A Conceptual Female Hygiene Product
DEVELOPED FROM NEEDS AND PREREQUISITES IN AN AGRICULTURAL EAST AFRICAN CONTEXT

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Maskinkonstruktion
Industriell produktion
Abstract

Menstruation is a large problem for females in development countries today. Studies have shown that around 40 percent of menstruating girls have been absent from school due to their menstruation. One of the challenges that need to be solved is the absence of female hygiene products amongst women, especially in low income and developing countries due to the cost of commercial products. In countries where the national economy is unstable or poorly comes a problem with importing products, it would be better if they could produce their own products so that the national economy is supported. Small factories and production sites that produce female hygiene products have started to form in some areas. This shows that it is possible to produce in the context where the product is going to be sold. One of the advantages of this system is from the environmental perspective, many of the local production sites use environmentally friendly materials and some products are up to 95 percent bio-degradable.

The purpose of this thesis is to develop a concept for a sustainable female hygiene product that women in developing countries can afford to buy, this so that social effects can be enabled due to the security that a functioning protection can bring. To be able to do so a field study in Uganda has been conducted. During the study users and local producers were interviewed to find out what demands and prerequisites there are to create a female hygiene product that can be produced and used locally. The field study gave a deeper understanding and knowledge about both the subject as whole and the technical aspects to take into consideration when developing a female hygiene product. The study confirmed that female hygiene products, or rather the lack of them, are a big problem that needs to be solved quickly. It also revealed that the possibilities for producing in the context existed but was not developed enough.

Through an analysis of the empirical findings as well as theories about, for example, material and production, six concepts were developed. The concepts and already existing products were evaluated and correlated to requirements collected in the field study. One concept was chosen for further development from this evaluation. This concept consists of a disposable napkin that is fastened by putting it in holders sewn in the panty. The panty can be bought as a product with existing holders or the holders can be sewn into the users own panties. The final concept has taken both technical aspects and social effects into account. Lists of requirements on material for the concept as well as the production of it are also included in the work. A prototype of the concept has been sewn and tested.

The final concept in this work is not a finished product and needs further developing before being released as a product. More work need to be done on specifying the production and specific materials to implement the concept. For further developing, it is also important to have in mind in what context the product would be used due to the different possibilities and demands that the setting gives.
Preface

First and foremost we would like to direct a huge thank you to Kerstin Johansen, our examiner, for helping us turning our idea into a thesis and for aiding us with funding to conduct the field study. Your ideas and support have been of great help during this project.

We also want to thank Vanja Pavlasevic, our supervisor, who has contributed with support and good input and David Eklöf for letting us trying his new design thinking method when evaluating our concepts.

Thanks to our opponents, Sofia Georgsson and Louise Johnson, for support and a good cooperation.

The field study would not have been the same without the orphanage Kids of Uganda, Cecilia Kleimert the board director and Rose Kituyi the matron of the orphanage, thank you for taking us in. A big thank you is also directed to Sofia Sörner for helping us to adjust to the life in Bubulo and for all the support and help that you have provided us with.

We want to direct a special thank you to the companies we have interviewed during our field study, both in Uganda and in Sweden, your information have been of great help to us when developing our concept.

To our friends and family thank you all for being there for us, in both in adversity and prosperity and to all the people that have read our blog, giving us input and spreading our work.

Last, but not least, we want to thank all the women we interviewed. Thank you all for talking openly about this very taboo subject and allowing us to take part of your private lives.

This is our solution to a bloody problem!

Lina Larsson

Maria Olsson
### Vocabulary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>CDO</td>
<td>Community Development Officer</td>
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<tr>
<td>Female hygiene products</td>
<td>A product for taking care of the menstrual flow</td>
</tr>
<tr>
<td>FGM</td>
<td>Female genital mutation</td>
</tr>
<tr>
<td>Menses</td>
<td>Menstruation</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
</tr>
<tr>
<td>NIH- syndrome</td>
<td>Not invented here syndrome</td>
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<tr>
<td>Period</td>
<td>Menstruation</td>
</tr>
<tr>
<td>REACH</td>
<td>Registration, Evaluation, Authorization and restriction of Chemicals</td>
</tr>
<tr>
<td>Sustainable development</td>
<td>Contains three parts; ecologically sustainable, socially sustainable and economically sustainable</td>
</tr>
</tbody>
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The exchange rate during the field study was 1000 UGX = 2,65 SEK (2014-02-28)
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1 Introduction

According to Livoti & Topp (2004) most of the world’s population will at some point in their life be affected by menstruation even if it is only the females that are affected directly. Throughout a lifespan a female in agrarian regions will have her period about 150 times and each time the period will last for 2–7 days (Livoti & Topp, 2004). House et al. (2012) stated in a compilation that women protect themselves with a variety of different products and materials such as napkins, tampons, cloths, rags, or even mud and leaves. The way of protecting clothes against bloodstains, and avoid embarrassment varies from continents and countries (House, et al., 2012).

Finley (1999) states that menstruation and female hygiene is taboo in many cultures and according to Musaazi et al. (2013) this leads to that the problem is not addressed properly wherefore clean and hygienic washing and toilet facilities for women are not prioritized. According to Biriwasha (2008) an extensive part of the women in developing countries do not have the financial ability to buy and use commercial and hygienic menstruation protections. Due to this, severe infections because of lack in hygiene can occur and it also makes some of the girls miss out in school or women not being able to take a job. For example; if a girl would miss school for four days each month due to her cycle she would lose 156 learning days in the four year period of high school, this is equivalent to 24 weeks (Biriwasha, 2008).

For a product to become a success, it is important to develop with the user in mind since the product will not be well received by the market without excessive research about the user and its habits (Cooper & Edgett, 2003). It is also important to use development teams that have different perspectives and that work close together (Hobday, 2000). For a product to be produced efficiently it is seemingly important to develop with production in mind from the beginning and also have people specialized in production involved throughout the whole development process (Magnusson & Berggren, 2001). According to Brundtland (1987) sustainable development is a combination of three factors, environmental, social and economic sustainability. So to develop with the user in mind gives a social perspective and to have a multifunctional team gives a more effective and economic development. This combined with an extensive environmental awareness might result in a sustainable product that does not affect the future generation’s needs.

Today’s products for menstruation protection can be categorized in to three sub-groups according to House et al. (2012); handmade, small scale enterprises and large scale enterprises. Handmade products can for example be made out of fabric that can come from old clothes. The products that come from small scale enterprises are commonly made out of local materials such as plants, or imported fabrics. These products are produced in the context where they are sold. The products from large scale enterprises are commonly made of highly processed materials such as cotton or cellulose from wood. The products are produced in large factories with automatic processes and the production sites might not be placed in the context where the finished product is sold. (House, et al., 2012)

Most of the sold products today are from the group of large scale enterprises and the problem for women in developing countries is that these are expensive to buy (House, et al., 2012). Averbach, et al., (2009) claims that some NGO’s (Non-Governmental Organizations) give out or sell sanitary napkins to a reduced cost. Imported products or products that are donated does not contribute to the developing countries own economic development since the companies that benefits from the sales are most commonly placed in developed countries (Musaazi, et al., 2013). House et al. (2012) argues that the large scale disposable napkins, which are not made of bio-degradable materials, leads to a contribution to the growing problem of waste management in developing countries. The products from the other two groups have problems with reaching the markets that need them and are sometimes not absorbing enough to satisfy the consumers, which in return makes the user use homemade alternatives such as handkerchiefs and rags instead (House, et al., 2012).
1.1 RESEARCH CONTEXT

Uganda is a country in Sub-Saharan Africa located north of Lake Victoria and is a member of the East African Community. This is an intergovernmental organization of Uganda, Kenya, Tanzania, Burundi and Rwanda, countries that are similar in development and nature. The nature in Uganda is exuberant with large national parks, the Lake Victoria in the south and the river Nile running through the country. The climate in the country is, apart from in the north, stable with high humidity and two dry seasons per year. This allows for crops to grow all year round and the possibilities for growing food have kept the country out of starvation. Bubulo, where the field study takes place, is a village in the Manafwa district in the eastern Uganda, near the city of Mbale. The red circle in Figure 1, marks out the place for the study.

Studies have shown that Ugandan girls, aged between 11 and 14, are absent for an average of three to five days a month due to their menses. This leads to them falling behind and having large gaps in their learning, especially in math and science. The materials used for protection, such as cloths and rags, are often not hygienic enough and girls fear leakage since the materials are not properly fastened in their panties. The cost of buying commercially made sanitary protection is the equivalent of one tenth of the family’s monthly income. (Kanyike, et al., 2005)

Attempts have been made to find a suitable solution to the problem with lacking menstruation protection in Uganda. The MakaPad made from papyrus and recycled paper and the re-usable AfriPad made out of fabric are two examples but since the problem still occurs none of the solutions are effective enough due to lacking quality, distribution problems or non-affordability. (House, et al., 2012)

1.2 PURPOSE AND AIM

The purpose of the work is to enable the social effects that can come when women in developing countries can afford to buy female hygiene products. The aim is to investigate the demands and possibilities for developing a sustainable female hygiene product and to present a concept idea of a menstruation product based on users’ and local producers’ prerequisites in the given context.

1.3 RESEARCH QUESTIONS

- What conditions are there to produce female hygiene products in a sustainable way in the East Africa Community?
- What user demands are there on female hygiene products in Uganda?
- What could be a feasible solution for a sustainable female hygiene product?
1.4 DELIMITATIONS

The project will result in a concept for a female hygiene product. A checklist for what should be considered when choosing materials and production methods will be created for use in the continued development of the concept. This continued development is not included in this work. Neither will this work include which specific materials should be used in different contexts, the economic feasibility nor how to solve distribution and marketing.

1.5 READING INSTRUCTIONS

Chapter 1 An introductory chapter with background, description and purpose of the project.
Chapter 2 Description of the workflow and methods used throughout the project.
Chapter 3 Includes history of menstruation products, short information about the female genitalia and female genital mutilation.
Chapter 4 The theoretical framework used throughout the project.
Chapter 5 Contains a description of the different female hygiene products used today.
Chapter 6 Observations from the field study are presented here.
Chapter 7 Contains the empirical findings found during the time in Uganda
Chapter 8 Compilations of opinions and thoughts of the interviewed experts.
Chapter 9 Description of the partial results and the process of concept development.
Chapter 10 A thorough description of the final concept and motivation of the choices made in the concept development process.
Chapter 11 This chapter includes a discussion about the result and the process.
Chapter 12 The conclusions of the project are presented in this chapter together with recommendations for future work. This chapter is followed by a list of references and appendices.
2 Method

During the first stages of the project the two focus areas, product development and production, were studied separately but closely, with information exchange and overlap between. The purpose of working closely together was to get a wide knowledge and understanding about both of the focus areas. As described in chapter 4.2, a close collaboration between production and product development is a key to a successful product. A holistic overview of the process can be seen in Figure 2 below. The process is based on Ulrich & Eppinger’s (2012) development process where the three first phases are planning, concept development and system-level design. The first two stages in Figure 2 represent planning, the third represent concept development and the last step in the figure partly represents system-level design.

Blogging have been a part of the working process and has been done throughout the project. Reflections, ideas and gained knowledge have been written down on the blog. The blog’s purpose was to communicate with the supervisor of the project. Readers have been able to comment on the blog and the given inputs have been taken into account throughout the project.

Figure 2 - Description of the working process

2.1 LITERATURE STUDY AND PREPARATIONS FOR FIELD STUDY

To start the project, information was searched for in written sources and gained through interviews. The sources were found through internet searches, reports and literature. This information was collected to get knowledge about menstruation and also see to materials and technical aspects needed for developing a suitable concept for the research context.

The preparations for the field study started off by studying the culture of Uganda. A study of the companies that produces female hygiene products in a local setting and within developing countries was made. This was made to find out more about their products and what prerequisites they had found during their development phase. Experts in Sweden and Uganda were also contacted in this part of the project. The people that were contacted were founders of menstruation product projects, experts in production,
product development and environment development. Studies on the products and materials that are used for female hygiene products today were carried out in this stage as well.

2.2 THE FIELD STUDY

The field study in Uganda was conducted to gain a further and deeper understanding of the problems that the users face when handling their menses and what demands they have on a female hygiene product. It also gave information regarding how the product was handled and the overall environment in the village. Uganda was chosen as the context due to the stability in the country and their growing economy. The main location for the study was a trading center in eastern Uganda named Bubulo, the nearby villages around the trading center and the city of Mbale. Observations were made to see what possibilities there are for producing female hygiene products locally. Three weeks were spent in Bubulo where women and experts were interviewed and observations were conducted. The interviews were customary done in a semi-structured way and the questions can be found in appendices A-F. This way of conducting interviews were chosen because it is giving the interviewees a chance to express themselves freely but at the same time giving structure to the interview (Bohgard, 2008).

During the time in Uganda forty-two women in the ages 13-75 were individually interviewed and forty school girls were also interviewed in one group session. The interviewees were randomly chosen and some of the interviews were conducted with an interpreter. The experts interviewed in Bubulo were Headmasters in schools, a Midwife and a Community Development Officer (CDO).

Another purpose of the visit to Uganda was to get the perspective from the producers. This was done during one week spent in the capital Kampala, where interviews were held with two different manufacturers of locally produced female hygiene products to find out more about their solutions and what challenges and prerequisites they have been faced with. During the field work four Product Safaris were made. This survey method is based on the method Service Safari where developers use a service to see how it can be perceived from a user perspective (Stickdorn & Schneider, 2012). This method can be further read about in appendix K.

A detailed description of the execution of the field study in Uganda can be found in appendix K.

After the visit in Uganda additional interviews in Sweden were made with experts on the subject. These experts were knowledgeable in product development, production and environment perspectives and were also interviewed in a semi-structured way. The questions from these interviews can be found in appendices G-I. An e-mail interview was lastly made with an organization that distributes menstruation cups in Uganda, the questions can be found in Appendix J. These interviews were made to get knowledge about products of today and see different companies’ views about future female hygiene products.

2.3 ANALYSIS OF DATA AND DEVELOPMENT OF A CONCEPT IDEA

The information gained from the literature study and the field study were the base in the creation of a specification of requirements and the development of a concept idea. The data gained from the field study was compiled into three different groups, one for the interviewed females, one for the experts in Uganda and one for the experts in Sweden.

Liedholm’s (1999) method of concept developing was used to get structure when generating ideas and concepts, this starts of by doing a general list of specifications. Needs of the customers and production were generated from the knowledge gained in the field study and the literature. To get environmental needs the method quality function deployment for environment (QFDE) was used as an inspiration. QFDE is a developing method that takes both the customer aspects and environmental aspects into consideration and turns them into measurable requirements (Sakao, et al., 2008). This method was combined with knowledge about materials and production methods from theory, this to take more aspects regarding environment into account. Ulrich & Eppinger’s (2012) process was used when
When developing the specifications supporting questions for development of requirements from Liedholm (1999) were also used. The decision to use both Liedholm and Ulrich & Eppinger as a basis for the specifications was made to get a wider range on the specifications and to make sure that all areas were taken into account. The requirements were not given any measurements at this point due to uncertainty regarding what type of concept that would be chosen in the end.

To get objectivity in the weighting of the requirement the seven basic human needs were used. This is motivated by the belief that a good product should fulfill as many human needs as possible to function well (Eklöf, 2014). The seven needs; reliability, to be seen, contribute, development, curiosity, balance and unify, were then given both a long-term effect and a technical aspect that were independent from each other. The effects and aspects were also set from both a product point of view and a production point of view and were given a score of 1, 2 or 3 depending on the importance. Each requirement was then correlated to the aspects and effects, if it fulfilled the aspect or effect it was given a one and if not it was given a zero. This was then multiplied with the score of the effect or aspect and summarized into a weight for the requirement. Demands that were the most important were given a full score and were set to be a “must requirement” and the rest to be “should requirements”.

A function analysis was the next step in the concept development. This was done to get an understanding of the different areas in the searched solution (Liedholm, 1999). An idea generation session, including brainstorming, was carried out from the seven different sub-problems generated, see further in Chapter 9. The sub-solutions gained from the session were later combined into 15 concepts which were then further developed and evaluated into six realistic concepts that later were weighted in correlation to the specification of requirements. This way of working is supported by the third phase, establishing concepts, which can be found in Liedholm’s (1999) method of development.

The six developed concepts were then evaluated with the method concept scoring. This method, according to Ulrich & Eppinger (2012), correlates the concept with the requirement in an objective way. Every concept idea is given a score that shows which of them that fulfills the requirements best (Ulrich & Eppinger, 2012). In this case a scale 1-5 was chosen, one meant that the concept fulfilled the requirement poorly and five that it fulfilled the requirement in whole. The scale 1-5 was chosen because it was an appropriate range of numbers to not become too large but at the same time give the possibility to separate the concepts from each other. Every concept was evaluated independently from the others, this so that they would not affect the scoring on one another. The point given was multiplied with the weighting score of the requirement and summarized to get the total score of the concept. The concept that was given the highest score was then chosen to be further developed in a later step. A concept scoring amongst already existing products was made in the same way as well to get the strengths and weaknesses of them. This was then taken into account when improving the new concept.

The new concept was taken further by discussion about how to reach and fulfill as many production and user requirements as possible. It was also tested to see how the concept could be designed in a proper way. This test was done by constructing mock-ups of part of the concept. The method of making mock-ups was considered to be suitable because it is a fast way to get answers regarding functionality in a product (Soegaard, 2014). For the concept to become more specified a checklist for demands that should be taken in to consideration about each part of the concept were made. Parts of the checklist was inspired by the environmental development checklist the ten golden rules. The ten golden rules is a checklist containing aspects to be considered when developing products from an environmental point of view (Luttrupp & Lagerstedt, 2006). The demands in the created checklist specifies what the producer should take into account when choosing materials and producing the concept in the future.
3 Essential Information about Menstruation

House et al. (2012) claims that 26 percent of the world’s female population are in their reproduction stage. This means, according to them, that these women will menstruate approximately two to seven days every month. Even though this stage of a woman’s life is completely normal and that almost every woman experience menstruation at some point during their life it is, according to House et al. (2012) a highly taboo subject in most parts of the world. This further leads to that the health of women and girls is neglected. During their menstruation the reduction in health is not only connected to physical aspects such as clean water, toilets and sanitary protections, but also to cultural attitudes regarding female purity and that they are unclean or dirty during their period (House, et al., 2012). Fehr (2012) claims that the problem with unclean water and absence of cleaning facilities makes it problematic for women and girls all over the world to take care of their hygiene, especially during their menstruation periods. This problem is particularly hard for girls in school (Fehr, 2012).

Studies have shown that increased level of education amongst women is one of the most important factors to enhance female health and to give females a more satisfying life (Musaazi, et al., 2013). Fehr (2012) shows in her study that over 40 percent of the menstruating women in the world have been absent from school due to their menses, mostly because of nonexistence of female hygiene products. This absence can then often lead to that girls have to terminate their studies in advance (Fehr, 2012).

Protections today consist out of multiple materials and vary virtuously around the globe; examples of materials are cotton, cloths, silicon, sponges, cellulose and even mud or cow dung (House, et al., 2012). According to Fehr (2012) it is most common for women to use different kinds of sanitary napkins or napkins. These protections can be locally produced, imported or self-made due to the high cost of commercial napkins. Fehr (2012) further claims that the reason for women to use commercial protections is that they want to be able to throw the product away after use and that they want the napkin to have a design that makes it stay in place. She further states that the women who use homemade protections feel unsecure and are worried about leakage. They also have issues with cleaning and drying when using reusable protections, due to that most women do not wish or cannot do this in public (Fehr, 2012). To not have the possibility to use sanitary menstruation protections can according to House, et al (2012) give females’ different types of genital infections. This mostly because of the lacking of intimate hygiene, difficulties to change their napkins, leaking or soaking napkins and the lack of possibility to clean themselves or their napkins in a sufficient way (House, et al., 2012).

House et al (2012) divides the production of menstrual protections in three categories; handmade production, small-scale enterprises and large-scale enterprises. More and more women over the world tries to start up their own production companies to produce sanitary napkins, these businesses have been shown to be successful in several countries such as India, Ethiopia and Rwanda (House, et al., 2012). But even if these small-scale productions exist, most sanitary napkins are imported to development countries from industrial countries according to Musaazi et al (2013). This, according to Musaazi et al. (2013), does not benefit the local or national economy due to the fact that the money does not stay in the local community. It is also important to support the local designers and producers of sanitary protections since this leads to less environmental impacts compared to importing menstrual protection (Musaazi, et al., 2013).

