	**Task Importance**			
Problem Type	1	2	3	4
H	9		20	20
S				
T				

Concept 3	**Task Importance**			
Problem Type	1	2	3	4
H			20	20
S				
T				

Concept 4	**Task Importance**			
Problem Type	1	2	3	4
H			20	20
S				
T	9			1

Table xxx shows that any of the errors where related to the Sequence of usage. The sequence of user actions that were estimated seems to be adequate, therefore no additional improvements needs to be made to guide the user to perform the tasks in the right sequence.

These matrixes shows that the errors that occur when inspecting and changing the pads inherits from lack of information about how these tasks shall be performed. The same goes for all systems.

It can also be seen that the errors that occurred when the test persons were trying to position the pads with concept 2 inherits from the lack of information about where the pads should be placed.

The Concept 4 matrix shows that some errors occur because of that the semantics of the concept is misinterpreted.

5. Conclusion

When considering both the matrixes some conclusions could be drawn about the different concepts. First of all, all the concepts lack user guidance about inspecting and replacing the pads. If this feature shall be included in future concepts additional information needs to be added in the products in order to guide the users when using the products.

For the different concepts some specific conclusions could be drawn:

Autobahn

The analysis shows that *Autobahn* first and foremost lacks information about how the inserts shall be placed in order to customise the product for men/women/night. If this concept shall be easy to use the guiding lines on the pad and in the base product is not enough. This calls for that some additional guidance has to be included in the products.

Arcs

Arcs was the concept that showed to be the one easiest to use. Only few and minor errors occurred that where related to the guidance system and the usage of a system with guiding lines and symbols seemed natural and intuitive for all the test persons. This made further development of this concept interesting.

The Window

The results when using this concept showed some diverse results, some users found the system with a “window” intuitive and used correct right away. Others found the system more difficult to understand and some errors occurred during usage. This shows that the concept has some potential but if it is going to be used some improvements needs to be made in order to prevent misunderstanding.

Appendix I – External brainstorm

This appendix can not be displayed due to SCA’s secrecy policy.

Appendix J – Final Internal Brainstorm

This appendix can not be displayed due to SCA’s secrecy policy.

Appendix K –Observation results and interview documents, Final Test cycle

Table K.1, Observation results

	Window			*Contour*			*Insert Printing*			*Arcs*		
Testperson	Tid	Guidning Ja=1 Nej=0	Antal Fel	Tid	Guidning	Antal Fel	Tid	Guidning	Antal Fel	Tid	Guidning	Antal Fel
1	85	1	1	40	1	0	87	1	3	80	1	0
2	60	0	2	83	1	1	33	0	2	60	1	0
3	32	0	2	45	1	1	30	0	1	20	1	1
4	21	0	2	46	1	0	60	0	1	30	0	1
5	45	0	3	40	1	1	45	1	1	45	1	1
6	45	1	1	26	1	0	40	1	1	30	1	0
7	45	0	2	50	1	1	40	1	1	40	1	1
8	103	0	1	93	0	0	96	0	1	92	0	0
9	58	0	1	52	0	1	55	1	0	57	0	1
10	45	1	2	21	1	0	50	0	1	50	0	1
11	44	0	1	34	1	0	75	1	1	52	1	1
12	76	0	0	75	1	1	44	0	2	64	0	1
13	47	0	1	48	0	1	44	0	1	57	0	1
14	28	1	0	20	1	0	24	1	1	30	1	0
15	60	0	1	40	1	1	39	0	1	53	1	0
	794	4	20	**674**	**12**	**8**	762	7	18	760	9	9

Appendix L – Ranking of the final concepts

Ranking Fastsättning

Testperson

	Arcs	*Contour*	*Insert Printing*	*Window*
1	4	1	3	1
2	4	1	3	1
3	4	1	2	3
4	2	4	3	1
5	3	4	2	1
6	4	3	2	1
7	4	3	2	1
8	3	4	2	1
9	3	1	2	4
10	3	1	4	2
11	4	1	3	2
12	4	2	3	1
13	3	4	1	2
14	4	3	2	1
15	3	1	4	1
	52	34	38	**23**