3.1 HISTORY OF MENSTRUATION PRODUCTS

Women have throughout the history used different types of menstruation protection states Finley (1999) and before the 1900s napkins of various kinds were mostly used. According to the author these were made from different materials depending on where in the world they were used. Normally they were constructed out of a rectangular cloth that was placed between the legs and secured by a lace around the haunch (Finley, 1999). This was either used on its own or with anything from animal fur to grass placed in it for absorption (Svensson, 2010). In some countries the women knitted their menstruation napkins
before the introduction of commercial napkins (Finley, 2009). Tampons are another type of method that women have been using for thousands of years and there is evidence that both Egyptian and Roman women used tampons out of papyrus and wool respectively (Friedman, 1981). It was not until the end of the 1800s and beginning of 1900s that menstruation protection became commercialized (Finley, 1999). If the women didn’t have the possibility to make their own protection they would not wear anything which made them bleed right down on the ground since undergarments was not used (Hering & Maierhof, 2002).

During the mid-1880s Johnson & Johnson in the US and Hartmann in Germany released the first disposable napkins. The design on these napkins was similar to the ones used today but they still needed to have a belt around the hips to hold them in place as shown in Figure 3. It was not until the 1970s that the napkins had adhesive on the back and the belt was not needed any more. (Zotti, 2006)

![Image of napkins with and without a hip-belt](Finley, 1998)

*Figure 3 - Swedish ad showing a napkin with and without a hip-belt (Finley, 1998)*

Even though the napkins were the first menstruation product to be commercialized according to Finley (2006), they also state that there were other options in the beginning of the 1900s. Tampons existed and the women made them themselves by rolling surgical cotton tightly. The commercial tampon came to market almost fifty years after the disposable napkin (Finley, 2006). During the same period one more type of method reached the market, the menstruation cup, but it was only used by liberal women due to the taboo to touch the vagina during the 1930s-1940s (Svensson, 2010). Most of the protections used today in the western countries have been developed during the past hundred years, but in most of the developing countries the protections look the same as in the 1800s (Finley, 2009).

### 3.2 THE DESIGN OF THE VAGINA

Here you find a short description of the female genitals.

#### 3.2.1 The inside genitals

The female reproductive system is composed of five organs; the ovaries, the fallopian tubes or uterine tubes, the uterus, the cervix and the vagina as can be seen in Figure 4. The ovaries are located on each side of the upper pelvic cavity and produces female sex hormones and ova (usually called eggs). The fallopian tubes are the connection between the ovaries and the uterus. The function of the tubes is to pick up and transport the ova, released from the ovaries, to the uterus. It is the uterus that protects, supports and surrounds the fetus if a woman is pregnant. This organ is shaped like a pear and at the lower end, the cervix connects the uterus with the vagina. The vagina is a tube that goes in to the body in a 45° angle towards the back. The function of the vagina is to receive the penis during intercourse and it also serves as the exit for the menstrual flow. (Taylor, 2013)
3.2.2 The external genitals

The collective name for female’s external genitals is vulva. The vulva has six constituents, mons pubis, glans clitoris, urethra, vagina, labia minora and labia majora. The mons pubis is prominence that is fronted with pubic hair. From the mons pubis the labia majora are extended backwards towards anus, these are two hair-covered folds of skin. On each side inside of the labia majora two smaller skin folds without hair are placed, these two are called labia minora. The labia minora goes from the vaginal opening up to the glans clitoris where it acts like a foreskin. The clitoris is the female sex organ and is made out of erectile tissue. It contains a large amount of nerve endings that can give the female orgasm upon sexual stimulation. The gap between the labia minora contains the urethra and vagina. The vagina can be partly closed by a membrane called the hymen. This membrane is usually erupted during the first coitus, but can be surgically removed if necessary. For females, the reproduction system and the urinary are completely separated. (Netter, 2003)

3.2.3 Female genital mutilation

According to Unicef (2012) female genital mutilation (FGM) can vary in forms and crudity. The mutilations are classified in four types of degrees of severity (World Health Organization, 2013):

1. Clitoridectomy - the hood of the clitoris and the surrounding tissue are removed.
2. Excision - the clitoris and the labia minora are removed.
3. Infibulation - the most severe. The procedure is to cut and reposition the inner or outer labia, with or without removing the clitoris.
4. Other kind of mutilations or harmful procedures for a non-medical purpose, this can be picking, piercing, incising or scraping the genital area.

FGM are widely spread over the African continent and parts of Asia and the Middle East and the procedures are not connected with a specific religion, it is a mixture of culture, social causes and religion (Kontoyannis & Katsetos, 2010). The procedures have been done on about 140 million girls and women all over the world and it is usually carried out on girls between infancy until the age of 15, but it sometimes carried out even on adult women (World Health Organization, 2013).

Even if FGM exists worldwide Unicef (2012) claims that the practices are concentrated to 29 countries in Africa and the Middle East. The prevalence varies widely between the countries, from 98 percent in Somalia to 1 percent in Uganda (Unicef, 2012). The third classification is the most common in the countries where FGM are performed the furthermore, the other classifications are more widely spread over the world (Kontoyannis & Katsetos, 2010).
4 Theoretical Framework

In this section theories regarding product development, production methods and environmental effects of materials relevant for this project are presented. Information from this chapter has been used throughout the development and evaluation process.

4.1 USER NEEDS AS A STRATEGY FOR PRODUCT DEVELOPMENT

Smith & Smith (2012) claims that the choice of strategy for product development can have a large impact on the finished product, this due to the fact that engaging design and customer needs give a higher product quality, customer satisfaction and success rate. This is also agreed upon by Cooper & Edgett (2003) that argues that 75 % of the developed products do not reach their target marks because of the lack of integration with customers in the development process. A product that has been developed with the user in mind has a higher merchantability compared to one that did not take the user into account, according to van Eijk et al. (2012). They further claim that if the user do not understand how to use the product they will think that the product does not work at all. They also state that it is almost impossible for a company to make a product profitable if it is supposed to satisfy a large range of people. To get viability for a product it is relevant to understand the character overview such as demography, user behaviors and personality (van Eijk, et al., 2012).

According to Ulrich & Eppinger (2012) a process to collect user needs can be divided in to five steps as followed:

"1. Gathering raw data from customers.
2. Interpret the raw data in terms of customer needs.
3. Organize the needs into hierarchy of primary, secondary and (if necessary) tertiary needs.
4. Establish the relative importance of needs.
5. Reflect on the results and the process."

(Ulrich & Eppinger, 2012)- page 75

4.2 DEVELOPMENT ORGANIZATION

If design errors are detected late in a development process it is likely that it will become costly to make changes, mostly due to that the production process is already planned and acquired for the specific product. An organizational integration between the departments of the company can lead to a more effective development because this minimizes the so called NIH-syndrome (not invented here). This gives the whole project team a feeling of responsibility for the project and if more areas of expertise are included from the start of the development process, the chances of making the design right from the beginning is higher. It also gives the development team more perspectives early which can lead to unsuitable solutions being avoided. (Johannesson, et al., 2013)

According to Unger & Eppinger (2011) there are two types of product development processes, a stepwise process and an iterative process. They further say that it will be costly to backtrack in the stepwise process because of the clearly divided steps that exists. Therefore they recommend that effective development is driven in mixed teams and/or that the communication between professionals is extensive. (Unger & Eppinger, 2011)
4.3 DEVELOP WITH ENVIRONMENTAL FACTORS IN MIND

Johannesson et al. (2013) state that, as the consciousness regarding environmental damages and issues increases amongst the consumers, the companies become more and more aware of the importance of developing sustainable products. They further argues that to develop sustainable is to take environment, economy and social factors in to account. It also means that the development and use of products today should not affect the possibility for future generations to satisfy their needs (Brundtland, 1987). Johannesson et al. (2013) considers working with environmental development not to be a specific method, but a state of mind to decrease a physical products environmental impact throughout the whole lifecycle. To complement this new way of thinking several methods to conduct environmental analyzes have been developed during the last years such as Quality function deployment for environment (QFDE) and environmental guidelines (Johannesson, et al., 2013).

Sakao et al., (2008) describe QFDE as a development of Quality function deployment (QFD) and the method is used in the same way except that this method also takes the voice of environment into account and not only the voice of the customer. Through this method it is possible to detect a number of improvement areas for a specific product both from the customers and the environments point of view (Sakao, et al., 2008). Checklist and guidelines are other ways to develop from an environmental standpoint; this is a collocation of different design principles that should, according to Garrette et al. (2009), be taken into account during development and design of products and services. The ten golden rules is another guideline that takes the whole lifecycle in consideration and some of the rules are for example; to use less chemicals and/or toxic substances in the producing of a product, to use as little energy as possible in the using phase and to invest in better materials to encourage a long product life and/or simplify the recycling or reuse (Luttropp & Lagerstedt, 2006).

4.4 PROCESS DESIGN

When producing products there are different ways to design the process in which the product is made. These can be divided into five different process types:

- Project processes - usually involving large, complex products that are individually constructed and designed for the customer. Examples of products produced in this way are houses or ships.
- Jobbing processes – usually customized products are produced but with the use of standard machines in a high variety, low volume way. Examples are the making of tools or tailoring.
- Batch processes – very similar to jobbing processes but the products are produced in batches with several products of the same kind. This can be used in a variety of volume sizes and variety in complexity. Examples of products produced in this way are gourmet frozen foods and components for mass-produced assemblies.
- Mass-processes – produce a high volume and a relatively narrow variety; the components of the product are so similar that the process of putting them together is the same. Examples of products produced in this way are cars and televisions.
- Continuous processes – higher volume and lower variety than mass-processes. Often very inflexible and expensive equipment is involved in this type of process. Examples of products produced in this way are steel and paper.

It is important to choose the right kind of process for the product to get the flexibility and cost that is desired. If the flexibility is too high the cost for machines will rise and the process will not be cost effective. However if the flexibility is lower than required this could lead to higher costs in the form of new equipment having to be bought to reach the desired level of flexibility. (Slack, et al., 2010)

4.5 THE PROCESS OF FLEXIBLE MANUFACTURING

Flexible manufacturing systems often refer to highly automated cells consisting of several processing stations. The processing stations are connected by an automatic system for handling of materials and the
whole system is controlled by an integrated computer system. A flexible system has its limits when it comes to how flexible it can be, this is why a system is designed to produce a certain type of products or certain sizes of a product. For a manufacturing system to be called flexible it needs to have; (1) the ability to process different parts in a non-batch mode, (2) the ability to accept changes in production schedule, (3) the ability to adapt to equipment malfunctions and breakdowns and (4) the ability to accommodate new part designs. (Groover, 2011)

4.6  FIXTURES

A fixture is designed to position, hold and support a part or product during manufacturing (Nee, 2004). The use of a fixture can assure higher accuracy in positioning of the part, faster production rates and make the work easier for the operator since it assures all parts will turn out the same (Groover, 2011).

Different methods for fixating the parts are used depending on how large the series of parts are and the shape and design of the part (Johannesson, et al., 2013). When large series of products are made it might be suitable to make a fixture specially designed for this part (Johansson, 1989). However, the cost for making a special fixture is high according Johansson (1989) wherefore it is not suitable for smaller series. In those cases a flexible fixture that can be adjusted for different products or parts is more suitable; this can be built up by standardized parts or constructed to fit several products with just a small adjustment (Johansson, 1989).

4.7  QUANDARIES OF AUTOMATION

Automation can have large effects such as cost reductions, labor saving, growth of productivity and improved product quality. However it is important to take into consideration that it might also affect the ability of adjusting output to demand, realizing the value produced through sales on the market and efficient utilization of fixed capital. Other costs connected to automation might arise connected to problems with machine downtime or capacity utilization. (Schoenberger, 1989)

4.8  SHAPES AND SCALABILITY

Shapes are divided into three different groups; geometrical, natural or organic and abstract. The group of geometrical shapes is most commonly used and these shapes are structured and regular, this includes rectangles, triangles and circles. Natural shapes are fluids or irregular, these shapes can be found in organic materials and in nature, such as in plants and animals. The last group, abstract, contains a more simplified version of natural shapes. Abstract shapes are used in signs to simplify patterns such as handicap parking signs. When using shapes it should be considered what the purpose for the design is. If the shape should attract attention it should be designed in an unusual shape and if not, a common shape should be used. (Siebert & Ballard, 1992)

According to Bendsoe (1989) shape, material optimization, size and scalability are closely related. All of them need to be considered when choosing a design for a product. Shapes that are geometrical are easier to optimize and scale compared to natural shapes, this is due to the structure and homogeneity of a geometrical shape (Bendsoe, 1989).

4.9  JOINING PROCESSES

In general two types of joining processes are usually being discussed, dissolving and permanent joints. When it comes to permanent joints it is referred to a way of joining two or more elements so that it is impossible to disassemble them without breaking the elements. Welding is one of the most common ways to make permanent joining; this is done through a high temperature process and can be performed in many different ways such as arc welding and spot welding. Other ways of making permanent joints are brazing, different adhesives and some mechanical joints. (Johannesson, et al., 2013)
Dissolving joints can on the other hand disassembled without breaking the structure. The main principle for this type of joining is to use a suitable geometrical locking to fixate the elements together. This type of joint includes snap fits, some types of mechanical joints, shrink fits, screws and glue. (Johannesson, et al., 2013)

4.10 THE METHOD OF CUTTING

Cutting methods can be divided into three sub-groups; shearing, blanking and punching. In all three, the cutting tool normally consists of two parts, one moving and one stationary. The moving part is called the punch and it moves past the stationary part, called the die, to perform the cutting. Shearing is when cutting is made in a line to divide the material into smaller pieces. Blanking is the process of cutting along a closed outline in a single step. The part that is cut out is called a blank and is the desired piece. Punching is similar to blanking with the difference that the cut out is the scrap, the original material, now with a hole, is the desired piece. (Groover, 2011)

4.11 THE METHOD OF GRINDING

Grinding is the process of atomizing a material to smaller particles by using mechanical forces. Different types of mills can be used for the grinding, for example ball mills and rod mills. The oldest methods for grinding is the pestle or the usage of stones, one large and one small where the small is moved and pressed on top of the large one to pulverize the material. Earlier it was common to use water, wind or working animals to power a mill whereas today most mills are powered by electricity. (Ek, 2014)

4.12 HOW INJECTION MOLDING WORKS

Injection molding is when a heated material, for example a polymer, is injected with high pressure into a mold cavity where it becomes solid. The production cycle can be repeated as often as every 10-30 second and often several products are made in one mold. The products produced are near net shape. It is possible to do complex shapes when using injection molding, in those cases the most complicated task is to create the mold. (Groover, 2011)

When using injection molding for forming rubber the advantages, compared to other methods, are better control of dimensions, less scrap and short cycle times. The cost for creating a mold for injection molding is high, why large production quantities are important. (Groover, 2011)

4.13 NATURAL MATERIALS

Natural materials are materials that include fibers and that can be found in the nature. The most commonly used material in this group is wood, either non-processed or processed. All natural materials are containing cellulose in a large or small extent. Today the development goes from traditional “forest products” into bio composites, this to broaden the areas of use. (Johannesson, et al., 2013)

4.13.1 Cellulose and pulp production

Cellulose is a part of the plant cell walls and is therefore the most common organic substance in the world. It is a crystalline polysaccharide that has high mechanical strength and is not soluble in water. Wood contains about 45-50 percent cellulose whereas cotton contains about 90 percent cellulose. Cellulose is also used as the name for the chemical mass created in pulp production. (Borgström & Eberson, 2014)

Pulp can be created from different fibers in nature. In past days it was very common to use cotton or different types of grass species, whereas today wood is most commonly used. When producing the pulp, different methods can be used to expose the cellulose fiber; either chemical or mechanical. When using chemical methods the lignin, which is the material holding the fibers together, is dissolved using either sulphate or sulphite. This processes gives about a 50 percent exchange from wood but the pulp is very
white and strong. Mechanical methods expose the fiber by pushing and grinding the wood (or other plant) and gives about a 97 percent exchange. The pulp created in this way is weaker compared to the one created in the chemical process. (Steenberg, 2014)

The main use for cellulose pulp is different kinds of papers and cardboard. Mechanical pulps are mainly used for printing paper but also for cardboard, wallpaper, fine paper, soft tissue and absorbent and molding products. (Sundholm, 1999)

Cellulose can also be further processed to become cellulose derivatives by chemical modification of the molecules in cellulose (Gierer, 2014). One of the cellulose derivatives, cellulose xanthate, can then further be regenerated to become viscose or rayon (Gierer, 2014). Compared to cotton, viscose has a lot shorter molecule chains and the fiber structure is more amorphous and this is why viscose is a lot weaker, especially when wet, but the ability to absorb water and moisture is a lot better in viscose compared to cotton (Furvik, 2014).

Zhang et al. (2010) states that the cellulose pulp can be used to make cellulose sponges. The cellulose is mixed with a pore forming agent and absorbing fibers as reinforcement. The mixture is then poured into a large mold where it is cooked, allowing the pore forming agent to melt and sink to the bottom of the mold. The pores in the finished sponge are created by the agents' movement (Zhang, et al., 2010).

### 4.13.2 Environmental effects of pulp production

In the process of making mechanical pulp very little solid waste material is created. The solid waste material that is created comes from the debarking process. The wood, sawdust and chipping dust is commonly used as fuel to utilize their energy value. During the process of making mechanical pulp a lot of emissions are dissolved and dispersed in the process waters. There is a lot of research conducted as to how large the amount of substances in the water is, but a lot of conditions vary wherefore the results are hard to compare. A lot of the water systems in pulping mills are circulated and the water is used several times in the process. Today there are several different methods for external and internal purification of the effluents. Canadian market pulp mills have created a technology called ”Zero Effluent” where the waste material is removed by mechanical clarifiers and the removed sludge is dewatered and burned in a waste fuel boiler. (Sundholm, 1999)

### 4.13.3 Cotton

Cotton needs a hot and sunny climate to grow, and during the growing season water/rainfall is needed. It also needs to have soil with a lot of nitrogen in it, which is implemented by the farmers who use fertilizers to improve the soil. (Zeander, 2002)

The process from seed to the raw fiber, called lint, is long; firstly the seeds are placed in ridges of soil either by hand or by a mechanical planter (Zeander, 2002). Kristensson (2005) describes how the plant grows up to between one and two meters high, then the buttons opens up to a flower. Following he describes how when the flower wilts, a small green ball of seeds is exposed. It is from of these seeds that the cotton fibers grow. Lastly it is stated how the ball bursts and forms a wad of cotton. To go from seed to cotton takes around six months (Kristensson, 2005). After picking the cotton balls, the next step in the process, according to Kristensson (2005) is transporting the cotton to a cotton wood room. In there the cotton fibers are separated from the seeds, the fibers are then washed, packed and graded after the length of the fiber, color, cleanness and strength (Kristensson, 2005).

The cotton fibers can be used in several settings where the most common usage is apparel which stands for 60 percent of all the usage according to Thorp, et al. (2014). Except for apparel, the cotton is used in home furnishing, such as washcloths and towels, and industrial products such as medical or hygiene articles (Thorp, et al., 2014).
4.13.4 Environmental effects of cotton production

Kristensson (2005) argues that the intensive use of water makes cotton one of the agricultural plants that use the highest amount of freshwater. WWF believes that the lack of fresh water is the most severe environmental problem, therefore are cotton production a threat to the environment. On top of the water usage, cotton farming is the world’s most chemical intense agriculture. According to Kristensson (2005) the growing of cotton are using 11 percent of the world’s agrochemicals and 25 percent of all pesticides. This since cotton plants are exposed to harmful insect pests that can destroy a whole crop. Large amounts of fertilizer are also needed to make the cotton plants grow. The fertilizers makes weed grow and the weed uses the fattening that the plants need, so to control the problem the farmers spreads herbicides to kill the weed (Kristensson, 2005).

When the cotton balls have started to open up the natural way the farmer uses defoliation to remove extensive leaves since the quality of the cotton decreases if it is contaminated, and also to accelerate the process of opening the cotton balls (Zeander, 2002). Chemicals are also used when transforming cotton into products like textile, these chemicals can include bleach and coloring chemicals (Chapagain, et al., 2006).

Lastly, most of the commercially grown cotton plants are genetically modified (GM), these plants are called the Bt-plant and came to the market in 1990. This plant is more resistant to pest which has led to a decreased usage of pesticides. Even if this is positive, the long term effects from GM-plants on the biological diversity have not firmly been examined. (Qaim & De Janvry, 2005)

4.13.5 Natural sponges

There are several variants of natural sponges, they can be large or small, round or flat and in an array of colors. Sponges are one of the simplest forms of animal organisms; they do not have a heart or lungs. They do not have a nerve system and their body is built by a soft material called spongin. (Coldiron, 2008)

Sponges exist in all kinds of waters from Antarctica to Arctic and in some waters they conduct 80 percent of the biomass according to Bergquist (2001). Most sponges grow on hard materials such as stones or underwater mountains (Bergquist, 2001). Krautter (1998) describes how sponges have their habitats in tranquil waters due to the fact that sediment can clog the sponges pore. They are not dependent on salt levels in the water so they are able to grow in a lot of different settings (Krautter, 1998).

Even though sponges grow in natural setting, more and more commercial sponges are cultured. This cultivation has increased from the 00’s until today because the market demands have exceeded the amounts that can be harvested from natural grown sponges. The natural sponges have decreased in extent the past years due to overfishing and periodic diseases. When it comes to aquaculture of sponges the two most common cultivation methods are to grow them in mesh nets and on threaded rope. (Duckworth, 2009)

4.14 POLYMERIC MATERIAL

Polymeric materials, plastics, can be divided into three main groups, thermoplastics, thermosets and elastomers. Regardless of which type of plastic that is used the ageing of the material needs to be considered. All polymeric materials are affected by water and the structure breaks down from UV-light from example the sun. All three groups are produced by polymerization of hydrocarbons that is mainly recovered from crude oil and natural gas. Today 4 percent of all crude oil is used in the production of plastic. Due to the environmental effects that the recovery of crude oil has had, the interest for using natural materials such as cellulose for producing polymers increased during the last decade. (Johannesson, et al., 2013)
4.14.1 Thermoplastics

The thermoplastics are fusible and can therefore be melted and reused. It is usually limited to use in environments under 100 degrees Celsius. These plastics are most common in household items such as electrical equipment and pipes. Injection molding is a common method to make items out of thermoplastics, but this method is expensive to use due to the extensive cost of tools. To make thin layer plastic the low density polyethylene (LDPE) is used, this plastic is suitable to make, for example, plastic bags from. Thermoplastics are also used in some types of textiles, usually polyamide (nylon/PA). (Johannesson, et al., 2013)

4.14.2 Thermosets

A chemical reaction that makes cross formations between the molecules when hardened makes thermosets. This type of plastic is resistant towards heat and cannot be melted and is degraded when heated. The property of not melting leads to the fact that thermosets cannot be reused in another form than the original shaped design. Due to its high form stability are thermosets suitable for structures that need high durability such as car and airplane structures. To be able to work with this type of plastic, good ventilation is needed because of toxics and dust that is excreted when forming and producing. (Johannesson, et al., 2013)

4.14.3 Elastomers

This type is a highly elastic material that is retaining its volume even when it is exposed to pressure or tensile. It is composed out of chemical reactions and vulcanization usually with sulfur. The polymer is cross-linked when formed in to a detail, which in return leads to that it cannot be recycled. Natural rubber is the most used type of elastomer today but other types of rubbers starts to take more market shares. The new types of synthetic rubbers have other properties that make them more sustainable towards high temperatures and chemicals. (Johannesson, et al., 2013)

Silicone rubbers are one type of elastomer that was developed specially for injection molding. To make silicone rubber products, two components are mixed and then cured into the desired shape. The two components contain polydimethylsiloxanes and polymethylhydrogensiloxanes respectively. The curing mechanism is either hydrosilylation or condensation cure. Hydrosilylation curing is when the curing begins directly after the two components are mixed due to chemical reactions in the silicone. Condensation curing is when water condensates and the silicone dries. (Moretto, et al., 2000)

4.14.4 Environmental effects of polymers

Due to the large range of plastics and proliferation of them combined with the fact that they are hard to recycle and need a lot of chemicals making them leads to an environmental hazard. Many of the chemicals used to produce polymers are hazardous for both humans and environment and can also be emitted throughout the use and afterlife, the worst kind of polymers are made out of monomers that is classified as carcinogenic. The production of raw material uses crude oil which also gives an environmental effect when produced. Since most of the used plastics goes to landfill there is also a risk of contaminating both the ground and land water. To use landfill as a solution for waste management means that valuable land goes to waste as well. A large part of the used plastics end up as litter in both water and on land. The littering in the oceans contains mostly plastics from landfill or waste on land, this becomes a large problem due to the fact that polymers can need more than hundred years to degrade. There are today a few polymers that are bio-degradable in a natural environment but the markets demands are leading to an increase of such plastics. (Lithner, 2011)
5 Menstruation Protection Methods Used and Produced Today

Descriptions of the female hygiene products used today will be found in this chapter. It also contains descriptions of how the different products are produced. In this chapter is also a categorization of the female hygiene products that exists today presented. The methods are divided into main groups; external and internal methods. These are then divided into smaller groups.

5.1 EXTERNAL METHODS FOR MENSTRUAL PROTECTION

These products are absorbent and are attached either onto a woman's underwear with some type of glue, held there with a string or just placed in the underwear without attachment. In this category there are four types, large- and small scale disposable napkins, re-usable napkins and finally cloths and rags. (House, et al., 2012)

**Large scale disposable napkins**

Sanitary napkins or napkins from large corporations, see Figure 5, that are usually made out of a cellulose material with polymer granulate as a core to absorb fluids. This type is produced in large numbers and can both be imported and exported to all the worlds' countries. The large scale disposable napkins comes in various models and labels, for high and low blood flow, long and short models, thick and thin, with or without wings. Most of the napkins have wings and/or glue on the back to attach them to the underwear. Napkins from this category are the ones that are most commonly found in commercial settings. (House, et al., 2012)

**Small scale disposable napkins**

The category of small scale disposable napkins includes napkins that are locally produced by small factories in low-income countries, see Figure 6. The napkins are made out of different local materials such as banana fiber or papyrus fiber. The core is usually made out of fibers that have not been processed into cellulose. These napkins are simplified and are made in a small scale and sold on a local market. Most of the labels are partly biodegradable and are chemical free. Some of the napkins have both glue on the back and wings, and some do not have this. (House, et al., 2012)
Re-usable napkins

Re-usable napkins, see Figure 7, includes both commercial and locally made re-usable napkins. According to House et al. (2012), this type of napkin is associated with some kind of absorbent fabric and is a sewed, washable napkin. The napkins are usually accomplished with a napkin holder that secures the placement in the underwear (House, et al., 2012). AFRIPads (2014) claims that a re-usable napkin can be used for up to a year if it is handled properly. The napkin needs to be washed before, during and after a period (AFRIPads, 2014).

Cloths and rags

The cloths and rags, see Figure 8, are often made out of old clothes or available fabrics. From this the women cut or tear pieces that then folds into a good size. Some uses clothes to cover up their lower part of the body when they get blood stains. This is a common way to handle menstruation in developing countries due to the low cost. Some women wash the fabric after use, while other throws them away. (House, et al., 2012)

5.2 INTERNAL METHODS FOR MENSTRUAL PROTECTION

The internally used methods are different types of protections that are inserted into the vagina. They either absorb the blood or hold the blood inside the body for the user to take out when full. The category is divided into three under groups; tampons, menstrual sponges and menstrual cup.

Tampons

Zotti (2006) states that a tampon, see Figure 9, is an absorbing plug that is inserted into the female body. Furthermore are there several types of tampons in different sizes. The tampons are usually made out of cellulose and/or rayon and tampons comes both with and without applicators, the type without is called digital (Zotti, 2006). House et al. (2012) describes the applicator as a cover over the tampon that is a double tube that pushes the tampon in place in the vagina. Digital tampons are placed in the vagina by the use of a finger (House, et al., 2012).
A menstrual sponge, see Figure 10, is inserted in the vagina to soak up the blood (CYWH Staff, 2013). As well as the regular type of tampon this also comes in two different types, disposable and reusable, the disposable sponges are made out of polyurethane and are soft, flat and drop shaped (TMM Ventures AB, 2013). The other alternative is the natural sea sponge; these are harvested from the ocean floor and can be used for up to six months according to CYWH Staff (2013). They further state that during use, the sponge only needs to be rinsed in clean water and then placed back in the vagina, and before the first use the user needs to boil or soak the sponge. Both kinds of sponges need to be inserted wet to avoid damaging the inside of the vagina (CYWH Staff, 2013).

Another alternative to the tampon according to Softcup (2013) is the menstruation cup, as seen in Figure 11, that rather than absorbing the blood, collects it. They describe the method as a cup that is inserted into the body to collect blood. There are both disposable and reusable alternatives of the menstrual cup. The reusable cup can, according to Softcup (2013), be used for several years. They state that it is made out of a silicone cup and that the lower part of the cup has a pull-tab that is fixated to make it easy to remove. This type is commonly made out of rubber or medical grade silicone (Softcup, 2013). The other type is a disposable one, a softer cup that should be thrown away after use (CYWH Staff, 2013). This cup is made out of a polymeric material (Softcup, 2013).

### 5.3 PRODUCTION OF EXTERNAL PROTECTION METHODS

The different methods can be produced differently depending on brand etc. Below are short descriptions of how the products are generally made.

#### Large scale disposable napkins

How It’s Made (2010) shows that the commercially available disposable sanitary napkins are produced in large, fully automated machines. Firstly cellulose pulp fluff is mixed with a polymer powder, the polymer is a superabsorbent that can absorb liquids up to 40 times its own volume and turns the liquid into a gel (How It’s Made, 2010). One superabsorbent material, used by SCA, is called Efficapt. It is added to their menstruation productions not for its ability to absorb the blood, but for its ability to absorb sweat and other moisture to make the napkin feel dry and comfortable. The reason Efficapt does not absorb blood is that the protein albumin in the blood stops it from doing so (Emilson, 2009).

The cellulose-polymer mix is then formed into the shape of a sanitary napkin by air suction. The mix is sucked into the mold and thereafter blown out from the mold on to a conveyor belt. In the following steps the formed napkin is sandwiched between two plastic sheets. The bottom sheet acts as a leak proof barrier while the top sheet is perforated to allow the liquids to flow through to the absorbent layer of the napkin and to keep it there. In the next step, a large roller seals and forms the napkin. This is followed by adding strips of glue to a paper strip and adding it on the bottom and on the wings of the sanitary napkin. In these steps, the process still consists of a long, moving tape. (How It’s Made, 2010)

Once all the parts of the napkin are in place, a large cutter cuts the napkin into the correct shape. The final steps of the process are folding and packaging the napkins, both individually and in the packs sold to the customer. (How It’s Made, 2010)
Small scale disposable napkins
Disposable napkins that are made in smaller scale are usually made in manual processes. It contains grinding of an absorbent material, such as banana fiber, water hyacinth, wood pulp or papyrus, to release the fibers and make the material absorbent. The loose fibers are then either on its own or together with recycled paper formed into the shape of the absorbent core of the napkin. The core is then covered with a top and a bottom layer. The top layer is a non-woven material that will allow fluids to flow through to the absorbent and keep it in the core. The bottom layer is either the same type of material as the top or a leak-proof plastic to avoid fluids to leak through the napkin. The top and bottom layers are melted together with electrical machines that are handled manually. Sterilization of the products can be made with UV-lights. (House et al., 2012; Jayaashree Industries, 2010; Musaazi et al., 2013)

Re-useable napkins
The difference between a re-useable napkin and a cloth is that the re-useable napkins are specifically designed and produced for use as a female hygiene product (House, et al., 2012). The napkin often contains several layers of absorbing fabric as well as an underlining plastic coated fabric that serves as a leak-proof barrier. The absorbing fabric can either be fleece or cotton. The fabric is cut either by hand or by machine and sewn together by sewing machines powered by manual or electric power. Buttons are added to the wings of the napkin by a hand powered machine. (Vigström, 2014; Stroud-Romero, 2014)

Cloths and rags
Cloths and rags are made from different types of fabric that can be found in the area. The cloths can be torn up t-shirts or handkerchiefs bought at the market but they can also be made from old fabric found in the household. The type of fabric used is preferably light cotton. Because there is not one type of fabric used the production method of the fabric is difficult to describe. However, most commonly the fabrics are made outside of the developing country. This information was found during the field study described in chapter 7.

5.4 PRODUCTION OF INTERNAL PROTECTION METHODS
The different methods can be produced differently depending on brand etc. Below are short descriptions of how the products are generally made.

Tampons
There are two main methods to manufacture tampons. The method used is decided by whether or not the tampon comes with an applicator. Usually all types of tampons have a cover of a non-woven layer to avoid lint release. (EDANA, 2014)

The digital tampons, without applicators, are produced by starting with a rectangular fiber napkin. The cord for removal of the tampon is folded around the napkin and thereafter the napkin is asymmetrically folded. The folded napkin is rolled and compressed into a cylindrical shape and during this process several longitudinal grooves are formed. When the tampon is exposed to liquid, it expands radially. (EDANA, 2014)

When manufacturing applicator tampons, one also starts with a rectangular fiber napkin. The cord for removal is sewn across the napkin and the napkin is then compressed to a cylindrical shape. This type of tampon expands lengthwise and width wise when exposed to liquid. (EDANA, 2014)

Menstrual sponges
Natural menstrual sponges can be either grown on a specific place or picked from its natural habitat. Since the methods to grow sponges are easy and do not need extensive equipment it can be a good way to increase a countries development and economy. The sponges can be grown in a large scale and still be sustainable for the marine life and the people that are dependent on the water life. To carry out aquaculture the farmer takes a large grown sponge and cut it down in smaller pieces. The pieces are then put in to their growing place and are left there for around two years. Afterwards the sponges are harvested
by divers, either free divers or scuba divers. They will bring them to dry in the air for some weeks. They will then be cleaned in a regular washing facility two times. The process of growing, harvesting and clean cultured sponges does not need any chemicals at all. The sponge is then cut into the right size and can further be cut in shape by the user to fit better. (Sustainable sponges, 2011)

The disposable sponges made of polyurethane (TMM Ventures AB, 2013). According to How Products Are Made (2014), Polyurethane is made by mixing polyols and diisocyanates and heating it up to create a polymer. They describe how foam is then created by mixing the polymer with carbon dioxide which causes the polymer to expand. After drying the foam can be cut into desired shape (How Products Are Made, 2014).

Menstruation cups

The menstruation cup is commonly made of medical grade silicone that is formed to a cup by injection molding. The process is very simple and not very labor intensive. The two components for the silicone rubber is injected into a mold where they react to reach the desired properties. No other materials or chemicals are used in the production. (Kjær, 2014)

Medical Grade Silicone is silicone that has gone through a certain level of tests. These can be biological testing, skin sensitization and pyrogenicity. It is often used for implants because of its superior properties when it comes to compatibility with human flesh and body fluids. It can withstand the high temperatures of sterilization and is an inert material, meaning it does not react with materials surrounding it. (Da/Pro rubber inc., 2014)
6 Observations from the Field Study

The section is describing the observations that were made from the field study in Uganda. The chapter explains both the authors’ findings and gives some of the interviewed people views of the life situation. The life standard in Bubulo is low and the average income is below 1 dollar per day and they are mainly living "hand to mouth". The buildings mostly consist of mud and the flooring in the houses is rammed soil. This combined with the climate in the area makes the surrounding dusty in the dry periods and flooded in the rain season. These conditions make it hard for the people to save personal things and money. Most of the population work as farmers and have only been in school for a short period of time, wherefore analphabetism is spread in the country. People living in Bubulo help each other out in a large extent and are both friendly and curious in their nature.

6.1 ELECTRICITY

A lot of the electrical energy in Uganda today comes from hydropower plants. The Nile, which starts in Lake Victoria, is dammed up to be able to extract energy from it. However, the electric energy is not stable. The power net delivers electricity most days but rarely for the full day and it comes and goes without a warning. During the three week stay in Bubulo the power was gone for as long as two consecutive days. The longest the power was on without a noticeable break was three days. Due to the fact that electricity is not reliable the people have lives and habits, such as cooking over a fire, that are not dependent on electricity.

The use of solar panels to power parts of the houses is becoming more and more common. However, the panels are still very expensive and very few individual families can afford them and therefore it is more common for businesses and organizations to have solar panels. It also seems to be difficult to link the power grid and the local solar panel system, this leads to that the solar panel have to have its own lamps and sockets. The possibilities and potential for using more solar energy in Uganda are good due to their many hours of sun, so it should be a good option to ensure electric power. The Community Development Officer of Manafwa district says that the solar energy is subsidized by the government and he believes that the rural areas can benefit from it even more in the future.

6.2 WATER

In Manafwa District very few households have water pipes connected to their houses. There are several water springs with fresh water in the area, some of them are functioning well whereas some just have a light drizzle as shown in Figure 12.

![Figure 12 - A dripping water hole and containers to carry the water](image)

In those cases it can take up to an hour to fill a 20l container. Many of the households have about 1km to their nearest water source where they go to get water several times each day. There is also the possibility
of collecting rainwater to use but very few applications of this kind seemed to be realized. Most likely the investment of such application is high wherefore none or few could afford it.

Because of the way water is handled, bacteria and diseases can be spread through the water. Some of the springs consist of ground water that is coming up and creates a puddle where the water is collected. During the raining season the puddle is larger and the water sits in it for longer, therefore creating a higher risk of collecting bacteria.

Students from Chalmers University of Technology came to Bubulo in 2010 to install 100 solar panels and a number of water pumps to pump water from Manafwa River to the households in Bubulo. The installation of the panels and the pump went as planned. The municipality of Manafwa was responsible to buy and install the water pipes to supply the households with the water but lack of sufficient funding has stopped the project. Now 20 solar panels are in use supplying only twenty percent of the households intended.

6.3 TOILET FACILITIES

The most common type of toilet in Bubulo is the temporary toilet. A deep hole in the ground is dug and permanent, Figure 13, or semi-permanent, Figure 14, walls are built around it, the opening of the hole sometimes surrounded by cement. The toilet is called a squatting toilet because the user squats down when using it. The toilet is used until it has been filled up, between 1-5 years depending on the number of users, and thereafter abandoned. Most often the toilets are close to but not directly adjacent with the residential houses. The temporary toilets existed both as private to one household, shared between several households as well as public toilets both with and without fees. Temporary toilets do not have any water nearby and the user has to bring water to the toilet if needed.

Some of the households and a few of the schools have fixed toilets. These toilets are, as the temporary toilets, squatting toilets but with the difference that these are emptied when full. The contents of these latrines will be transported away from Bubulo and grinded and made into fertilizer to use on the plantations. Some households had fixed toilets with flushing equipment to flush the excrement down in the hole; these toilets were also squatting toilets.

The water closet as it is known in the west is not very common and can only be found in places where there are a lot of tourists.

The visual difference between a fixed toilet and a temporary toilet in a permanent house is very small as can be seen in Figure 15 and Figure 16.
Common for all the different types of toilets is that the privacy is questionable. A lot of doors are missing or non-existing and the toilets that have doors are missing locks. This leads to that people do not feel safe when going to the toilet and avoids staying in there for too long.
6.4 WASHING AND ABLUTION

The washing of clothes was made by hand by women, either in the yard or down by the river. For the ones who lived far from the river they carried water from their nearest water source to their houses to wash. The clothes were then hung outside to dry as can be seen in Figure 17. Washing in the river was made mostly during the weekends. The women carried the clothes down to the river and after washing and rinsing them, Figure 18, they hung them to dry on bushes or laid them flat on the grass.

![Figure 17 - Hanging clothes](image1)

![Figure 18 - Woman washing clothes at the Manafwa river](image2)

Washing of bodies, ablution, was often made in outside bathrooms or just outside. The bathrooms were often temporary buildings made out of banana leaves as can be seen to the right in Figure 14. A tub of water was brought to the bathroom and ablution was conducted by pouring water over oneself. Some also washed themselves from a tub inside their houses.

The soap used for washing was the same soap that was used for ablution. A large piece of soap that could be broken down in smaller pieces was priced at about 7000UGX which was not an affordable price for everyone. Single bars of washing soap were not common and could almost only be bought at supermarkets in the cities.
6.5 VEGETATION AND CLIMATE

Throughout the whole context area the climate is beneficial for all types of plants, both edible and others. In the area there are two dry seasons and two rain seasons in one year, and the plants grow during both seasons. Due to the height above the ocean the air is moist and the temperature is in average below thirty. The soil is nutritional and it is possible to grow in most places. This climate and surroundings makes it easy to grow and harvest any type of vegetation except for some types of rosacea such as apples. Some of the most common plants to grow were sugar canes, cassava, tomatoes, matoke, coffee beans and soy beans, some of the plants are shown in Figure 19. Along the riverbeds of the Nile and other damp areas, papyrus and water hyacinths can be found.