Ranking Guidning

Testperson

	Arcs	*Contour*	*Insert Printing*	*Window*
1	3	1	2	3
2	4	4	4	4
3	1	1	1	1
4	4	1	2	4
5	1	3	4	2
6	2	1	3	4
7	4	1	3	2
8	2	1	3	3
9	3	2	1	4
10	3	1	4	2
11	2	1	3	4
12	4	4	4	4
13	3	1	4	2
14	1	3	4	2
15	1	4	4	2
	38	**29**	46	43

Appendix M– Differences in urine patterns for men and women.

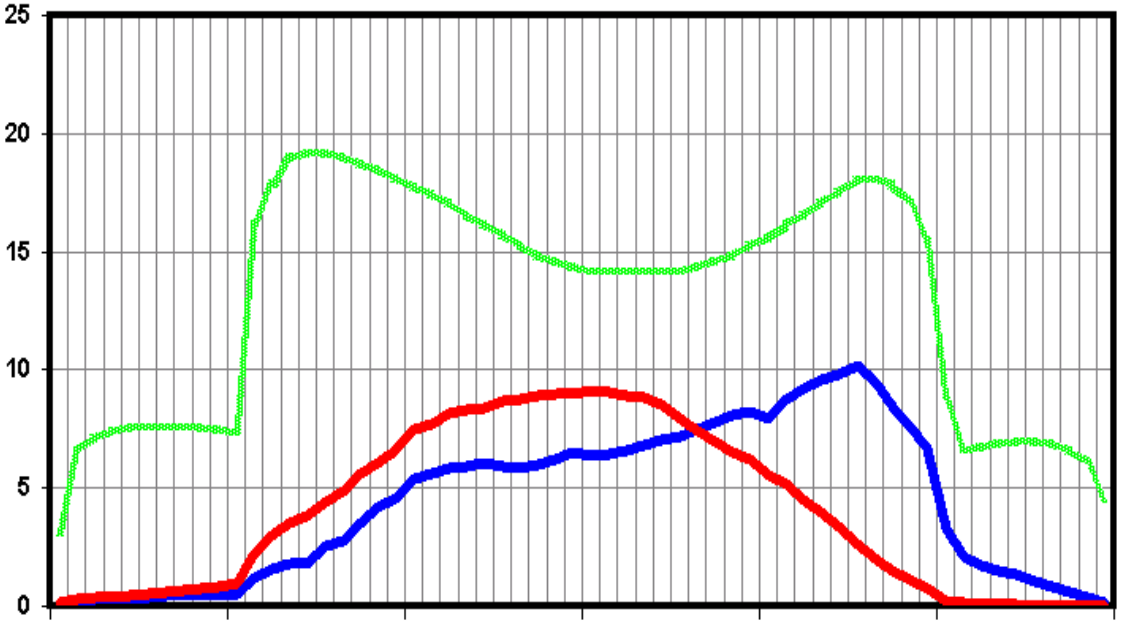


Figure M.1, The green line marks the capacity of the new TENA *Slip*. The red line marks where most urine is accumulated for female usage and the blue line marks the urine accumulation for men.. Birring, M. (2007a).

Appendix N– Summary for material savings

High SAP" Insert

Flex, High SAP:	Size S	M	L	XL
Scenario 1	-7%	-6%	5%	13%
Scenario 2	15%	14%	22%	25%
Scenario 3	-7%	-6%	5%	13%
Scenario 4	47%	47%	53%	56%

Slip:			
Scenario 1	-7%	4%	-1%
Scenario 2	7%	13%	13%
Scenario 3	-7%	4%	-1%
Scenario 4	47%	52%	49%

Comfort:	No Sizes
Scenario 1	1%
Scenario 2	10%
Scenario 3	1%
Scenario 4	51%

"Low SAP" Insert

Flex, Low SAP:	Size S	M	L	XL
Scenario 1	-16%	-16%	-2%	7%
Scenario 2	10%	9%	18%	23%
Scenario 3	-16%	-16%	-2%	7%
Scenario 4	42%	42%	49%	53%

Slip:			
Scenario 1	-13%	1%	-8%
Scenario 2	4%	11%	10%
Scenario 3	-13%	1%	-8%
Scenario 4	44%	50%	46%

Comfort:	No Sizes
Scenario 1	-16%
Scenario 2	1%
Scenario 3	-16%
Scenario 4	42%

Appendix O– Original calculations for material and cost savings for TENA *flex*.

This appendix can not be displayed due to SCA's secrecy policy.

Appendix P– Summary for cost savings

This appendix can not be displayed due to SCA’s secrecy policy.

Appendix Q– Production investments and savings

This appendix can not be displayed due to SCA's secrecy policy.

Appendix R – Fulfilment of needs

Table R.1, Needs sorted (Ulrich & Eppinger, 2008).

No.		Need	Owner
1	The insert	does not cause an increased number of leakage problems.	PCG
2	The insert	feels dry aginst the skin during usage.	PCG
3	The insert	supports all patients mobility	PCG
4	The insert	does not cause allergic reactions.	PCG
5	The insert	feels soft aginst the skin.	PCG
6	The insert	prevents odour.	PCG
7	The insert	is able to incinerate together with the base product.	PCG
8	The insert	is easy to select.	PCG
9	The insert	is easy to understand.	PCG
10	The insert	is easy to position.	PCG
11	The insert	is easy to attach.	PCG
12	The insert	fits in both Slip, Flex and Comfort.	SCA
13	The insert	fits in all sizes in the Tena assortment.	SCA
14	The insert	solution decreases the complete TENA ssortment	SCA
15	The insert	aquires less shelfspace at local nursing homes.	SCA
16	The insert	is secured in base product during usage.	PCG
17	The insert	enalbes a larger range of absorbtion levels.	SCA
18	The insert	increases the possibility to have the complete assortment.	SCA
19	The insert	facilitates a customized absorbtion capacity of the base product.	PCG
20	The insert	is possible to detach from the base product.	SCA
21	The insert	does not crumble during usage.	PCG
22	The insert	is economically defenceable to produce.	SCA
23	The insert	guidning system works even if the base product is applied backwards	PCG
24	The insert	feels thinner than competing products	PCG
25	The insert	guidning system does not cause irritation to the caretaker's skin	PCG
26	The insert	attachment consists of as few working moments as possible	PCG
27	The insert	is easy to change	PCG
28	The insert	guiding system consists of as few markings as possible	PCG
29	The insert	system leads to that the overall workload is decreased	PCG

Table R.2, Metrics sorted (Ulrich & Eppinger, 2008).

Metric No.	Need Nos.	Metric	Units
11	23, 26, 27, 28	Final evaluation	Ranking
1	1, 2	SCA test	Result
6	14, 15, 18	The TENA assortment	Binary
10	24	Market analysis	Binary
5	12, 13	Calculations of Shape	Binary
8	20	Attachment strength	N
7	17, 19	Absorbtion capacity	ml
2	1, 2, 3,16, 21	Usage test	Binary
3	2, 4, 5, 6, 7, 25	SCA Materials	List
4	8, 9, 10, 11, 27	Failures during assembly	Nr.
9	22, 29	Expert consultation/Calculations	Binary

Final evaluation

The observation of the prototypes during the final evaluation will be used to find the solution that is the easiest to understand. This will be made by timing the handling of

each prototype and by counting all errors while positioning the insert in the base product.

SCA test
The two tests which need to be conducted are within absorption. The tests need to be in comparison with existing products and the result cannot be worse than the existing products.

The TENA assortment
A comparison between the existing TENA assortment and the new TENA assortment need to be conducted. The number of articles needs to be lower than before.

Market analysis
Search the market and analyze the existing competing insert products. The thinnest insert found on the market need to be thicker than the developed insert.

Calculation of Shape
Use blueprint from all restricting sizes and models when calculating the Shape so that the insert fits in all models and sizes.