![Image](image.png)

*Figure 19 - From left to right, coffee beans, matoke and cassava*

The landscapes that consist of both high mountains and low valleys allow for crops to be cultured on both the mountainsides and in the glens. Harvesting of the plants has led to corrosion in some places and this is further escalating in the rain seasons. It also leads to that the valleys flood during these times of the year. The sun is almost always present which allows for quick drying of clothing or the use of solar powered energy.

6.6 PRODUCT SAFARIES

Four different types of protection have been tested by the authors to gain an understanding of what the users experience during their period. During the field study in Uganda a commercial sanitary napkin and a menstruation cup was tested. After the field study a washable napkin and a small-scale produced disposable napkin was tried in the authors’ ordinary context in Sweden.

6.6.1 Testing of commercial sanitary napkin

The tested napkin was one of the cheapest on the market, of the label Princess and had an absorbing area of 24 by 6 centimeters. Due to the darkness in the morning and lack of electricity the padding was hard to execute and the sanitary napkin got in to the wrong place in the panties the first time, it took longer than expected to get it right. It was also hard to determine which part of the sanitary napkin that would go in the front and back. When the napkin was in place and the panties put on, another problem arose, the wrapping paper around the napkin and the glue needed to be disposed. This needed to be thrown away somewhere but there was no waste bin to put it in.

After half an hour the sanitary napkin started to itch on the skin and after forty minutes of sitting down it was creating a burning feeling. Water was poured onto the napkin to simulate blood, even though it was only a table spoon of water the whole napkin felt totally soaked. Even though water cannot simulate blood, it gave a perception of what the napkin would feel like when filled. After a walk for an hour and a half, the napkin had moved and one of the wings had fallen of.
6.6.2 Testing of menstruation cup in Uganda

The menstruation cup was brought from Sweden since it is not available locally. When using the menstruation cup it is, according to the producer, of outmost importance that the hands are clean and that the cup is able to be cleaned. When hands were washed with water and soap, the user did not feel sufficiently clean but often used disinfectant as well before changing the cup, making sure no bacteria were on the hands. The cup needed emptying at least twice a day which leads to a large use of water since the hands needed to be washed before and after emptying the cup. During the test period the user felt no discomfort during the actual use since the cup is not noticeable once placed right. However, there was always a worry as to how and where the emptying and cleaning of the cup should take place. After the menstruation period the cup needs to be boiled to be disinfected, this would have been difficult to do discretely without anyone noticing.

6.6.3 Testing of washable sanitary napkin bought in Uganda

This napkin had an absorbing area of 24 by 6.5 centimeters. The placement in the panties was not a problem due to both lighting and the fact that the napkin was symmetrical and did not have a front and a back. The fastening with snap buttons on the bottom part and the elastic to put the upper part in place was logic and easy to understand but did not feel safe. The napkin itself was soft towards the skin but felt a little bit thick. The use of it did not bother but the napkin was noticeable during the whole time. When it was time to change napkin a problem with handling raised, it was hard to keep the napkin in a discrete place until it was possible to wash it. When using the napkin overnight, it had moved out of place in the morning and blood had been smudged out onto the panties and on the bed sheets. Next problem came when it was time to wash the napkins. The napkin first needed to be soaked which needed a lot of space and the water became disgusting to watch. A lot of blood and secretion were left on the napkins. One napkin was washed in a washing machine and the other by hand. It was not pleasant to wash the napkin by hand and when it was finished it did not feel as if the napkin was clean. The napkin that was washed in a washing machine ended up having stains.

6.6.4 Testing of small-scale, locally produced sanitary napkin bought in Uganda

The absorbing area of the napkin is 20 by 5 centimeters. The napkin did not have a front and back but was difficult to place in the panties since it was hard to know the best placement without experience. When the napkin was used it did not follow the body in a desirable way but was rather stiff, though not uncomfortable. It was creased during usage which led to that the inner, absorbing core started to break apart inside the outer plastic shell. This did probably not affect the function of the napkin but did not make the user feel safe but rather worried that the napkin might break and start to crumble. The user did not feel a worry that the napkin would leak even though it had a rectangular shape and not the soft, figure-of-eight shape you find on napkins produced in large-scale.

6.7 STUDY VISIT ON A SMALL-SCALE PRODUCTION UNIT FOR DISPOSABLE NAPKINS

The production of the disposable napkins is mainly made by hand or by machines that are handled manually. Papyrus plants are comminuted into fibers and mixed with recycled paper. The recycled paper has on beforehand been soaked in water for 24h and crushed with a pestle. The mixture is diluted with water and formed into absorbing cores. After drying, the absorbing cores are softened in rollers and cut into shape by manually handled machines. A bottom leak-proof layer and a top non-woven layer are melted together with a heater, powered by electrics but handled manually, with the absorbing core inside. The excess material is cut away with ordinary scissors and adhesive strips are added to the back of the napkin. The packing of the napkins is made manually and the plastic bags of napkins are sealed with a heater. The packets are then placed in barrels with UV-light for them to be sterilized. The water used on the site is rainwater that has been collected over time. Solar power was used to power the heaters.
7 Empirical Findings in Uganda

The sector regards the results from the empirical finding from the field study. This presents the data collected from the forty-two individual interviews and the group interview made with forty schoolgirls. The representation is divided into five parts, from their view on their life situation to their knowledge about menstruation and their user requirements for future menstruation protections.

Even though the interviews gave qualitative data, the theses authors found it suitable to present the results in a quantitative manner due to the large number of respondents.

7.1 LIFE SITUATION IN BUBULO

The span on the respondents stretched from the age of 13 up to 75 years. Most of the interviewees were up to 18 years old and the median age of the respondents were 18, the whole range can be seen in Figure 20. Ten of the interviewed women are boarding students that lived at the school in dormitories. A comparison of how the interviewed women lived can be seen in Figure 21. As can be seen most families lived in their own houses, these houses were of semi-permanent type. The people that are renting and the ones that live in dormitories live in permanent houses. Two of the interviewees did not make a statement in the question. If the responding girls that lived in dormitories are excluded, the average family consists of 5.3 people. Out of the interviewed girls and women 27 were not married yet, 9 were already married and 6 of the women were widows.

![Ages on the respondents](image1)

**Figure 20 - The range of ages on the respondents**

![Housing](image2)

**Figure 21 - Description of the living situation**

The occupations amongst the interviewees did not vary in a large extent, there was only five different occupations represented. Almost half of the interviewees are students and furthermore were there nine of the interviewed that did not have an occupation at all, shown in Table 1 is all the occupations represented. Occupations in the families were showing similar numbers where six different occupations were represented. Ten of the females said that they had at least one person in the family that were working and six stated that they did not have anyone working, this occupations are also showing in Table 1.

<table>
<thead>
<tr>
<th>Occupations amongst the participants</th>
<th>Occupation represented in the participants families</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmer</td>
<td>Business woman</td>
</tr>
<tr>
<td>Hair dresser</td>
<td>Business man</td>
</tr>
<tr>
<td>Social worker</td>
<td>Student</td>
</tr>
<tr>
<td>Student</td>
<td>Teacher</td>
</tr>
<tr>
<td>Teacher</td>
<td>Business owner</td>
</tr>
<tr>
<td></td>
<td>Farmer</td>
</tr>
</tbody>
</table>
All of the women that have been interviewed have some form of education but most of the girls have not reached a higher level of education than primary school, only three girls had a diploma or degree. When it comes to economics and poverty, which is widespread throughout Uganda, there were only three participants that said that their family had enough money and for the others the economy was insufficient.

As can be seen in Figure 22, most of the interviewees have temporary toilets, almost 73 percent of them. In the group that has a fixed toilet are ten of them living in dorms and their toilets are taken care of by the school. Only one person had a fixed toilet at home and she was renting her room. Out of the people that do not live at a school seven of them share the toilet with at least one other family than their own and the girls that live at school share three toilets all together.

![Toilets used](image)

**Figure 22 - The proliferation of the different types of toilets amongst the interviewees**

Everyone except for one cleans themselves outside, some have a specific place to take baths and some cleans themselves out in the open, 13 of the interviewed that have a specific place to take baths shares it with other families. None of the women have access to running water and all of them had to carry water home between one and three times a day depending on the largeness of the household. The distance to get water varies from 30 meters to 15 kilometer and most of the interviewed had between one and one and a half kilometer to water.

When it comes to waste handling, most of the interviewees had a specific place to throw away garbage. All of them burned their waste in some amount. In 20 of the families the rubbish pit contained all kinds of waste and got burned between one time a week and three times a year. Only one said that she did not have any place to throw her own garbage and therefore threw it at the roadside. Two girls stated that they throw everything that decompose on the banana plantations and only burned plastics.
7.2 KNOWLEDGE AND ACTION TAKEN IN CONJUNCTION WITH MENSTRUATION

The span over when the interviewees got their first period were broad, from 11 years old up to 18 years old, and the average age to get their period were 14.6, the age span can further be seen in Figure 23.

The knowledge about menstruation and how to handle it before the interviewed females got their first menses were collected from seven different sources, mother, school, sister, aunt, grandmother, best friend and older girls at school but 16 of the responding females did not have any knowledge at all before they got their first period.

Most of the interviewees told their mother when they got their period but some did not tell anyone and only one person said that she told a friend. A majority of the participants said that menstruation is not something that they talk about. Due to the fact that many of the girls did not know that menstruation existed, some of them got scared and embarrassed when they had their first period. It was 38 participants that answered the question about what kind of method they used the first time, most said that they used napkins but some also used cloths, only panties, rags that they tied to their bodies and a handkerchief, this can be seen in Figure 24.

Figure 23 - The spread over what ages the respondent females got their first period

Figure 24 - Showing of which methods the participants used during their first period
A vague majority of the polled women have been inhibited by their menstruation during their life. These inhibitions are both due to their menstruation method but also from menstruation pains and infections. Out of the 33 females that responded to “if they have had any inhibition due to their menstruation” had nine of them missed out on school because of their menses, this is shown further in Figure 25.

![Inhibitions due to menstruation](image)

*Figure 25 - Showing the different problems that the responding females replied they have had*

The different kinds of illnesses that responding females have experienced due to their menstruation are shown in Table 2.

*Table 2 - Showing the different diseases that interviewees have experienced*

<table>
<thead>
<tr>
<th>Illness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaginal infection</td>
</tr>
<tr>
<td>Extensive menstruation pains</td>
</tr>
<tr>
<td>Rashes</td>
</tr>
<tr>
<td>Burns</td>
</tr>
<tr>
<td>Itchiness</td>
</tr>
<tr>
<td>Urinary tract infection</td>
</tr>
<tr>
<td>Fatigue and Weakness</td>
</tr>
<tr>
<td>Weight loss</td>
</tr>
</tbody>
</table>
Another problem that girls faced were that most of the girls could not afford to buy protections for themselves, most of them said that either they or their parents had trouble paying for napkins. From the group that talked about costs for napkins said 77 percent that they had a hard time affording napkins, this shown in Figure 26. They said that they are paying between 2000-3000 UGS for a package of napkins; most of them also said that they only needed one package per period due to that they could use a napkin for up to 12 hours before changing.

![Affordability Chart](chart.png)

*Figure 26 - Chart of how many of the interviewed females that could afford to buy napkins*

### 7.3 MANAGING THEIR MENSTRUATION

During the study all the females got a question concerning what type of method they were using today, many of the women used a combination of two methods. Most of the respondents wanted to use napkins if they could, but as shown earlier a majority could not afford to buy them. Therefore the responding female used at least on other method than napkins. Figure 27 shows what methods the interviewees were using; because of the mixed use of methods from the respondents the question got 69 answers.

![Used products](chart.png)

*Figure 27 - What protection the respondents’ use today*
The changing from a used to a clean protection mainly takes place inside the house if the participant were at home or the dormitory for the girls that were living at school. In the group that went to school or worked during the day, the change took place at the toilet during the day and inside the house when they were at home. Some of the interviewees always changed at the toilet and a few in the bathroom. When it comes to the changing the responding females stated that they needed to change their protection between 2-5 times during a day.

Table 3 is showing the different ways that the interviewees kept their protections before use and it also shows how they dispose their product. What can be said is that more or less all of the females in the study that used their protection only once threw it in the toilet. If they were using a protection that was possible to use more than once, like a rag or a cloth, they sometimes used it only once and sometimes more than once with washing in between uses.

Table 3 - Handling of protections before and after use

<table>
<thead>
<tr>
<th>Ways of handling the protection before use</th>
<th>Ways of handling the protection after use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keep them in a box (napkins, reused cloths, rags etc.)</td>
<td>Throw them in the toilet (one time use protections, both napkins and fabrics)</td>
</tr>
<tr>
<td>Keep them in a bag (napkins, reused cloths, rags etc.)</td>
<td>Throw on the rubbish pit (cloths)</td>
</tr>
<tr>
<td>Iron them (protections made from fabric)</td>
<td>Wash directly and then dry them inside (reused cloths, rags etc.)</td>
</tr>
<tr>
<td>Wash an apparel and then tear it into smaller pieces</td>
<td>Roll in newspaper and put in bag, washes once coming home</td>
</tr>
<tr>
<td></td>
<td>Wash and dry outside if no one is around to see</td>
</tr>
</tbody>
</table>

Most of the interviewees was throwing their used protection into the toilet or washed them and hung them inside the house and some of them also got the question why they handled their protection the way that they did. This made it clear that they had worries about what others would think about them if they exposed their product after use or when washing and drying them. They believed that it would look bad if someone would see it or that children or animals would pick them up from a rubbish pit. There were also a few that said they did what a teacher or the school said that they should do and one girl stated that she was throwing the napkin into the family toilet because it will decompose and that is good for the plants.
7.4 KNOWLEDGE ABOUT PROTECTIONS AND THE POTENTIAL USE OF OTHERS THAN TODAY

When it comes to the question about what kind of protection the interviewed females would like to have, it was 41 people answering, the ones that had had menstruation. Out of this group, 88% wanted to have disposable napkins. The others wanted to use panties, rags or washable napkins. The spread of ages compared with preferred protection can be seen in Figure 28. The reason most of the participants gave for why they do not use napkins today was that they are too expensive; if they could afford it they would use them. The knowledge was low regarding other products or protection than napkins. Only one person said that she knew about another product than napkins on the question “if they know any other products than napkins”. This person said that she knew about MakaPads, thought this is also a disposable napkin but she would not want to use it because it is for “poor people”. The others stated that they had heard of people is using cotton, rags and cloths. 21 of the females that got interviewed got questions about protections that should be worn inside the vagina. Out of these, only one knew that such protection existed, this person had also tried to use a tampon once. Out of the others that did not know about an insert able protection, seven said they would try it if such protection existed and 14 stated they would not try it even if it existed. The reasons to use such a product diverge, but some states that they probably would be better than the protection they have today which makes them want to try it. Another girl believes it would be more hygienic than the rags she was using since she could throw it away, but foremost it was important that the protection would not hurt. Reasons for not using the inside protection was for example that they would not be comfortable to have something inside their body, the thought that it would not be good for the body and it could bring sickness, diseases or pain.

Figure 28 - A comparison between the interviewee’s age and what protection they prefer
Figure 29 shows what the interviewed females thought about washable napkins. There were 19 people that answered the question. The motive to use washable napkins was only that they are more affordable in the long run. The reasons not to use a washable napkin can be seen in Table 4.

![Use of washable napkins](image)

**Figure 29 - The amount of interviewed girls that knew about washable napkins and if they would like to use them**

**Table 4 - The answers on why the interviews did not want to use washable napkins**

<table>
<thead>
<tr>
<th>Why they did not want to use it</th>
<th>Feels better to throw away than to wash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can be difficult to dry them due to privacy</td>
<td>Feels outdated</td>
</tr>
<tr>
<td>Lack of hygiene that comes with it</td>
<td>It would look bad and dirty to have to wash the napkin</td>
</tr>
<tr>
<td>Problem with the smell when they have to carry them home from school</td>
<td>Problem with smell</td>
</tr>
<tr>
<td>Needs water and soap to clean them, which they cannot always afford so they cannot be washed correctly</td>
<td>Because it needs to be washed</td>
</tr>
<tr>
<td>Does not like the idea of washing blood</td>
<td>Would be difficult to wash in school</td>
</tr>
</tbody>
</table>

The last part of the interview sessions was about what future products could look like. The response rate on this question was low due to that most of the interviews saw napkins instead of their now used method as the future for them. One girl thought that it would be washable because that would be more affordable. Two females stated that they needed to be disposable and one said that she did not want it to be napkins because they are so uncomfortable.
7.5 USER REQUIREMENTS

If the females in Bubulo got the possibility to decide the price on napkins for the future, some of them think that they should be free while others said that it is important that they have a price otherwise no one would take care of them. In average the price should be around 1700 UGX if the interviewed females could decide.

A majority of the girls that had something negative to say about napkins thought that they were too expensive as noted before, see Figure 30.

![Cons](image)

**Figure 30 - What the interviewed group thought was negative with their protection**

The interviewees also had the possibilities to say what they believed is important for a working usable napkin; the requirements are summed up below:

- It should not leak
- It should not give out smell
- It should be affordable
- It should be soft towards the skin
- It should be able to throw away into a toilet
- It should sit firmly
- It should not need water to use
- It should make them feel free
- It should be comfortable
- The user should feel clean
- It should have individual sizes
- It should be flexible
- It should not make anyone sick or give rashes, burns etc.
- It should hold blood for more than four hours
- It should be easy to use
- It should be light and thin
- It should be wider
- It should be longer than the usual napkin
- It should be shorter than the usual napkin
8 Opinions from Experts

The chapter shows the results from interviews made with experts both in Uganda and in Sweden regarding life situations, the future development of both Uganda and the protections as well as their view of environmental issues.

8.1 OPINIONS FROM EXPERT INTERVIEWS IN UGANDA

The experts are representatives from two small-scale manufacturers, a headmaster from a school in Bubulo, the Community Development Officer (CDO) of Bubulo, a midwife and an organization distributing menstrual cups in Uganda.

All the interviewed agrees on that the taboo and stigma around menstruation is still very large. It is mentioned that menses is too private to talk about and that even husbands does not know when his wife is on her period. The stigma affects the private life in general and to wash panties and/or washable napkins or cloths soaked in menstrual blood where somebody else can see is unacceptable. The drying of the same is also needed to be done in private.

The situation for women in general is not very easy and it is seldom prioritized for families to make sure girls attend school. One of the interviewees says that the attitudes are changing and that some of the families have realized that girls often do better in school and have a higher tendency to go through with higher education. Still, he continues, this is not the same for all the families and some girls are married off at the age of 13 or 14 to increase the family’s wealth. It has been reported of boarding students who do not want to go home between the semesters due to the fear of not being allowed to return.

The interviewees tell of girls staying home from school due to lack of protection. The girls are scared of the embarrassment a possible leakage would cause. It is also told of the need of good, clean latrines in school since some of the girls today choose to use the bushes or not go to the toilet at all. The headmaster describes the problem of disposal of used napkins, he believes there is a hygienic risk if the napkins are thrown where they can be found and therefore recommends his students to throw the napkins in the toilets.

According to two of the interviewed the problem often lies in that the families do not prioritize buying menstrual protection for their girls. Very often the money goes to other things such as alcohol instead. The two representatives from the manufacturers of hygiene products state that the families that can afford buying napkins often buy the name-brand products since these are the ones advertised the most and therefore the one they think is the best. It is easier to get the ones already spending money on protection to change the type of protection they buy than to get the ones who do not prioritize it to buy any. Many in the target group for local products are still too poor to be able to buy anything at all. The CDO and the midwife state that work is done to try to get families to see the importance of girls having napkins.

One of the manufacturers mentioned that because Uganda used to be a colony, the country have very little belief in itself. Many believe that products produced outside the country are of higher quality compared to locally produced goods. Both the manufacturers state that they use material from outside the country because the type of material and quality they ask for is not produced in the country.
The manufacturers, the Midwife and the organization distributing menstrual cups were asked to list what is good and bad with their products. These opinions are summarized in desired characteristics of a method for protection:

- soft on the body
- follows the body
- quickly dries after wash
- low cost
- hygienic
- economical
- sustainable in long term
- no or little need for water when changing
- long time between changes
- absorbent
- retaining
- sterile
- simple production process
- scalable production process
- figure of eight shape
- material on back to avoid leakage
- raw materials should be easily processed before production
- privacy
- bio-degradable

These characteristics were mentioned by more than one interviewee:

- low environmental impact
- comfortable
- stays in place

One of the producers says that the base components of a napkin is a top layer allowing the liquid to flow one way, an absorbent allowing the liquid to be absorbed and retained, and a bottom leak-proof layer.