Absorption capacity
Calculate the theoretical absorption capacity in the existing products and with the new insert system. The capacity need to be larger with the new system.

Attachment strength
The actual force in Newton (N) is not determined at this point. The attachment method therefore needs to be tested after usage and before usage. It cannot destroy the top layer and must be fixed at all times during usage.

Usage test
Some needs cannot be controlled in a laboratory. Use the base product with the inserts and investigate if it fulfills the needs. This test is recommended for SCA to conduct in the future.

SCA materials
The use of existing materials within SCA eliminates the risk of causing allergic reaction on the caretakers' skin.

Failures during assembly
The number of failures will determine which prototype that is the easiest to interpret and understand. The prototype with the shortest time and the least errors will be the winner.

Expert consultation/Calculations

Some data is needed from experts within SCA in order to calculate is the insert is economically defensible to produce. Calculation will determine the outcome of this need and experts will determine is this system is worth to further investigate in the future.

Table R.3, Need-Metric table (Ulrich & Eppinger, 2008).

		1 SCA Test	2 Usage test	3 SCA Materials	4 Failures during assembly	5 Calculations of Shape	6 The TENA assortment	7 Absorbtion capacity	8 Attachment strength	9 Expert consultation/Calculations	10 Market analysis	11 Final evaluation
1	does not cause an increased number of leakage ….	x	x									
2	feels dry aginst the skin during usage.	x	x	x								
3	supports all patients mobility		x									
4	does not cause allergic reactions.			x								
5	feels soft aginst the skin.			x								
6	prevents odour.			x								
7	is able to incinerate together with the base product.			x								
8	is easy to select.				x							
9	is easy to understand.				x							
10	is easy to position.				x							
11	is easy to attach.				x							
12	fits in both Slip, Flex and Comfort.					x						
13	fits in all sizes in the Tena assortment.					x						
14	solution decreases the complete TENA …						x					
15	aquires less shelf space at local nursing homes.						x					
16	is secured in base product during usage.		x									
17	enalbes a larger range of absorption levels.							x				
18	increases the possibility to have the complete ...						x					
19	facilitates a customized absorbtion capacity of …							x				
20	is possible to detach from the base product.								x			
21	does not crumble during usage.		x									
22	is economically defensible to produce.									x		
23	guiding system works even if the base-…											x
24	feels thinner than competing products										x	
25	guiding system does not cause irritation to …		x	x								
26	attachment consists of as few working …											x
27	is easy to change				x							x
28	guiding system consists of as few markings …											x
29	system leads to that the overall workload is …									x		

Discussion of needs

1.1 The insert is easy to select

Unfulfilled: The insert need to be packaged so that it is easy to see how many inserts that are necessary for a certain absorption level. This has been outside the scope of this project but is important in order to give the correct amount of information for the PCGs.

1.2 The insert facilitates a customised absorption capacity of the base product.

Fulfilled: Since a variety of inserts can be added to the base product and be placed depending of the user, the inserts should result in a facilitation of the customization of the absorption capacity.

1.3 The insert enables a larger range of absorptions levels.

Fulfilled: See 1.2

1.4 The insert increases the possibility to have the complete assortment.

Fulfilled: Since a variety of inserts can be added to the base product the PCGs have the possibility to customise a product equal to the Maxi and Ultima levels (or even higher) which would widen the available assortment in the retirement homes.

1.5 The insert supports all caretakers' mobility

Fulfilled: The regular products fulfilled this need (according to SCA), the base product plus insert should also fulfil it since an attached insert should not affect the base products from a mobility point of view.

1.6 The insert's guiding system works even if the base product is applied backwards

Unfulfilled: The aspiration to fulfil this need was dropped after the final D-B-T cycle since the PCGs found the guidance and markings to extensive and confusing.

2.1 The insert does not cause an increased number of leakage problems

Undecided: Since no actual tests with inserts in the base products have been performed it is not possible to say if the inserts would increase the leakage problems. According to experts within SCA the final product will most certainly work satisfactory.

2.2 The insert prevents odour

Fulfilled: Since the same materials that are used in the base product (which prevents odours) are used in the insert it will also prevent odour.