The headmaster sees the problem that alternatives to the commercially produced napkin are not available locally. He tells us that he has heard of washable napkins but that they are only available in the bigger cities. This is confirmed by the midwife who sees this as a big problem. Several of the interviewees believe that in the future it needs to be a lot of alternatives available on the local market. They do not believe in one single universal solution but that there are solutions depending on the local circumstances and the demands from the women.

The distributors of the menstrual cups describe how important it is to not only distribute the product but also information along with it. They inform both about the usage of the cup as well as menstruation and health issues in general. The midwife describes how essential it is to start with the grassroots when trying to spread information. She also tells us of how she goes out to schools and talk about health.

Local production of menstruation protection is important according to both manufacturers. They say that not only is it important because it creates affordable products but also because it creates working opportunities. This is also a reason for not making the processes automatic since that would take away labor from the workers.

Regarding the development of the country as a whole, the opinions diverge amongst the interviewees. The CDO believes the future is bright with higher level of education, more enterprises and that the agriculture will become more modernized. He also believes that within a few years many of the households and most schools in Bubulo will have running water and flushing toilets. One of the manufacturers however believes that the poverty in the country will grow and that the gap between rich and poor will become even wider this due to the growing population. The other manufacturer as well as the CDO believes that the expansion of solar panels will lead to higher education since the students will be able to study in the evenings.
8.2 OPINIONS FROM EXPERT INTERVIEWS IN SWEDEN

These thoughts and opinions come from two product developers and one environmental specialist in the field.

All interviewed are agreed on that the subject of menstruation and menstruation protection is very taboo and stigmatized. One of the product developers have had experiences where women talk very openly about menstruation even though it is very taboo. She has also experienced that women in developing countries answer questions in a different way compared to, for example, Swedish women. Swedes care to elaborate a lot more without needing to be asked whereas in other countries a lot of follow up questions are needed to get answers. They interviewees agree on that they think it will get less taboo in the future.

The product developer for menstruation products says that women in developing countries often use their napkins for longer periods of time, meaning they need fewer products for the duration of their period. She says that there are different demands on different markets but that this does not affect the design of the product but rather what products are sold on the certain markets.

There are difficulties in spreading information about handling and dispose of the products. A lot of information are printed on the package but this does not guarantee that the information is read and understood. It is also difficult for companies to affect waste handling etc. locally in different countries. From a sustainable point of view, the waste of products is not the most important issue, it is more important that school girls get the possibility to attend school even though they are menstruating. In that perspective waste handling is a smaller problem.

For the future, the product developers see that new materials will come that are more environmentally friendly. The development this far has come from new materials and new processing techniques and it is likely that it will be the same for the future. There are a lot of patents in the industry affecting the development of new products, both in positive and negative ways. Patents need to be worked around but at the same time an obstacle can lead to new ways of thinking.

All the interviewed state that the production of their products is made as material efficient as possible. The little production waste that is created is often recycled or reused. One of the environmental aspects both companies are working on now is trying to reduce the amount of material in their products, to absorb the same amount but with less material. A product with less material will lead to less use of resources as well as less waste and as such smaller environmental impact. It is also mentioned that they want to use the raw material as efficient as possible and reduce waste since the raw material is expensive.

When asked if the company uses any material from renewable sources or recycled material the response is that the demand is not big enough. Those materials are today more expensive which will lead to a more expensive product, something the customers are not interested in yet. It is also discussed the difficulties in changing from one material to another since they have found that material from renewable sources sometimes do not have the same properties as materials used today. Further it is questioned whether bio-degradable really is a good option since if it degrades without oxygen, methane gas is created. Both companies interviewed demand full traceability on their products and raw material, because of that there is a difficulty in using recycled material. It is also believed that the recycled material have quality variations.

One of the companies interviewed work extensively with life cycle analysis, LCA, on their products. The LCAs show that the extraction and processing of raw materials are the biggest contributions on the environmental effects from the product. This even though 60 percent of the napkins sold in Europe end up as landfill.

A difference between the two companies is the location of their production relative to their product development department. One of the companies has their production and product development close to
each other, leading to easiness in trying to get a holistic view and a tight process, according to the interviewee. The other company has a global production with several production sites out in the world but none close to the development department. This, they believe, leads to that distribution of the products on a global market is easier. However, all interviewees agree on that distribution to rural areas in developing countries is a very difficult and complex question.

The basic demands on a napkin are having a top layer, an absorbing layer and a bottom leak-proof layer, according to two of the interviewees. Other demands or wishes that are put on their products, for now or in the future, have been transformed into demands on a product down below:

- discrete
- individually wrapped
- easy to dispose
- flushable
- visible bleeding pattern
- sit tight on the body
- discrete packaging
- absorption and spread of the blood
- flexibility in material
- soft
- ability to fasten in panties
- environmental friendly
- color & fragrance
- easy to wash

The size of the product mostly depends on how heavy the flow is. Women are very similar in size when it comes to the width between the tendons in the crotch. This space is more or less independent of weight or age on full grown women.

Regarding what markets the companies are aiming for in the future the answers are different. One of the companies’ replies that they are aiming more for Europe whereas the other company does not want to talk about what their future markets are. The latter sell their products in small packets in developing regions. This is for people to be able to afford their product even if they do not have a steady income or can build up capital over a few days.
9 Concept Development

During the concept development phase all the studied areas were analyzed together, this includes both the gained knowledge from the field study and the theory. The methods to develop towards a final concept included both discussions and well established processes. A description of the results from each part of the concept development phase can be found below.

9.1 THE NEEDS AND SPECIFICATION OF REQUIREMENTS

The opinions from users and producers from the field study were combined together with the environmental needs from QFDE and the studied theory to get a list of needs to start the concept development process. Listed in Table 5 below are the converted opinions.

Table 5 - List of needs

<table>
<thead>
<tr>
<th>No.</th>
<th>Need</th>
<th>No.</th>
<th>Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minimize use of water in use</td>
<td>16</td>
<td>Easy handling</td>
</tr>
<tr>
<td>2</td>
<td>Minimize use of soap</td>
<td>17</td>
<td>Reduce smell</td>
</tr>
<tr>
<td>3</td>
<td>Minimize use of water in production</td>
<td>18</td>
<td>User should feel fresh</td>
</tr>
<tr>
<td>4</td>
<td>Minimize use of electricity</td>
<td>19</td>
<td>Safe emission</td>
</tr>
<tr>
<td>5</td>
<td>Scalable production process</td>
<td>20</td>
<td>Ensure no leakage</td>
</tr>
<tr>
<td>6</td>
<td>Raw materials should be easily processed before production</td>
<td>21</td>
<td>Reliable</td>
</tr>
<tr>
<td>7</td>
<td>Easy dispose of product</td>
<td>22</td>
<td>Available in individual sizes</td>
</tr>
<tr>
<td>8</td>
<td>Hygienic</td>
<td>23</td>
<td>Maximize time for holding liquid</td>
</tr>
<tr>
<td>9</td>
<td>Follow body movements</td>
<td>24</td>
<td>Not noticeable for the user when worn</td>
</tr>
<tr>
<td>10</td>
<td>Not cause irritation on skin</td>
<td>25</td>
<td>Harmless to living environment</td>
</tr>
<tr>
<td>11</td>
<td>Not cause irritation in vagina</td>
<td>26</td>
<td>Minimize use of raw material</td>
</tr>
<tr>
<td>12</td>
<td>Not cause pain</td>
<td>27</td>
<td>Minimize use of material</td>
</tr>
<tr>
<td>13</td>
<td>Affordable</td>
<td>28</td>
<td>Easy to process and assemble</td>
</tr>
<tr>
<td>14</td>
<td>Available locally</td>
<td>29</td>
<td>Easy to process wastes from production</td>
</tr>
<tr>
<td>15</td>
<td>Discrete handling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The needs were used to create the specifications of requirements. Requirements and needs were correlated to make certain all needs were taken into account when creating the specification of requirement. This first specification of requirements was made general to not exclude any solutions. The different requirements were divided into “musts” and “shoulds”, the “musts” are presented below and the “shoulds” can be found in Appendix N and O together with the general specification of requirements.

- Low complexity of production – to make sure the production can be run as simply as possible and without the need of expensive equipment
- Not cause user or others harm – to make sure the product will not harm the user in any way, not causing rashes or pains
- Production cost – the cost for making the product should be as low as possible to make sure it is affordable for women in the context
- REACH – fulfill the demands of REACH on chemical substances to not be harmful for the environment
- Retain menstrual liquid – specifies how much liquid the product will hold and will set the period of time for how long the product can be used
- Safe emission – energy and materials used in product and production should not let out any harmful emissions
• Source of materials – materials in the product should come from sustainable sources or be recycled material
• Sterilization in production – the product needs to be sterilized in production to make sure it will not spread diseases or bacteria
• Workers should not be harmed in production – to make sure the factory is a safe and attractive working environment

The “shoulds” were weighted using four parameters for each of the seven human needs. The four used parameters were created for each human need; long term effect and technical aspects in production and product respectively. These parameters can be found in Appendix M and how they were scored can be found in Appendix N. The requirement was weighted regarding to how many of the parameters it fulfilled and got the collected score from these parameters. The “must” requirements were given full score which was 58 points.

9.2 IDEA GENERATION

A function analysis was made to find solutions to be combined into concepts. The handling of menstruation was analyzed with regards to the information collected during the literature review and field study. The sub-problems that needed to be solved to find a concept were defined as:

• user friendly
• environmental friendly
• retain menstruation liquid
• fastening
• production
• function after use
• cleanliness

Different solutions to the sub-problems were generated and the result can be found in Appendix P. These different solutions were combined randomly to create 15 starting concepts. The starting concepts where discussed thoroughly to find new ideas and solutions to the different sub-problems. Finally six concepts were created that were believed to be able to be developed to realistic products. These are presented on the following pages.
Homemade tampon

A tubular mesh, shown in Figure 31, that can be filled with a suitable absorbing material of users choice. The mesh needs to be disinfecting to ensure potential bacteria in the filling material are removed. The user can buy only the mesh or buy material to fill it with as well. To ensure user does not bring bacteria from hands into the vagina the tampon is inserted with the help of an applicator and can be removed by using the other end of the applicator. Depending on the filling material and the amount of material the tampon will absorb different amounts and fit the user. The mesh should be bio-degradable, have a discrete color and contain a plant seed that can grow once the product is disposed. It would also be possible to make this concept into a service where the used product is sent in return, to be washed and reused, when new ones are bought.

Figure 31 - Homemade tampon

Menstruation cup for short time use

Menstruation cup for short time use, Figure 32, which is made of an elastomeric material and can be produced cheaply by manually brushing material into a mold. The life-length of the cup does not need to be longer than six months and the cups can then be collected and reused for other purposes, for example being assembled into a mattress. It is important that the production cost is low so that the product will be affordable even though it is not a single use product.

Figure 32 - Menstruation cup for short time use

One time use menstruation cup

A product, shown in Figure 33, that can be inserted into the vagina at the start of the period and not be taken out until the period is over. It consists of a soft bag that is rolled up inside a holder. The holder sits firmly on the walls of the vagina and as the bag fills up it is rolled out of the holder allowing it to hold more liquid. This product is only used once but only one is needed per menstruation cycle.

Figure 33 - One time use menstruation cup
Panty with disposable napkin

Reusable panty with holder/fasteners for disposable napkin, shown in Figure 34. If user wants to they can fold rags and put it in the holders. The disposable napkins are bio-degradable and can be used as fuel when they are rolled up and locked together by geometry. The napkin is simple and cheap to produce due to its rectangular shape and no need of wings or glue and can be made from renewable sources. After use the napkin should have a discrete color. The panty has one holder in the front and two holders in the back to allow different sized lengths of napkins to be used. After years of usage the fabric in the panty can be used to create other products, for example mop heads. It should also be possible for the user to sew on the holders on their existing panties.

Disposable napkin

A sanitary napkin, shown in Figure 35, with wings and glue to fasten the napkin in the panties. The napkin should be made out of bio-degradable materials so that it can be disposed of easily. A seed should be contained in the napkin so that when the napkin is disposed a plant will grow out of it. The napkin should have adjustable sizing and could, if desired, be rolled up and used as fuel.

Tampon with applicator

A tampon, shown in Figure 36, made of bio-degradable material and therefore easily disposable. The tampon can be made my rolling a material on a thin rod and thereafter cut in the right length. The hole in the middle of the tampon will allow oxygen to flow through and help in the degradation. A seed should be contained in the tampon so that when the tampon is disposed, a plant will grow out of it. To ensure user does not bring bacteria from hands into the vagina the tampon is inserted with the help of an applicator and can be removed by using the other end of the applicator.
9.3 WEIGHTING AND CHOOSING A CONCEPT

The six realistic concepts were weighted with the help of concept scoring to determine which concept fulfilled the requirements best. The points awarded were based on the collected knowledge from the user interviews, the expert interviews, the product safaris and the literature study. The result can be found in Appendix Q. The concept with the highest score was the panty with a disposable liner and it was therefore chosen for continuing development.

Existing products and methods; commercial sanitary napkin, tampon, washable sanitary napkin, locally produced sanitary napkin, reusable menstruation sponge, menstruation cup and rags/cloths, were also weighted with regards to the same requirements to find weaknesses and strengths. These learnings were taken into account when further development of the new concept was made. In the existing products the manufacturers have learned to optimize the use of material and to design the products to absorb and retain menstrual liquid as efficiently as possible. The need for water when using and producing some of the existing methods; menstruation sponge, tampon, washable sanitary napkins and menstruation cup, makes it hard to fulfill demands such as low usage of water and sustainable materials. Some of the methods are often made in large, complex machines, making it difficult for them fulfill the demand of local, manual production. The full evaluation can be found in Appendix R.

To test the new concept of the panty further, mock-ups of the holders were sewn. The tested holders are further presented in Appendix T, Figure 37 shows all of the tested holders as well as the one that functioned the best and the one that functioned the least.

A prototype was also sewn into a pair of panties to evaluate the concept further, this can be seen in Appendix U. A homemade mock-up of a sanitary napkin based on the locally produced sanitary napkin bought in Uganda was used as an example when testing the concept. The glue on the back was not used and before the testing, the wings of the napkin had been cut off. The result from the testing showed that the holders could be used as fasteners for the sanitary napkin without making a large alternation on a pair of existing panties and that the holders should be between 1.5-2 centimeters long and about 0.5 centimeters wider than the napkin to secure the placement of the napkin. In the prototype the distance between the front and the back holder was tested and the result showed that the space should be 3.5 centimeters shorter than the napkin; this can be seen in Figure 38.
10 Final Concept – Requirements and Motivations

The final concept contains two parts and can be adjusted to different market segments. Firstly it will have a single use sanitary napkin and secondly a panty that can either be bought separately or made by the users themselves. This makes the concept fit either a market that affords buying a special set of panties for their menstruation or a market that prefers adjusting their existing panties. Independent of what the user prefers both panties need to add the sanitary napkin for absorbing the menstrual liquid. The sanitary napkin is specially designed to fit the panties and to be made on a simple production site.

To get the sanitary napkin to stay in place the user should place it in the panties by putting the front and the back end into holders in the panties. Figure 38 shows the concept, both when the panty is not stretched and when stretched out. If the user wants or needs to adjust their existing panties all they have to do is to follow a description on how to sew in holders. In each package of napkins an instruction sheet will be included where it is described how to alternate an existing pair of panties. For the other segment that buys their panties with holders included it can be used directly.

Figure 38 - The concept with two holders for a daytime napkin. Seen both from above and side when the panty is not stretched and stretched out.

After using the sanitary napkin the user will throw the napkin away in a suitable place or burn it if that is preferable by the user. The napkin will decompose in time if thrown away or can be used as a source of energy if burned. Description of the different parts of the concept can be found below. Apart from fulfilling the existing Specification of requirements, there are also checklists for the materials and production that need to be fulfilled.

10.1 REQUIREMENTS OF THE MATERIALS AND PRODUCTION OF THE SANITARY NAPKIN

The napkin is made of two different materials; an absorbing material and a material that allows liquid to flow through in only one direction. The material that allows the liquid to flow in only one direction covers the napkin to make sure the liquid goes in to the absorbing core but not back out again. The material covers the whole napkin which means the napkin does not have an up or down but can be used either way. To make the napkin easy to produce the shape is rectangular without wings. The napkin comes in two different lengths, one shorter for daily use, about 20 centimeters, and one longer for nightly use, about 28 centimeters, both of them have the same width, between 5-6 centimeters. The napkin does not have wings or glue and is fastened in the panty by placing it in the holders.

The absorbing middle layer of the napkin should be made of a material that can be easily processed and not harm the user or the environment, see checklist below. Preferably the material should be made of suitable vegetation in the context where the napkin is produced. It is important that the harvesting of the plants is made in a sustainable way and that production of food does not get a lower priority. The plant should preferably grow without having to be watered or cultivated. It would also be an advantage if the material does not need any extra binding material to keep the fibers together in the napkin. One suitable material in the Uganda context is the Papyrus plant that can be dried, finely chopped and used as absorbent. Other options are leaves from Cassava or Matoke plants that are not being taken care of today.
It is important that the plant does not need extensive processing and can be easily stored both before and after processing.

Checklist for absorbing material:

- Material should be easily processed, preferably by hand
- Material should be able to be shaped into a cohesive surface
- Material should be able to be incinerated without giving away toxic emissions
- Material should absorb and retain menstrual liquid
- Material should be made from sustainable sources that are available in the context where the napkin is produced
- Material should, once in product, be pliable

The outer layer of the napkin should be made of a material that only allows the menstrual liquid to flow in to the absorbing layer but not escape back out again.

Checklist for outer layer:

- Material should be able to be incinerated without giving away toxic emissions
- Material should allow liquid to flow in one direction
- Material should be made from sustainable sources, preferably from the context of production
- Material should be soft towards the skin

When producing the napkin it is important that the production site is local in the context to create working opportunities and support the economic growth in the country. Because of this, and the inconsistency in electricity, it is also preferable that large parts of the production are made manually or by machines that can be driven by hand. It is also important that little water is used in the production or that the water that is used comes from collected rain water. When the napkin is produced it is important that it is sterilized to make sure no harmful bacteria are contained.

For the production of the napkin, one possible option is to first form the absorbing core into a rectangle and then fold the outer layer around it and melt the outer layer together around it with a simple machine using little electricity. The core could be formed by pressing the absorbing material together manually in a mold, either with the help of a tool or just using hands. This mold, which can be looked up on as a fixture, can be made adjustable to fit both the longer night napkin and the shorter day napkin. Another option is to make larger sheets of the absorbing material that is later cut into the right size. The cutting can then be adjusted for both sizes of the napkin. To allow the napkin to fit better a crease in the back can be created by cutting a slice in the absorbing core before folding the outer layer around it. To sterilize the napkins, UV-light can be used. It may be that sunlight can be used for this sterilizing process or for other, for example drying, processes in the production. Down below is a checklist for the production of the sanitary napkin.

Checklist for production:

- Minimize energy usage and use energy from sustainable sources
- Production of napkin should be made as cheap as possible, allowing for the napkin to be cheaper in purchase than other napkins
- Sanitary napkin should be easy to assemble
- Sanitary napkin should be sterilized in production
- Sanitary napkin should contain only the absorbing material and the outer layer
- Fastening of materials should be made without adding another type of material
- Finished products should not contain any sharp edges that can harm user
- Minimize use of water in production and use collected rain water if possible
10.1.1 Motivation of choices for production of and materials in the sanitary napkin

To reduce the production cost it is important to minimize scrap materials and optimize the use of material. A geometrical shape of the design is better from the perspective of optimization according to Bendsoe (1989). This will also lead to less complexity in the production which in turn gives lower costs and a better ground to manually produce. When a rectangular shaped sanitary napkin was used in the product safari the conclusion was that the shape did not affect the user in a negative way. All the napkins tried in the product safaris had an area of about 5-6 by 20-24 centimeters, to have a length of 24 centimeters for a daytime napkin did not seem necessary during the safari. The size was decided with that in mind combined with the factor of trying to minimize the use of material.

The sanitary napkin’s form will also be familiar to the user since geometrical shapes are more commonly used according to Siebert & Ballard (1992). The experts in Uganda pointed out the importance for the napkin to stay in the right place, this is done in a different way than using glue or wings. The decision to not use glue or wings to secure the fit is due to ease the production by reducing the numbers of steps, this also gives the production a higher flexibility, less scrap material and might reduce the need to import materials. A positive environmental effect can also be seen as a lower number of materials need to be processed and it is likely that the product can be made bio-degradable if fewer materials are used.

With the shape there is an advantage when it comes to scalability. Bendsoe (1989) states that an elementary form will make it simpler to reduce of enlarge a product. The shape combined with flexible fixtures and molds will also lead to a more flexible production where the same production unit can make several sizes of napkins using the same tools. A fixture will furthermore facilitate manual work and make the positioning easier (Groover, 2011). For a smaller production site a flexible fixture should be a good option according to Johansson (1989) due to the cost of making them. The fixture, or mold, for making the absorbing material will assure that all products turn out the same even though the production is manual. The flexibility that all the above gives is one of the most important factor of making a sanitary napkin in this type of context according to the experts in Uganda.

The production process can be classified as a jobbing or batch process from the definitions made by Slack et al. (2010). Simple machines and methods should be used in the process and it is likely that these machines are not specially designed for this process but a standard machine or method. To allow the production to move further up in the automation process it would be suitable to use a semi-automated process where some manual work is conducted and some processes are automatic. It could also be that suitable machines are machines that are driven by manual power and mechanically creates the desired processes.

The choices of materials are vital due to the increasing environmental awareness and pollution. This goes for both extraction of raw material as the environmental specialist in Sweden pointed out as well as the waste after use as the observation and the interviews from the field study showed. Musaazi, et al., (2013) explains in their article how it is a severe problem to import products and materials for the national economy, therefore locally produced and harvested materials is preferred. This means that the absorbing core can consist out of different materials depending on the context where it is produced as long as the material used can absorbed and retain liquid. Some materials should be avoided in whole or to a large extent due to the environmental effects that they have, these types of materials can include cotton (Lithner, 2011), chemically produced cellulose (Kristensson, 2005) and some polymers (Sundholm, 1999). When it comes to choosing materials they should be bio-degradable, this goes for both the absorbing core and the cover. The observation in the field study showed a wide variety of plants that could be used for this purpose. Johannesson, et al., (2013) also points out in their book that bio-degradable plastics exists and that more types of plastics with environmentally friendly properties is developed each year. This fact shows that it is possible to do a completely bio-degradable sanitary napkin.
Usability of the product has been taken into account when developing the concept. Due to the choices of materials a user can throw away the napkin in the same place as they are doing at the moment. The interviews with the females in Uganda revealed that most of them were throwing their used napkin into the toilet. This was, according to one of the experts, a problem since it caused the toilet to fill up too quickly. With a bio-gradable product this will not be a problem. Neither will they end up as landfill nor contaminate the land or water, as some plastics do according to Lithner (2011). To use the same material on both the top and bottom layer of the napkin leads to that the user can insert the napkin in any way they like without reducing the performance. The usage of a disposable napkin as the absorbent makes it possible for the user to change the napkin quickly and without water. Clean water was deficient and the observations and interviews indicated that most of the females had insufficient access to cleaning facilities before and after changing their napkin. One expert gave another perspective about this issue where he explained that females had a lack of privacy in toilet facilities, this was also confirmed by the interviewed females where most of them changed their menstruation protection in their bedrooms. The concept is feasible for all women, regardless of FGM, since the product sits on the outside of the body and is independent of the shape of the inner and outer genitals.

The largest issue the interviewed females had with commercial products today was that they are too expensive to buy. Most of them did not afford to use sanitary napkins every time they had their period. Designing the napkin in the described way will most probably make it a cheaper alternative to today’s products which is the largest advantage with the concept.

10.2 REQUIREMENTS OF THE MATERIALS AND PRODUCTION OF THE PANTY

In each panty there will be three holders, one in the front and two in the back, this to make it easy to shift from day to night napkin. The holders should be about 0.5 centimeters wider than the napkin and will be sewn so that 1.5 - 2 centimeters of the sanitary napkin is covered in the front and back to secure the placement. A single hem of 1 centimeter should be sewn to make the holding stable. The front holder and the two holders in the back need to be spaced so that they secure the fit when the napkin and panty is in place on the user. From the testing it was determined that the spacing should be 3.5 centimeters shorter than the napkin. This leads to that the napkin will need to be slightly bent when inserted.

For the users that want to alternate their own panties, holders can be made out of existing fabric that the user already have at home for example a fabric that comes from recycled clothing. In the case of factory produced panties it is important that they consist of sustainable raw materials with high quality to make them have a long technical life, see checklist down below. They should also be available in different sizes and models to attract a large variety of users. A range of different raw materials for this purpose can be used depending on the context where they are produced. Everything from banana leafs and pineapple leafs to wood pulps can be made into fibers to produce the raw material. More specified requirements for the materials can be found in the checklist below.

The instruction that is accompanying every package of sanitary napkins will give the user a guideline on how to alter their own panties to make the napkins fit. The instructions will include information about; size of the holder, placement of the holders and how they should be sewn into the panties. It will also include a user guide on how to rightly place the sanitary napkin in the panties and how to handle the waste when used. For the instructions to be easily understood by everyone, regardless of analphabetism, it is important that they contain both describing pictures and text.

For the assembling of the product it is most crucial that the stitches are made of a stretching seam to be able to flex when the panties are on the user. This goes for the fabric on the panties as well.
Checklist for panty

- Panty should allow different sized napkins
- Holders should be easily sewn on by hand in existing panty
- Panty should be of high quality and have a long technical life length
- Panty should have low environmental impact
- Panty should be comfortable and soft
- Panty should be available in different sizes
- Panty should be made of material from sustainable sources, preferably from the context of production and be processed as little as possible

A local production site is equally important for the production of the panty as it is for the napkin for the same reasons as described above in chapter 10.1. The sewing of the panty can either be done with a non-electric sewing machine driven by foot or if this is not possible they can be sewn by hand using only needles and thread. This is due to the lack of a reliable source of electricity. For the production of the panty water is not necessary, but if it is used it should preferably come from collected water. More requirements for the production can be found in the checklist below.

When cutting the fabric into pieces to get the shape to make the panty, the scrap material could be used for making the holders. The production of the fabric and thread used in the panty should also preferably be made in the context but might be more difficult to do in small scale.

Checklist for production

- Minimize energy usage and use energy from sustainable sources
- Fastening of materials should be made without adding another type of material
- Finished products should not contain any sharp edges that can harm user
- The holders should be easy to assemble
- Panty should be easily manufactured
- Minimize use of water in production and use collected rain water if possible

10.2.1 Motivation of choices for production of and materials in the panty

Based upon the fact that the sanitary napkin does not have either glue or wings to secure the fit, the holders in the panty are a suitable solution. They will make the user feel safe and make the napkin stay in place even when the user is moving around. The holders can be seen as a dissolving joint since they, according to Johannesson, et al. (2013), makes a geometrical locking without destroying the material when disassembled. Independent of which way the users handles their menstruation today a pair of panties is necessary. To be able to make the holders by hand in a home environment will not affect the user’s economy and they do not need another product to use the concept. The instruction paper that follows every package of sanitary napkins will make it easy for the user to adjust their existing panties at home. If the users would prefer to buy a pair of specially made panties, this will also be possible. This makes the concept attractive to several market segments. The interviewed females had different economy where some of them could not afford to buy napkins and others could afford it. For the females that today felt insecure when using rags or cloths during their menstruation could the panty secure the placement of the rag and at the same time the cheaper napkin could let them afford to buy a commercial product.

As seen in the field work, menstruation is taboo and it is hard for the females to wash a washable sanitary napkin. Since all of the females use panties, this will not cause a problem when washing and drying. The observations and interviews also made it clear that electricity is not a reliable source of energy, the holders in the panty and the panty itself can be completely made by hand or by non-electric machines. This also gives flexibility in the production due to the simplicity to make them.
Washing of clothes was observed during the field study; this was done by hand and included both rubbing and wringing the clothes. The quality of the fabric both secures the panty from shrinking and traction when washed and provides a long technical life. To produce in a local context as well as using locally produced materials increases the possibilities of a growing economy and a cheaper product.


11 Discussion

During the work with developing a technical solution to the problems surrounding menstruation that would fit in the context and in similar contexts many other challenges aroused. To be able to make females all over the world, no matter where they live, able to use a female hygiene product is a complex challenge that cannot be completely solved with only a technical solution even if it is a step in the right direction. In this; distribution challenges, market challenges, changing political systems, prioritizing, getting girls to school early and letting them stay in school until graduation are some of the other issues that need solving. It can also be discussed whether or not it is more important to get all females a hygiene product than for the hygiene product to be environmentally friendly both when producing and as a waste product.

Since countries and cultures are so different from each other depending on where you are it might not be only one solution that will fit everyone at every time. This have to be taken into consideration when it comes to this question, a method that can be used several times might have to be supplemented with a single use product for those times when the menstruation comes unplanned and so on. In this project one solution to the problem have been developed, this said there could be several other solutions that can fulfill the same purpose as this.

11.1 DISCUSSION OF THE RESULT

The final concept is considered to be a feasible solution in the context because of the low cost and the fact that the napkin is familiar and easy to use. The napkin and the panty can be cheaply and locally produced enhancing the community’s economy. This has been seen as vital by the authors since it will even out the differences between developed and developing countries. A well-functioning product is also believed to help girls attend school and women being able to work.

The holders can be sewn into existing panties, decreasing the cost, and the napkin is familiar which minimizes the risk of faulty handling. If the holders are placed correctly in the panties this will minimize the risk for the napkin being placed wrong and causing leakage. Since the napkin is bio-degradable it can be disposed of anywhere without making a large impact on the environment. The use for water when changing the product is not larger than for just an ordinary visit to the toilet and for the total menstruation cycle the use of water will be the same as for washing ordinary panties. If ordinary napkins were to be used the user would still need a pair of panties wherefore this solution with holders and napkins without glue is seen as a good economic choice. However it can be seen as an issue that holders, or special panties, need to be in place to be able to use the product.

The product should be able to be produced manually with simple measures and with little use of electricity, something that is seen as suitable in the context. However this might not be a good solution in other countries where wages, availability of electricity and other production prerequisites are different.

Depending on in what context the panty and napkin will be used it should be made out of different materials, namely suitable materials from the nearby environment. This would contribute further to the country’s economy but there might also be difficulties in finding the right type of materials in the context. A study in each country or context will have to be conducted to find suitable, environmental friendly, materials. There might be differences as to what can be found suitable as, for example, a good absorbing material which might lead to varying performance of the product in different contexts.

One of the largest disadvantages with the concept is that it will need a lot of marketing and spreading of information before it will be commonly known by the users. Even though the new napkin is similar to already existing napkins it might not be clear how it should be used, why information about how to use it need to be spread. The instructions for sewing the holders in the panties will have to be very clear to
ensure the holders will be sewn in correctly. This could be a disadvantage to have this type of solution depending on if the user are used to reading and looking at instruction.

Waste and garbage is not taken care of in the context but is spread in the nature. This implies that a larger use of commercial napkins will lead to more waste in the environment since these are not bio-degradable. This could be helped with a bio-degradable product which might also lead to more people being aware of the ecological issues connected with waste.

One thing that the authors have questioned during this project is the quality of products in developed countries. The demand on quality is very high and all products need to be exactly the same, without variations. This could be defendable when it comes to manufacturing cars but is it really necessary when it comes to producing female hygiene products? If the product is of a “good enough” quality, does it need to be improved since it is used only for such a short period of time? Maybe it would not be an issue if the products varied a bit as long as they were fulfilling the basic needs. Another thought similar to this is that the napkin might not need to be of such high quality as this leads to using it for many hours which in turn might lead to infections or rashes. When reflected on that the authors do not believe it is problem with manual production that can lead to variation nor with the usage of different materials in different contexts.

Regarding different types of production and where the production should be located there are different aspects that should be considered. An overview of the different options can be found in Figure 39 and are discussed below.

![Figure 39 - Different options for producing a female hygiene product](image)

If products are made in a developed country and sold in a developing country it is likely that the product will become too expensive for the users but also that there might be difficulties in distributing the product to remote locations. Production outside of the country will not lead to contributions to the lands economy but it might be that the product is seen as more attractive and of higher quality by the user.

Another option is for the products to be produced in a developing country in the context and sold to other developing countries nearby. This contributes to the economy for one developing country and it can be imagined that the cooperation between the countries would benefit from this type of solution. There is still a problem with distributing to the more rural areas.

Production on one site within the country of use would contribute to the economy in form of working opportunities and also lead to that the people can believe in themselves and what they do. Knowledge in the country would rise and raw materials that have not earlier been used can come to use in a new environment. Distribution within the country is still a problem and it might be difficult for a national company to afford the large advertisements that international companies can afford.

An alternative to producing on one site in the country is to produce on many, regional sites. This would probably help solve parts of the distribution problem of the finished product since they are made closer to where they are used. Placing the production sites in different parts of the country would not contribute to urbanization of people moving to the larger cities for work. This in turn could lead to difficulties with refining raw materials for each site, the problem with refining could be solved by having one national production site that is specialized to do the refining. Having production sites spread will also lead to that the products will become more visible in several regions due to the presence of the company.
The last option for producing is having a small production unit in each village. This might lead to distribution problems regarding to raw materials but will help with distributing the finished products. A company that is present in the village will become known by the public and might not need as much advertisement as a company that produces on one site in the country or outside of the country. Production in the villages would however make it difficult for the company to get an overview of the operations and variations in quality might occur.

The authors believe that it is important to remember that the conditions in the context are very different from what we are used to. It is important to reflect on this fact and not judge any of the conditions to be right or wrong. It is imaginable that there should be an exchange of values and knowledge both ways between developing and developed countries rather than what is done today.

11.2 DISCUSSION OF THE WORK

Most of the theoretical background is well grounded and legitimate sources have been used. The information found in the literature research has been used throughout the project and been a good base to stand on. The sources about how products are made and what materials they contain comes from the producers of the different products, therefore these can be questioned if they are objective sources. This has not, however, been seen as an issue since the information only have been used for evaluating the existing products during the concept generation phase to find suggestions for improvements and is not thought to have affected the result.

The preparations for the field study in form of writing interview questions were very useful and it was a necessity to revise the questions over time when the interviewers realized that they did not get the answers they were expecting. However, to get a more comparable interview result it would have been desirable to ensure that all interviewees answered the same questions, this is a negative found with using semi-structured interviews.

There are several factors that could have affected the results of the interviews. One of them is concerning language issues, the interviews could have been affected by that English is not the native language of either the interviewer or the interviewee. Interviews held with an interpreter can also have been affected due to the interpreter’s willingness and understanding of the questions and the translations of the answer. Another issue can also have been that the interviewees are unused to the interviewing concept and do not understand that there is no correct answers to the posed questions. Many of the interviews were held with others, apart from the interviewers and interviewee, present and this is thought to possibly having an effect on the answers as the answers might have been affected by other answers given by other interviewees earlier. The knowledge of menstruation and different types of female hygiene products is low in the area that was visited during the field study. Questions regarding different types of products are therefore believed to have been answered differently since the females might find it difficult to know anything about the use of a product that they have never heard of and that are unfamiliar.

The knowledge received from the producers in Uganda is believed to be quite objective since they were able to discuss pros and cons about their, and other, products. Their concerns and goals with their products were similar to the ones in this project. Interviews with the Swedish experts gave interesting aspects to how quality is looked upon and about business models in developed countries. These aspects were taken into considerations when developing the concept and in the evaluation of the concepts and existing products.

Performing Product Safaris is believed to be a good way for the authors to experience and compare the different products to each other. However for the comparison to be more valid all products should have been tested by the same person. It would also be desirable to try out all seven categories of products for a fuller understanding of the differences between the methods of protection.
The process for creating a concept included many different methods; the reason for this was that the authors believe that this helped in widening their perspective and creating a form of objectivity. It helped in creating a structure for the process and avoiding the risk to miss any vital parts in creating in the concept. Ulrich & Eppinger was used as a ground base, built upon with Liedholm’s specified process and topped with methods, for example for generation of ideas. The combination of the different methods is believed to have strengthened the result and allowed the concept to be developed further.

During the process of generating and choosing a concept a lot of parameters could have changed the outcome. Focus has been on creating a product suitable for the context and local production. This has affected many of the choices made and it is likely that the outcome would be very different if the context of the product would be different. If another focus had been chosen, this would probably also change the outcome.

Focus during the project has been on creating a product with good materials based on user and producer demands. This is believed to have strengthened the final concept further since many demands have been included and makes the product feasible both for using and producing.

A blog was used as a way to spread information during the project. This way of openly sharing developing ideas and thoughts to the public have given the project unexpected input and perspective because of the interactivity with users and producers. The blogging have also given the authors time to process the experiences continuously throughout the project. This might have affected on the way the process have been carried out. However, at the end of the project, the blogging got a low priority since focus needed to be kept on finishing the project.

To work with production and product development in a close collaboration is believed to have helped the project and create a more complete concept in the end. This because inputs have been given from both sides that would not have been considered otherwise. The perspective has been widened for both of the authors which in turn gave a broad base for carrying out the project and interesting discussions throughout.
12 Conclusions

Social effects are enabled for women in development countries that is able to afford female hygiene products. These effects include for example girls being able to go to school and enabling women to take a job. It can also be that the women feel free and comfortable with their protection and therefore can walk to the market to sell their crops.

The concept derived from the demands and prerequisites found in the field study is believed to be a feasible solution for producing and using in the given context.

12.1 WHAT CONDITIONS ARE THERE TO PRODUCE FEMALE HYGIENE PRODUCTS IN A SUSTAINABLE WAY IN THE EAST AFRICA COMMUNITY?

For producing a sustainable female hygiene product it is important that the costs are held low and that the production has a low environmental impact. The production process should preferably be manual and the raw materials should be easily processed before production. This is due to the inconsistency in the electrical net and the low investment cost that comes from labor intensive industries. Little water should be used due to the lack of fresh water in many regions. Local materials should be used as far as possible to contribute to the local economy. Because of the manual handling it is important that the product is sterilized at the end of production.

12.2 WHAT USER DEMANDS ARE THERE ON FEMALE HYGIENE PRODUCTS IN UGANDA?

The ten most important user demands to take into account is listed down below:

- The napkin should retain menstruation liquid and not leak
- The napkin should sit firmly and not lose the position when the user moves
- Water should not be needed when using, changing or disposing the napkin
- The napkin should not inhibit the user in their daily activities
- The napkin should feel soft and the user should be comfortable when using the napkin
- The napkin should not cause harm to the user in form of illness, rashes or burns
- It should be easy to understand how to use the napkin
- The napkin should be produced in such way that it is affordable for the user to buy
- The napkin should be able to be thrown into a permanent or temporary toilet without destroying the environment
- The napkin should come in different sizes so that it fits all users and purposes
12.3 WHAT COULD BE A FEASIBLE SOLUTION FOR A SUSTAINABLE FEMALE HYGIENE PRODUCT?

A feasible solution for a sustainable female hygiene product could be:

A rectangular shaped non-adhesive, no wing napkin made of a local absorbing material, such as papyrus, with a cover of a bio-degradable, cellulose based plastic. The napkin comes in two sizes, one for daytime use and one for nighttime use. The napkin should be combined with a panty with holders to secure the fit of the napkin, the panty should be made out of a sustainable textile from a local plant such as banana leaves or pineapple leaves. Below in Figure 40 is a presentation of a potential product. The product is produced in, for the context, a local production facility with manual production steps. Caution should be taken for the usage of water and electricity in production.

![Figure 40 – A feasible concept](image)

12.4 FUTURE WORK

The result of this study results in a concept of a product. There are therefore several areas that need further investigation before the product can be realized. A main focus for further studies should be to find suitable materials, both for the absorbing center, the outside of the napkin as well as the panty. For the product to be spread and well known it will take a lot of information and marketing, this and how distribution should be solved is an important issue to solve. This should also include decreasing the taboo on the subject menstruation and make families seeing female hygiene products as a necessity to buy to ensure females are not inhibited by their menses.

The size of the product, specifications of the production unit and the economic feasibility of the concept are other things that need to be evaluated further. The information leaflet that describes how the holders should be placed in the panties needs developing to ensure it is easy to understand.


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Appendix A – Interview Questions for Young Girls (Pre Menstruation)

Background
- How old are you?
- Can you describe your current family situation?
- How many people live with you?
- What sexes are they on the people that live with you?
- What ages are they on the people that live with you?
- Do you know anything about your family’s economy? Do you know what your family’s economic situation looks like?
- In what kind of house do you live in?
- How many rooms are they?
- Do you have your own toilet?
- If no, how do you do it?
- If yes, what does it look like?
- Where do you leave your waste? Do you have a garbage can/place?
- Do you have menstruation?
- If yes, for how long have you had your period?