3.1 The insert is secured in the base product during usage.

Undecided: Since no actual tests with inserts in the base products have been performed it is not possible to say if the inserts would stay secured during usage. Important to point out is that inserts available today do not have any attachment at all so at least the final insert will be attached better than exciting solutions.

3.2 The insert does not crumble during usage.

Undecided: Since no actual tests with inserts in the base products have been performed it is not possible to say if the inserts would not crumble during usage. The attachment method had although been design to cover the insert all the way to the end of the inserts to minimise the risk of crumbling.

3.3 The insert feels soft against the skin.

Fulfilled: Since the insert is covered with a layer of Nonwoven and has a bulk density of 5.5 it should feel relatively soft.

3.4 The base product works satisfactory as an incontinence product even without inserts

Fulfilled: Since no major adjustments have been made to the base product it should still perform satisfactorily.

3.5 The insert feels thinner than competing products.

Fulfilled: A thickness of 1.6mm is thinner than any competing product found on the market.

4.1 The insert feels dry against the skin during usage

Undecided: Since no actual tests have been performed with the inserts it is not possible to say if it would stay dry, but the high level of SAP should withhold plenty of fluids and keep the surface of the insert relatively dry. At the same time the low density will not aloud fluids to stay in the inserts without being absorbed by the SAP, instead the fluids will most certainly keep going down and be absorbed in the base product.

4.2 The insert does not cause allergic reactions

Fulfilled: Since the same material that are used as in the base product, which does not cause allergic reactions, the inserts should not cause any reactions.

4.3 The insert's guiding system does not cause irritation to the skin

Fulfilled: Since the guiding system will be printed on the top sheet it should not be possible to feel the printing. A print that is well tested should also be used to prevent allergic reactions.

5.1 The insert is easy to understand

Fulfilled: The final guiding system is a simplification of the system that was perceived easiest to understand during the final D-B-T cycle, therefore it should be relatively easy to understand.

5.2 The insert is easy to position

Fulfilled: See 5.1

5.3 The insert is easy to attach

Fulfilled: Two thin glue stripes were chosen as attachment method for the final insert. During the observation no one of the PCGs had trouble with attaching the insert method.

5.4 The insert is easy to incinerate together with the base product

Fulfilled: Since the same material is used in the insert as the ones in the base product they should be able to be incinerated together.

5.5 The insert's attachment consists of as few working moments as possible

Fulfilled: The winning attachment method is open glue without a protecting strip of paper. This is also the attachment method with least working moments in the actual attachment situation since it just can be positioned and attached directly.

5.6 The insert is easy to change after usage

Fulfilled: Since the glue used to attach the insert will be relatively weak it will be relatively easy to remove used inserts and either keep using the base product without a new insert or attach a new insert.

5.7 The insert is possible to detach from the base product.

Fulfilled: See 5.7

5.8 The insert's guiding system consist of as few markings as possible

Fulfilled: After the consumer test the number of different placements was reduced from six to two, which is the lowest number of markings that still allows men a distinction between placements for men and women.

6.1 The insert fits in TENA slip, flex and comfort
Fulfilled: Se chapter 6.1 Shape
6.2 The insert fits in all sizes in the TENA assortment
Fulfilled: Se chapter 6.1 Shape
6.3 The insert solution decreases the complete TENA assortment.
Fulfilled: The new system will replace both Maxi and the Ultima models with one or more inserts. This will reduce the amount of articles within Flex, Comfort and Slip from 30 to 20.
6.4 The insert acquires less shelf space at institutions
Fulfilled: Since the new system reduces the amount of material that is needed, less shelf space would be acquired.
6.5 The insert is economically defensible to produce.
Fulfilled: Se chapter 7.2.3 Production and Logistics
7.1 The time invested in matching and attaching the inserts leads to that the overall workload is decreased.
Undecided: Since no actual tests have been performed it is not possible to judge if the workload would be decreased, but if the insert is used as the PCGs see themselves using it (as a night product that facilitates changing used products during the night) the workload would probably decrease.