Knowledge
- Do you know anything about menstruation?
- If yes, what do you know?
- Who told you about it?
- What kind of menstrual products do you know exists?
- If she doesn’t have had her period yet: Have you heard of any problems regarding menstruation?
- If she has had her period: What problems have you experienced with your menstruation?

Future
- What would you like to do in the future?
- What dreams do you have for yourself?
- What do you think about school? And for how long do you expect to go to school?
Appendix B – Interview Questions for Young Adults (13-20)

Background
- How old are you?
- What are you doing for a living?
- Level of education
- Can you describe your current family situation?
- How many people live with you?
- What sexes are they on the people that live with you?
- What ages are they on the people that live with you?
- Do you know anything about your family’s economy? Do you know what your family’s economic situation looks like?
- Do you have your own children?
- If yes, at what age did you receive your first kid?
- If no, at what age do you plan to have children?
- In what kind of house do you live in?
- How many rooms are they?
- Do you have your own toilet?
- If no, how do you do it?
- If yes, what does it look like?
- Do you have access to sanitation facilities?
- If no, how do you do it?
- If yes, what does it look like?
- Do you have access to water?
- How far away?
- How many are sharing?
- Is it for free? Where do you leave your waste? Do you have a garbage can/place?
- Do you have menstruation?
- If yes, for how long have you had your period?
- What are your dreams for your future?

Knowledge
- Did you know anything about menstruation before you had your first period?
- Did you know what kind of products that excited?
- Who told you about menstruation?
- Who did you tell first that you had got you menstruation?
- Which product are you using today?
- Do you know about any other products?

Current solutions
- Why are you using your current product?
- How does it work?
- How do you handle your product?
- During the periods?
- Between the periods?
- What do you see are the biggest problem/issue today?
- With menstruation?
- With the product?
- Have you gotten any diseases, illnesses related to menstruation?
- What are the pros and cons about your choice of product?
- How do you get your product?
- Where do you buy it?
- How much does it cost?
- What do you do with the product after you are done using it? And why are you doing it that way?
• Have you tried any other products?
• Have your menstruation or the products you are using inhibited anything in your life?

Desired solution
• If you could dream or see in the future, how do you wish that it would be then?
• What kind of product would exist? Why?
• What would you change if you could?
• In what way do you think a working solution would change your life?
• How much should a menstruation protection cost, if you could decide?
Appendix C – Interview Questions for Women (20-30)

Background
- How old are you?
- What are you doing for a living?
- Level of education?
- Can you describe your current family situation?
- How many people live with you?
- What sexes are they on the people that lives with you?
- What ages are they on the people that lives with you?
- Do you know anything about your family’s economy? Do you know what your family’s economic situation looks like?
- Do you have your own children?
- If yes, at what age did you receive your first kid?
- If no, at what age do you plan to have children?
- In what kind of house do you live in?
- How many rooms are there?
- Do you have your own toilet?
- If no, how do you do it?
- If yes, what does it look like?
- Do you have access to sanitation facilities?
- If no, how do you do it?
- If yes, what does it look like?
- Do you have access to water?
- How far away?
- How many are sharing?
- Is it free? Where do you leave your waste? Do you have a garbage can/place?
- Do you have menstruation?
- If yes, for how long have you had your period?
- What are your dreams for your future?

Knowledge
- Which product are you using today?
- Do you know about any other products?
- Have your menstruation affected your life?
- If yes, in what ways?
- If they have kids: do you speak about menstruation with your kids?
- If yes, what do you tell them?
- If no, why not?

Current solutions
- Why are you using your current product?
- How does it work?
- How do you handle your product?
- During the periods?
- Between the periods?
- What do you see are the biggest problem/issue today?
- With menstruation?
- With the products?
- Have you gotten any diseases, illnesses related to menstruation?
- What are the pros and cons about your choice of product?
- How do you get your product?
- Where do you buy it?
- How much does it cost?
• What do you with the product after you are done using it? And why are you doing it that way?
• Have you tried any other products?
• Have your menstruation or the products you are using inhibited anything in your life?

Desired solution
• If you could dream or see in the future, how do you wish that it would be then?
• What kind of product would exist? Why?
• What would you change if you could?
• In what way do you think a working solution would change your life?
• How much should a menstruation protection cost, if you could decide?
Appendix D – Interview Questions for Older Women (30-)

Background
- How old are you?
- What are you doing for a living?
- Can you describe your current family situation?
- How many people live with you?
- What sexes are they on the people that lives with you?
- What ages are they on the people that lives with you?
- Do you know anything about your family’s economy? Do you know what your families economic situation looks like?
- In what kind of house do you live in?
- How many rooms are they?
- Do you have your own toilet?
- If no, how do you do it?
- If yes, what does it look like?
- Do you have access to sanitation facilities?
- If no, how do you do it?
- If yes, what does it look like?
- Do you have access to water?
- How far away?
- How many are sharing?
- Is it for free? Where do you leave your waste? Do you have a garbage can/place?
- Do you have menstruation?
- If yes, for how long have you had your period?
- What are your dreams for your future?

Knowledge
- Which product are you using today?
- Do you know about any other products?
- Have the products changed over the years?
- Can you describe what they looked like before?
- Have you always used the same kind as now?
- Have your menstruation affected your life?
- If yes, in what ways?
- If they have kids: do you speak about menstruation with your kids?
- If yes, what do you tell them?
- If no, why not?

Current solutions
- Why are you using your current product?
- How does it work?
- How do you handle your product?
- During the periods?
- Between the periods?
- What do you see are the biggest problem/issue today?
- With menstruation?
- With the products?
- Have you gotten any diseases, illnesses related to menstruation?
- What are the pros and cons about your choice of product?
- How do you get your product?
- Where do you buy it?
- How much does it cost?
- What do you do with the product after you are done using it? And why are you doing it that way?
- Have you tried any other products?
- Have your menstruation or the products you are using inhibited anything in your life?

**Desired solution**
- If you could dream or see in the future, how do you wish that it would be then?
- What kind of product would exist? Why?
- What would you change if you could?
- In what way do you think a working solution would change your life?
- How much should a menstruation protection cost, if you could decide?
Appendix E – Interview Question for Expert in the Area in Uganda

**Background information**
- Can you describe your role and your responsibilities in the organization?
- Can you describe the organization's work?
- How long has the organization worked with this problem?

**Knowledge**
- In your opinion, what is the biggest issue when it comes to menstruation and menstruation products?
- In what way is your organization addressing this problem?
- Why have you chosen this method to address the problem?
- How do you spread information about your work?
- How do you see feminine hygiene products of today?
- What do you see is a suitable option for the future?
- What is the best way to solve the problem?
Appendix F – Interview Question for Production and Entrepreneurs in Uganda

Background
- Can you describe your role and your responsibilities in the organization?
- Can you tell us more about the organization's work?
- How long has the organization worked with this problem? How come you have addressed this problem?

Knowledge
- How and when did you discover the problem?
- Why did you decide to address the problem in this way?
- How did you come up with this solution?
- What pros and cons do you see with your solution?
- How is your product marketed? Who do you see as your target group?
- What do you see as the main concerns with the product and with the production method?
- What is your opinion on other solutions for female hygiene products?
- How do you see the development of yours and other products on the market for the future?
- In what way do you work with product development?
- Have you had users involved in the product development?

Production
- How is the product made?
- Where does the raw-material come from? How, when and where is it processed?
- How much water is consumed by the production unit?
- How much electric energy is consumed by the production unit?
- Are there ever problems with stops in production due to lack of raw material and/or water and energy?
- What types of machines are used in the production?
- How many products can be made in one day?
- How is the production unit staffed?
- Is there any waste material from the production?
- How are the finished products distributed to the users?
- Have you had sustainability and environment in mind when designing the product?
- What wishes are there for the future regarding the design of your product and your production unit?
Appendix G – Interview Question for Product Developer 1 in Sweden

Background and product methodology
- Tell us about your role in the company and in which way you work with product development?
- In which way are users involved in the development of your products?
- In which way do you have sustainability and the environment in mind when developing new products?
- What makes tampons and sanitary napkins to the best solution to handle menstruation? Do you think that there are other ways of handling it? What do you think is going to be used in the future?
- What do you see as pros and cons for your type of products?
- What recommendations are you given regarding hygiene to the users?
- What are the basic demands on your products to be able to sell them commercially? How much can you simplify the product and still sell it commercial?
- Can you shortly describe what the production of your products looks like? Does it generate much waste material? What pros and cons do you see with your production methods?
- What demands on the production do you have when it comes to health regulations?
- Do you see any flaws with having the production and the developing in two separate places?
- How do you work with securing quality of your products? In which way does this affect the pricing on the product? Why does your way of working look the way it does? Do you believe the demands are too strict? Do you get in many complaints?
- Why does the products look like they do? What has caused this? How come is has the shape like it has? How are the sizes selected - only absorbency or for a sense of security?

Materials
- How do you choose today’s material to your products (sanitary napkins/tampons)? What materials are included? Where does these come from? Why these materials?
- What percentage fluff vs. superabsorbent are there in the sanitary napkins? Why do you add chemicals?
- Are the users involved when it comes to evaluation of the materials?
- How important are the traceability of the materials?
- Do you use recycled material/materials from sustainable sources or bio- degradable materials in the products? Why/why not?
- If you can look at the materials in the future, will the products include the same constituents as today?

Market segments and distribution in the future
- What market segments do you invest in today? Do you think differently about the products depending on which country they are supposed to be sold in?
- What does your future markets look like? What markets you planning to focus on?
- What markets do you believe is going to grow in the future and how do you believe that the product needs to change in order to fit in there? Is it possible to make them cheaper?
- Do you think that the products will look/looks different in different markets today and in the future? For example regarding design and materials?
- How does fashion and trends affect your development?
- How do you distribute your products to the users? How does the information spread regarding the products?
- What are your wishes regarding design and production of your products in the future?
- What do you believe to be the largest differences on the products and the attitudes towards the products in the future?
Appendix H – Interview Question for an Environmental Specialist in Sweden

Overall
- Can you tell us about your work?
- How does your company work with environmental issues? Checklists? Standards?
- How do you handle the new environmental trend? Are you affected by that the consumers have more environmental awareness?

Materials
- How do you choose the materials in your products? What materials are included? Where do they come from? Why this types of materials?
- What percentage fluff vs. superabsorbent are there in the sanitary napkins? Why do you add chemicals?
- Are the users involved when it comes to evaluation of the materials?
- How important are the traceability of the materials?
- Do you use recycled material/materials from sustainable sources or bio-degradable materials in the products? Why/why not?
- If you can look at the materials in the future, will the products include the same constituents as today?

Handling and waste
- What do you think of the handling of your products after usage on the different markets? What can be improved? What is good today? Is this an aspect that is considered when the product is developed?
- What recommendations are you giving the customer regarding handling of the waste product? How do you spread the information about this? How do you ensure this? Are the recommendations the same regardless of where in the world the product is sold?
- What happens to discarded products from production? How do you handle the scrap materials?

Environment
- What part of the products lifecycle contributes most to the environment? How do you work to improve this?
- What part/parts of the sanitary napkin affects the environment most?
- Which of your products are best/worst regarding the environment?
- Are there any producer responsibility that you have to consider? On which parts of the product in that case?
- Do you work with carbon offsetting and in that case in which way?
- How does the placement of the production site affect your environmental profile?
Appendix I – Interview Questions for Product Developer 2 in Sweden

Background and product development methodology
- Tell us about your roll in the company and in which way you work with product development?
- In which way are users involved in the development of your products?
- In which way do you have sustainability and the environment in mind when developing new products?
- What makes tampons and sanitary napkins to the best solution to handle menstruation? Do you think that there are other ways of handling it? What do you think is going to be used in the future?
- What do you see as pros and cones for your type of products?
- What are the basic demands on your products to be able to sell them commercially? How much can you simplify the product and still sell it commercial?
- How do you work with securing quality of your products? In which way does this affect the pricing on the product? Why does your way of working look the way it does? Do you believe the demands are too strict? Do you get in many complaints?
- Why does the products look like they do? What has caused this? How come is has the shape like it has? How are the sizes selected - only absorbency or for a sense of security?
- Why have you chosen to have the production and development in the same geographic place?

Materials
- How do you choose today’s material to your products? What materials are included? Where does these come from?
- If you can look at the materials in the future, will the products include the same constituents as today?
- Hur väljer ni idag material till era produkter? vilka material ingår? vart kommer dessa ifrån?
- Hur ser du på material i framtiden, kommer produkterna innefatta samma beståndsdelar som idag?

Handling and waste
- What do you think of the handling of your products after usage on the different markets? What can be improved? What is good today? Is this an aspect that is considered when the product is developed?
- What recommendations are you giving the customer regarding handling of the waste product? How do you spread the information about this? How do you ensure this?

Markets and distribution and future
- What does your future markets look like? What markets you planning to focus on?
- What markets do you believe is going to grow in the future and how do you believe that the product needs to change in order to fit in there? Is it possible to make them cheaper?
- Do you think that the products will look/looks different in different markets today and in the future? For example regarding design and materials?
- How do you distribute your products to the users? How does the information spread regarding the products?
- What are your wishes regarding design and production of your products in the future?
- What do you believe to be the largest differences on the products and the attitudes towards the products in the future?
- How do you think the development of your products and other products on the market will look like in the future?

Environment
- What part of the products lifecycle contributes most to the environment? How do you work to improve this?
- Do you work with carbon offsetting and in that case in which way?
Appendix J – Interview Questions for Distributor of Menstruation Cups in Uganda

- Can you describe your organization and what you work with?
- How did you first come in contact with the problem and subject? Why did you choose to address the problem in this way?
- For how long have your organization worked with the problem?
- In which way do you spread your information regarding menstruation cups in Uganda? In which parts of the country do you work in?
- How have you been treated by the females in Uganda when you talk about the menstruation cup? Have you meet any resistance from either males or females?
- What types of methods do the women you meet use today?
- Did they like the menstruation cup?
- What is the pros and cons with the cup?
- How do you recommend that the users take care of their hygiene regarding both themselves and the cup? Do they do this?
- Do they find it hard to retain the cleanliness that is needed when using the menstruation cup? (For example because of the lack of fresh water and that they cannot afford soap?)
- How do you finance the project? How much does it cost for you to buy a menstruation cup?
- Do you believe that the menstruation cup is a sustainable solution for the future?
- What happens when the project ends?
- Are they going to be able to buy or get hold of a new cup when the old one is worn out?
- Do you think that the menstruation cup will outcompete other methods, or which product do you believe is the solution for the future?
- How do you distribute and produce the cup in Uganda? How do you think it is going to work in the future?
Appendix K – Execution of the Field Study

The field work consisted of study visits, expert interviews, user studies, product safaris and observations.

Interview method

To successfully conduct an interview it is important that the interviewee feels safe and comfortable to share information. Most people find it easier to open up in a familiar environment. (Stickdorn & Schneider, 2012)

In semi-structured interviews open questions are asked to give to interviewee the possibility to elaborate their answers. Follow-up questions can be asked depending on the answers from the interviewee. In a semi-structured interview it is important that the interviewer has a deep knowledge of the subject. (Bohgard, 2008)

A contextual interview is when the interview is conducted while the user is using a product or is in the context where the product is used. A combination of observations and questions is used to gain deeper knowledge. In a contextual interview the interviewee can describe specific details that would not have been remembered in an ordinary interview. It also gives the opportunity for the interviewer to observe and acknowledge things in the environment that the interviewee did not think about. A contextual interview often gives a more holistic view of a situation compared to an ordinary interview. (Stickdorn & Schneider, 2012)

Observations

When using observation studies it is of certain importance to reflect on what should be observed, what the expected result is and why observation studies will give the information needed. It may be difficult to make observations completely objective but it might also be the only possible way to gain certain information or see the behavior in a group. Observations can be either structured or non-structured and participating or non-participating. Non-structured interviews are good for long projects where the expected result is unclear and many observations are needed to find patterns. Structured studies mean that an observation schedule in form of i.e. a checklist, logging book, or table, is used for registering events. The person observing can be either participating or non-participating, the objectivity of the former is questionable since the observer is also a part of the processes and developments of for example a group. (Bell, 2006)

Product safari

This is an interpretation of the use of a service safari. The designer can use the method to get understanding and knowledge about what the user is going through when they are using a product or a service. During the “safari” the advantages and disadvantages of the product can be illuminated, this understanding can lead to more innovative products and services. It is not necessary to use a comprehensive amount of tools to carry out the method, but it is necessary to be able to document the steps and what the pros and cons are with the steps. (Stickdorn & Schneider, 2012)

Expert interviews in Uganda

During the stay in Uganda five expert interviews were conducted. This was done to get a deeper understanding about both the problem that comes out of the nonexistent of menstruation protection products and the production of locally produced sanitary pads. The experts interviewed was, three headmasters of schools, one midwife, one community development officer, one founder and producer of locally manufactured sanitary napkins and one representative from a washable sanitary napkin that is manufactured locally.

Interview with the headmaster of St Edwards secondary school, the headmaster of St Edwards primary school and the headmaster of Mayenze secondary and primary school

Interviews with the headmasters were conducted before any user interviews were done. During the interview the answers was written down as notes and then transcribed.
Interview with a midwife in Manafwa district

During the stay in Bubulo an interview with one midwife was conducted. This interview were made in her office and she was also given the opportunity to come with her views on menstruation protections used in Sweden such as menstruation cup, tampon and menstruation sponge. The conversation was recorded and notes was written down.

Interview with the Community development officer of Manafwa district

The last expert interview made in Manafwa district was done with the community development officer (CDO) in the district. The interview was conducted at his office in the community building. It was both written and recorded. This interview did not have pre-made questions; the CDO was given different topics to talk freely around. The topics were for example the future for electricity and water development, education and sanitation facilities.

Interview with the founder and owner of a local small scale napkin maker

The first interview that was made in Kampala was with the founder of a local sanitary napkin, during this interview a visit to their production center was also made. The questions for the interview can be found in Appendix F. Both written notes and recordings were done during this interview.

Interview with a representative for a washable locally made sanitary napkin

The same question as was given to the founder of the locally made single use napkin was also given to the representative of the washable locally made napkins. This was the last expert interview that was done in Uganda. During the interview both recordings and notes were taken.

User studies in Uganda

The user studies were a part of the collection of requirements for a future product. This studies were conducted around the Manafwa district with women of the ages 13-65. It was both group and individual interviews made to complete the study. During some of the interview an interpreter was helping with the translations due to that some of the women did not speak English. The interviews was semi-constructed and some of them also contextual. Most of the interview was in qualitative purpose and there was a few that was aimed as quantitative studies.

The women that was interviewed was chosen by the person that was in charge for the institution where the interview was carried out. All the interviews were recorded and notes was made during the questioning. There was in total 82 women that was included in the study. 42 were interviewed one by one or in smaller groups and 40 was interviewed in a large setting. The interviews were made in ten different sessions.

Visit to St Edwards secondary school

Throughout this visit five girls were interviewed in their dormitory. The questions for this session can be found in Appendix B. During this visit a demonstration over how the users were padding themselves was also shown as well as a tour over the cleaning and toilet facilities.

Visit to the interpreter at her home

The second action taken was to interview seven women from the age of 20 and up at the home of the interpreter. The questions during this session was modified from the questions in the first interview to fit the participants’ age. The question used can be found in Appendix C and D.

Visits to women in the village in their homes

During the third interview occasion was held with six different women in their own homes. During these interviews observations over how the people in the village lived and also the distance to water. The questions in this session was the same as in the second session and can therefore be found in Appendix C

First session at the orphanage

In the fourth interview date two women were interviewed that came to an orphanage. The same questions as during the two sessions above was the starting point but more follow-up questions as why they were doing something was asked. The interviews where done without an interpreter.
Visit to St Edvards primary school

This interviews where done with eleven school girls in the ages of 12-15 years old. The session was carried out in an open room with all the girls present but only one girl was interviewed at the time. To conduct this sitting an interpreter was present. The questions were asked in a simplistic way and they can be found in Appendix B

Visit to the Red Cross facilities

Two interviews were conducted with volunteers for the Red Cross. In these interviews there were no interpreter present and the questions asked can be found in Appendix C

Second session at the orphanage

At the orphanage was during the second session three interviews done. One of these were conducted with an interpreter and the other two without. A visit home to one of the girls to see her cleaning and toilet facilities were also completed. The questions asked was the same as for the women at the Red Cross facilities and can be found in the same appendix as the question for the previous described session.

Visit to Mayenze primary school

A visit was made to a primary school in the district Mayenze. A discussion and tour around the school with the headmaster was made before a group interview were carried out. This interview was carried out with 40 schoolgirls where 18 of them had have their first period. The question during this sitting was asked in a simplistic way and the answers type was with both show of hands and shouting out their answers.

Third session at the orphanage

The last interview session at the orphanage was made with one user and without an interpreter. The question asked can be found in Appendix B

Visit to Manafa high school

Lastly, a visit to Manafa high school was executed and five girls were interviewed. The girls were from 15 to 18 years old and the session was done without an interpreter. The questions used can be found in Appendix B.

Observations and Product Safaris from Uganda

During the field study both observation about the surroundings and the environment as well as trying out the locally used products were conducted. Observations were done both individually and in context with user the areas of observations were hygiene and cleaning facilities, electricity, water, toilets, vegetation, production and waste handling. The result from this can be found in chapter 6.

Expert interviews in Sweden

The knowledge gained from the field work were then used to do deep interviews with experts in the field in Sweden. The interviews were done with experts in both product development and environment. The questions asked in these sessions can be found in Appendix G-I and the result is presented in section 8.2
Appendix L – Visiting a Small Scale Production Site

Removed with respect for the producer.
## Appendix M - Human Needs

<table>
<thead>
<tr>
<th>Human Needs</th>
<th>Long-Term Effect</th>
<th>Technical Effect</th>
<th>Immediate Effect</th>
<th>Medium-Term Effect</th>
<th>Short-Term Effect</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable society</td>
<td>Improved stability</td>
<td>Long-term technical effect</td>
<td>Increased</td>
<td>Shrink</td>
<td>Long-term technical effect</td>
<td>Medium-term technical effect</td>
</tr>
<tr>
<td>Strongen women's position in society</td>
<td>Increased economy</td>
<td>Long-term technical effect</td>
<td>Stability</td>
<td>Long-term economic effect</td>
<td>Long-term technical effect</td>
<td>Medium-term technical effect</td>
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<tr>
<td>Allows women to feel free</td>
<td>Stable income</td>
<td>Long-term technical effect</td>
<td>Life-long</td>
<td>Long-term income effect</td>
<td>Long-term technical effect</td>
<td>Medium-term technical effect</td>
</tr>
<tr>
<td>Increased knowledge</td>
<td>Working skills</td>
<td>Long-term technical effect</td>
<td>Long-term</td>
<td>Long-term knowledge effect</td>
<td>Long-term technical effect</td>
<td>Medium-term technical effect</td>
</tr>
<tr>
<td>Decreased taboo</td>
<td>Decreased taboo</td>
<td>Long-term technical effect</td>
<td>Long-term</td>
<td>Long-term taboo effect</td>
<td>Long-term technical effect</td>
<td>Medium-term technical effect</td>
</tr>
<tr>
<td>Level out gaps between females and males as well as developing and developed countries</td>
<td>Level out gaps between females and males as well as developing and developed countries</td>
<td>Long-term technical effect</td>
<td>Long-term</td>
<td>Long-term equity effect</td>
<td>Long-term technical effect</td>
<td>Medium-term technical effect</td>
</tr>
<tr>
<td>Not affect the natural bacteria</td>
<td>High, consistent quality</td>
<td>Long-term technical effect</td>
<td>Long-term</td>
<td>Long-term health effect</td>
<td>Long-term technical effect</td>
<td>Medium-term technical effect</td>
</tr>
<tr>
<td>Sustainable future and increased environmental awareness</td>
<td>Sustainable future and increased environmental awareness</td>
<td>Long-term technical effect</td>
<td>Long-term</td>
<td>Long-term sustainability effect</td>
<td>Long-term technical effect</td>
<td>Medium-term technical effect</td>
</tr>
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</table>
## Appendix N – Specification of Requirements, General list with Weighting

<table>
<thead>
<tr>
<th>Metric</th>
<th>Need no.</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effect:</strong></td>
<td>Lon</td>
<td>Tech</td>
</tr>
<tr>
<td>Human need</td>
<td>Reliability</td>
<td>To be seen</td>
</tr>
<tr>
<td>Aspects for production (X) Effects Technical</td>
<td>Sustainable society</td>
<td>Not harm workers</td>
</tr>
<tr>
<td>Weight:</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Aspects for product (x) Effects Technical</td>
<td>Sustainable society</td>
<td>User friendly</td>
</tr>
<tr>
<td>Weight:</td>
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<td>3</td>
</tr>
<tr>
<td>Requirement</td>
<td>Reference(s)</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>---------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Low complexity of production</td>
<td>5,6,28</td>
<td>Few and simple machines used in process</td>
</tr>
<tr>
<td>Not cause user or others harm</td>
<td>8,9,10,11,12</td>
<td>Not cause rashes, infections or pain</td>
</tr>
<tr>
<td>Production cost</td>
<td>13</td>
<td>Cost for making of product</td>
</tr>
<tr>
<td>REACH</td>
<td>25</td>
<td>Fulfill REACH demands on chemical substances</td>
</tr>
<tr>
<td>Retain menstrual liquid</td>
<td>20,21,23</td>
<td>Amount of liquid retained</td>
</tr>
<tr>
<td>Safe emission</td>
<td>19,25</td>
<td>Amount of harmful emissions from production or product</td>
</tr>
<tr>
<td>Source of materials</td>
<td>25,26</td>
<td>Materials should be from sustainable sources or recycled</td>
</tr>
<tr>
<td>Sterilization in production</td>
<td>8,17</td>
<td>Amount of harmful bacteria after production</td>
</tr>
<tr>
<td>Workers should not be harmed in production</td>
<td></td>
<td>Working environment and production site must be safe</td>
</tr>
<tr>
<td>Produced locally</td>
<td>14</td>
<td>Produced in the context where it is sold</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>x,X</th>
<th>x,X</th>
<th>x</th>
<th>x,X</th>
<th>X</th>
<th>x,X</th>
</tr>
</thead>
</table>

| X | X | X | X | x,X | x,X | X | x,X |

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27
<p>| Not inhibit users daily life | 9 | User should not be affected by the product | x, x, x | x, x | x, x, x, x | x, x, x, x | 24 |
| Life-span | 21 | Life length without decreased performance | x, x, x | x | x, x | x, x, x, x | 23 |
| Bio-degradable | 7, 25 | Percent of product (per use) that is bio-degradable | x, x, x | x | x, x, x | x, x, x, x | 20 |
| Produced manually | 28 | Imposition of hands in all production processes | x, x, x | x, x, x, x, x | x, x, x, x, x | 19 |
| Will have a function after use | 7 | Possibility for usage of disposed product | x, x, x, x | x, x, x, x, x | 18 |
| Production rate | 17 | Number of products per hour | x, x, x, x, x, x, x | 17 |
| Water used in production | 3 | Amount of water used in production | x, x, x, x, x, x, x | 16 |
| Water-use when changing | 1, 2 | Amount of water needed when changing | x, x, x, x, x, x, x | 16 |
| Amount of material in product | 7, 27 | Amount of material used | x, x, x, x, x, x, x, x | 14 |
| Energy-usage in production | 4 | Amount of electricity used in production | x, x, x, x, x, x, x, x | 14 |
| Increase environmental awareness | 25 | Users mindset should be affected | x, x, x, x, x, x, x, x, x, x | 14 |</p>
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<tr>
<th>Feature</th>
<th>16,22</th>
<th>Description</th>
<th>x</th>
<th>x</th>
<th>x</th>
<th>X</th>
<th>x,X</th>
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Appendix O - Specifications of Requirements, General list

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<th>Explanation</th>
<th>Units</th>
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<td>5,6,28</td>
<td>Few and simple machines used in process</td>
<td>subj. (1-5)</td>
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<tr>
<td>Not cause user or others harm</td>
<td>8,9,10,11,12</td>
<td>Not cause rashes, infections or pain</td>
<td>Binary (1/0)</td>
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<td>Production cost</td>
<td>13</td>
<td>Cost for making of product</td>
<td>UGX/product</td>
</tr>
<tr>
<td>REACH</td>
<td>25</td>
<td>Fulfill REACH demands on chemical substances</td>
<td>Binary (1/0)</td>
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<tr>
<td>Retain menstrual liquid</td>
<td>20,21,23</td>
<td>Amount of liquid retained</td>
<td>ml</td>
</tr>
<tr>
<td>Safe emission</td>
<td>19,25</td>
<td>Amount of harmful emissions from production or product</td>
<td>Qty.</td>
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<td>Source of materials</td>
<td>25,26</td>
<td>Materials should be from sustainable sources or recycled</td>
<td>subj. (1-5)</td>
</tr>
<tr>
<td>Sterilization in production</td>
<td>8,17</td>
<td>Amount of harmful bacteria after production</td>
<td>Qty.</td>
</tr>
<tr>
<td>Workers should not be harmed in production</td>
<td>Working environment and production site must be safe</td>
<td>Binary (1/0)</td>
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<tr>
<td>Produced locally</td>
<td>14</td>
<td>Produced in the context where it is sold</td>
<td>Binary (1/0)</td>
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<tr>
<td>Not inhibit users daily life</td>
<td>9</td>
<td>User should not be affected by the product</td>
<td>subj. (1-5)</td>
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<tr>
<td>Life-span</td>
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<td>Life length without decreased performance</td>
<td>months</td>
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<tr>
<td>Bio-degradable</td>
<td>7,25</td>
<td>Percent of product (per use) that is bio-degradable</td>
<td>%</td>
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<td>Produced manually</td>
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<td>Impose of hands in all production processes</td>
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<td>Will have a function after use</td>
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<td>Possibility for usage of disposed product</td>
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<tr>
<td>Production rate</td>
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<td>Qty/h</td>
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<td>Amount of water used in production</td>
<td>l/product</td>
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<td>Amount of material in product</td>
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<td>Amount of material used</td>
<td>g</td>
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<td>Amount of electricity used in production</td>
<td>kW</td>
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<td>Increase environmental awerness</td>
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<td>Users mindset should be affected</td>
<td>subj. (1-5)</td>
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<td>Size</td>
<td>16,22</td>
<td>Size of product when in use (fits the 90th percentile)</td>
<td>Binary (1/0)</td>
</tr>
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<td>User feels safe</td>
<td>9,16,21</td>
<td>User tests</td>
<td>subj. (1-5)</td>
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<tr>
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<td>21</td>
<td>How much can the product move without decreased performance</td>
<td>mm</td>
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<tr>
<td>The product cannot be used wrong</td>
<td>10</td>
<td>User tests to determine amount of faulty handling</td>
<td>%</td>
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<td>User feels free</td>
<td>1,2,16,24</td>
<td>User tests</td>
<td>subj. (1-5)</td>
</tr>
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<td>Water-use during menstruation cycle</td>
<td>1,2</td>
<td>Amount of water needed during the whole menstruation cycle</td>
<td>l</td>
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<td>Material used in production</td>
<td>27,29</td>
<td>Amount of waste material in production</td>
<td>g</td>
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<td>Number of materials</td>
<td>27,28,29</td>
<td>Number of different types of materials used</td>
<td>Qty.</td>
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<td>Recyclable</td>
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<td>Percent of product that is recyclable</td>
<td>%</td>
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<tr>
<td>Retain other liquids than menstrual liquid</td>
<td>Amount of other liquid retained</td>
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<tr>
<td>User feels clean and fresh</td>
<td>17,18</td>
<td>User tests</td>
<td>subj. (1-5)</td>
</tr>
<tr>
<td>Size of used product</td>
<td>7,15</td>
<td>Size should fit in pocket</td>
<td>cm</td>
</tr>
<tr>
<td>Can be used regardless of FGM</td>
<td>22</td>
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<td>Binary (1/0)</td>
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<tr>
<td>Follow body movements</td>
<td>9,12,24</td>
<td>User tests</td>
<td>subj. (1-5)</td>
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<td>9,24</td>
<td>User tests</td>
<td>subj. (1-5)</td>
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<tr>
<td>Available</td>
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<td>Percent of menstruating population in context that can get product locally</td>
<td>%</td>
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<td>16</td>
<td>Time it take to change/empty products</td>
<td>s</td>
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<td>Product and the menstrual liquid contained after use</td>
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<td>Ability to adjust production</td>
<td>subj. (1-5)</td>
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Appendix P - Function Analysis and Solution

User-friendly
- semantics
- Balance
- distinct
- weight distribution
- fulfills a function
- ergonomics
- fit
- easy
- price
- logic
- quality
- reliability
- recognition
- easy shape
- understanding
- safe
- Poka – Yoke

Cleanliness
- Smell
- Right bacteria
- Bacterial free
- Easy to clean
- Sterile
- Collecting
- Clean/not dirty
- Wiped
- Hand sanitizer
- Boiling
- Fresh
- Water
- Soap
- Detergent
- Covered
- Pressured, water, air
- Shaken
- Frozen
- Heated

Environmental friendly
- Fair trade
- Organic
- Brown
- Green
- Now processing
- No additives
- Nature
- Natural
- Energy efficient

Production
- Central
- Automated
- Manually
- Locally
- Only using recycled material
- In home
- Small scale
- Factory
- Grow
- Chop
- Grind
- Assemble
- Melting
- Casting
- Hardening
- Cutting
- Resource efficient
- Safe/no emission

Retain menstrual liquid
- Absorbing plug out of cotton
- Absorbing panty
- Potty
- Menstrual cup
- Drying the blood
- Washing the blood directly
- Made fabric napkins
- Clothes that holds the liquid and then emptying
- Cloth that is tide around waist
- Cotton wadding

Afterlife
- Be combusted
- Be a plant
- Be a building brick
- Become energy
- Become clothing
- Landfill
- Compost
- Food
- A new product
- Fuel

Holding in place
- Tape
- Rubber band
- Friction
- Flour and water
- Velcro
- Ziploc
- Resin
- Concrete
- Thumbtack
- Cast
- Adhesive
- Safety pin
- Geometry
- Pressure
- Vacuum
- Bolt
- Hooks
- Suction
- Press stud
- Button
- Nail
- Screw
- String
- Snapfit
- Springs
- glue
- putting on the inside of the body
- Belt
## Appendix Q - Weighting of Concept

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<th>Concept 2</th>
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<th>Concept 4</th>
<th>Concept 5</th>
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<tr>
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<td>Users mindset should be affected</td>
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## Appendix R – Weighting of Existing products

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<th>Commercial sanitary napkin</th>
<th>Tampon</th>
<th>Menstrual cup</th>
<th>Locally produced sanitary napkin</th>
<th>Washable napkin</th>
<th>Menstruation sponge</th>
<th>Cloths/rags</th>
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1-5

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<th>Amount of harmful bacterias after production</th>
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## Appendix S – Specification of Requirements – Specified List

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<td>Percent of menstruating population in context that can get product locally</td>
<td>%</td>
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<td>Percent of napkin that is bio-degradable</td>
<td>%</td>
<td>95</td>
<td>100</td>
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<td>Few and simple machines used in process</td>
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</tr>
<tr>
<td>Material used in production</td>
<td>27,29</td>
<td>Amount of waste material in production</td>
<td>g</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Maximum product movement</td>
<td>21</td>
<td>Maximum movement of the napkin without decreased performance</td>
<td>mm</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Not cause user or others harm</td>
<td>8,9,10,11,12</td>
<td>Not cause rashes, infections or pain</td>
<td>Binary (1/0)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Not inhibit users daily life</td>
<td>9</td>
<td>User should not be affected by the product</td>
<td>subj. (1-5)</td>
<td>3 or higher</td>
<td>5</td>
</tr>
<tr>
<td>Number of materials</td>
<td>27,28,29</td>
<td>Number of different types of materials used in product</td>
<td>Qty.</td>
<td>7 or less</td>
<td>5</td>
</tr>
<tr>
<td>Processing of materials</td>
<td>3,4,6</td>
<td>How complicated the process of producing material</td>
<td>subj. (1-5)</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Produced manually</td>
<td>28</td>
<td>Imposition of hands in all production processes</td>
<td>Binary (1/0)</td>
<td>1/0</td>
<td>1</td>
</tr>
<tr>
<td>Produced locally</td>
<td>14</td>
<td>Produced in the context where it is sold</td>
<td>Binary (1/0)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Production cost</td>
<td>13</td>
<td>Cost for making of napkin</td>
<td>UGX/product</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Production rate</td>
<td></td>
<td>Number of products per hour</td>
<td>Qty/h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REACH</td>
<td>25</td>
<td>Fulfill REACH demands on chemical substances</td>
<td>Binary (1/0)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Retain menstrual liquid</td>
<td>20,21,23</td>
<td>Amount of liquid retained</td>
<td>ml</td>
<td>15 or higher</td>
<td>30</td>
</tr>
<tr>
<td>Safe emission</td>
<td>19,25</td>
<td>Amount of harmful emissions from production or product</td>
<td>Qty.</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Feature</td>
<td>Value</td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size of product when in use (Fits the 90th percentile)</td>
<td>16, 22</td>
<td>Size of product when in use (Fits the 90th percentile)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area of absorbing surface on day time napkin</td>
<td>Length times width</td>
<td>cm²/cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source of materials</td>
<td>Materials should be from sustainable sources or recycled</td>
<td>subj. (1-5) 3 or higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sterilization in production</td>
<td>Amount of harmful bacteria after production</td>
<td>Qty. 0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The product cannot be used wrong</td>
<td>_user tests to determine amount of faulty handling</td>
<td>% 85 or higher 100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User feels clean and fresh</td>
<td>User tests</td>
<td>subj. (1-5) 3 or higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User feels comfortable</td>
<td>User tests</td>
<td>subj. (1-5) 3 or higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User feels free</td>
<td>User tests</td>
<td>subj. (1-5) 3 or higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User feels safe</td>
<td>User tests</td>
<td>subj. (1-5) 3 or higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water used in production</td>
<td>Amount of water used in production</td>
<td>l/product</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water-use during menstruation cycle</td>
<td>Amount of water needed during the whole menstruation cycle</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water-use when changing</td>
<td>Amount of water needed when changing</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>Product and the menstrual liquid contained after use</td>
<td>g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will have a function after use</td>
<td>Possibility for usage of disposed product</td>
<td>Binary (1/0) 1/0 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workers should not be harmed in production</td>
<td>Working environment and production site must be safe</td>
<td>Binary (1/0) 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size of holders</td>
<td>Length times width</td>
<td>cm²/cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size of hem on holder</td>
<td>Length of hem</td>
<td>cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length between holder</td>
<td>Difference in length between napkin and distance between holders</td>
<td>cm 3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area of absorbing surface on night time napkin</td>
<td>Length times width</td>
<td>cm²/cm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. 25, 26
2. 8, 17
3. 1, 2, 16, 24
4. 9, 16, 21
5. 130, 292
6. 3
7. 7
8. 1, 2
9. 15
10. 5
11. 1, 2
12. 17, 18
13. 16
14. 9, 24
15. 9, 16, 21
16. 1, 2, 16, 24
17. 1, 2
18. 17, 18
19. 16
20. 9, 24
21. 9, 16, 21
22. 16
23. 1, 2, 16, 24
24. 9, 16, 21
25. 16
26. 1, 2, 16, 24
27. 9, 16, 21
28. 16
29. 9, 24
30. 9, 16, 21
31. 16
32. 9, 24
33. 9, 16, 21
34. 16
35. 9, 24
36. 9, 16, 21
37. 16
Appendix T - Testing of Holders

The figure shows the mockup made to test the length and hem of the holder.

Figure 41 - Testing of different sized holders

1. 2 centimeter single hem
2. 1 centimeter double hem
3. 2 centimeter single layer
4. 1 centimeter single layer
5. 1 centimeter single hem
6. 3 centimeter single layer
7. 2 centimeter length with 1 centimeter hem
8. 3 centimeter length with 2 centimeter double hem
9. 2 centimeter length with 1 centimeter double hem
10. 3 centimeter length with 2 centimeter double hem
11. 3 centimeter single hem
12. 3 centimeter length with 1 centimeter double hem
13. 2 centimeter double hem
Appendix U - Testing of the Concept

The figure shows pictures from the testing of the final concept. The prototype were sewn by hand and the holders were a replica of G 2 centimeter length with 1 centimeter hem. The two holders were placed in such way that they in when the panty were not stretched out differed 3.5 centimeter from the napkin.

*Figure 42 - Testing of concept*