Design Concept for Thule Strollers

Improving the user experience in the dark

Torun Nachtweij

DIVISION OF PRODUCT DEVELOPMENT | DEPARTMENT OF DESIGN SCIENCES
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MASTER THESIS

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Department of Design Sciences
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Division: Product Development
Supervisor: Per Kristav
Co-supervisor: Daniel Åhman (Thule Sweden AB)
Examiner: Axel Nordin

Abstract

For most people getting a stroller is an obvious thing to do when having a baby. It's mainly used for transportation of the baby but has other functions as well. For example, it is used as a storage, serves as a shopping bag for groceries and makes a perfect bed for a baby nap. Using a stroller should be easy and safe, but when it's getting dark outside it can be hard to see the road ahead and find things in the storage, especially if there are no streetlights. And in addition to this it becomes harder to detect the stroller which increases the risk of an accident to occur. 40 % of all accidents where a pedestrian is involved happens when it is dark outside, even though less people are out walking during this time.

This master thesis is a collaboration with Thule Sweden AB and aims to improve the experience of using a stroller in the dark.

To get information about the users' opinions and experiences, a research and a user study took place. This gave knowledge about the existing market but also revealed what was important to focus on when continuing to the development phase. Several concepts were discovered through an iterative process including sketching, brainstorming and building mock-ups. In the end one of the concepts was selected for further development resulting in a prototype designed with high focus on safety, usability and aesthetics.

The final concept lights up the inside and outside of the stroller and gives it an aesthetic glow which improves the visibility. It provides the user with a full overview of the baby, lights up the road ahead and makes it easy to find things in the basket. The solution includes one light diffusing fiber attached to the inside of the canopy through a meshed trail and two light diffusing fibers attached to the bottom of the basket through plastic trails. The plastic trails allow the light to act on both sides providing light both inside and outside the storage.

The discreet and user-friendly design correspond to the values of Thule and the mission to help people live an active life with their kids safely, easily and in style.

Keywords: User experience, Lights for strollers, Safety, Aesthetics, Behavioral design, Thule, Concept development.

Sammanfattning

För många är det en självklarhet att skaffa barnvagn när man får barn. Vagnen används huvudsakligen för transport av barnet men har också många andra användningsområden. Till exempel används den ibland för att förvara saker i, som en varukorg när man handlar eller en säng när bebisen behöver sova. Det ska vara lätt och säkert att använda barnvagnen men när det blir mörkt kan det vara svårt att se vägen framåt och att hitta saker i varukorgen, speciellt om det inte finns någon gatubelysning. Samtidigt blir det svårare för andra trafikanter att se vagnen och risken att en olycka inträffar ökar. Fyrtio procent av alla olyckor, där en fotgängare är inblandad, sker när det är mörkt ute även om det är färre människor som är ute och går vid den tiden.

Detta examensarbete sker i samarbete med Thule Sweden AB och syftar till att förbättra upplevelsen av att använda en vagn i mörkret.

För att få information om användarnas åsikter och erfarenheter gjordes efterforskningar och en användarstudie. Det gav kunskap om den existerande marknaden och pekade ut vad som var viktigt att fokusera på under utvecklingsfasen. Ett flertal koncept formades genom en iterativ designprocess innehållande skissning, brainstorming och prototypbygge. Till slut valdes ett koncept ut för ytterligare utveckling på en mer detaljerad nivå som resulterade i en prototyp med högt fokus på säkerhet, användarvänlighet och estetik.

Det slutliga konceptet lyser upp både insidan och utsidan av vagnen och ger den ett estetiskt sken som gör vagnen mer synlig i mörkret. Lösningen ger användaren full översikt över barnet, lyser upp vägen framför vagnen och gör det lätt att hitta i varukorgen. Den består av en ljusslinga som träs genom en nätkanal på insidan av suffletten och två ljusslingor som träs genom plastkanaler i botten av varukorgen. Plastmaterialet gör att ljuset skiner igenom på båda hållen och gör därför nytta både på insidan och utsidan av korgen.

Den diskreta och användarvänliga designen lever upp till vad Thule står för och bidrar till målsättningen att hjälpa människor leva ett aktivt liv med sina barn, på ett säkert, enkelt och stilfullt sätt.

Nyckelord: Användarupplevelse, Barnvagnsbelysning, Säkerhet, Estetik, Användarvänlighet, Designkoncept, Thule.

Acknowledgments

First of all, thank you Daniel Åhman, my supervisor at Thule, for all the time you've invested in this project and for your valuable input and support. You´ve taught me a lot during this process and I´m thankful for our developing conversations and good laughs.

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Thank you Per Kristav, for being my supervisor at LTH and supporting me with inputs and thoughts on the design process and report.

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Lund, May 2019

Torun Nachtweij

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Introduction

This section presents the background and project description as well as the goals and delimitations for the project.

1.1 Background

The human population is constantly growing, and the birth rate keeps increasing. This means the market for strollers and baby care accessories has a sustainable growth for many years to come. Companies make effort to design and develop strollers and accessories to fulfill the needs of the users. This results in more advanced functions and features to improve the comfortability and safety (Credence research, n.d.). But even though the risk of being hit by a car increases by three times when it's dark compared with daylight, most strollers on the market does little or nothing to increase the visibility of the strollers (Folksam, n.d.). And having lights on the stroller to increase the usability is a nearly undiscovered market. Although many users come up with their own solutions and attach bicycle lights and various reflectors to achieve the goal. This shows there is a request for these products, especially in countries where it is dark a large part of the year. At the same time strollers are getting more expensive and for some it is a way of expressing status and welfare. That means hiding it under a reflective vest or attaching unsightly lights is not an option (abc NEWS, 2011).

1.2 About Thule

Thule's motto "Active life, simplified" describes their ambitions clearly. They want to make it easier for people to live an active life by developing solutions for transport. They are global market leaders in categories such as roof boxes, roof racks, and bike racks that you use on the car, but also multisport- and bicycle trailers and camera bags. They grow rapidly in the category of sports-and suitcases, as well as jogging- and city strollers (Thule Group, 2019).

The Thule brand was established in 1942 and is a sport and outdoor company developing smart solutions that are user friendly, secure, and stylish. They offer a wide range of premium products in more than 140 countries and have around 2300 employees working in more than 40 production facilities and sales offices worldwide.

There are four main categories; “Racks and Carriers”, “Active with Kids”, “Luggage and Bags” and “RV Products” (Thule Group, 2017).

The “Active with kids” category entered Thule in 2011 and contains products such as strollers, bike trailers, child bike seats and child carrier backpacks. According to the annual and sustainability report of 2018 (Thule Group, 2018, p. 55), this category is growing fast and during 2018 it had a growth of 22 %. The reason is partly because of Thule’s first four wheeled stroller “Thule Sleek”, designed for city adventures.

1.3 Project description

The project aims to improve the experience of using a stroller in the dark through improving the visibility and usability of the stroller. To avoid high production costs the solution will mainly be attachable and bought as an accessory to the stroller. There are three main areas that should be considered during the design process; safety, behavioral design and aesthetics. The three areas are all key values of Thule’s brand and should carefully be weighed against each other. To be aware of, understand and communicate the important tradeoffs of this project, a “project triangle” will be used. The triangle illustrates that the solution can’t be extreme in one area without losing in another. It should therefore strive to have something from all the important corners, making sure the final product obtains a balance between them (Schenkelberg, n.d.). In other words, it should be placed somewhere near the center of the triangle in figure 2.2.

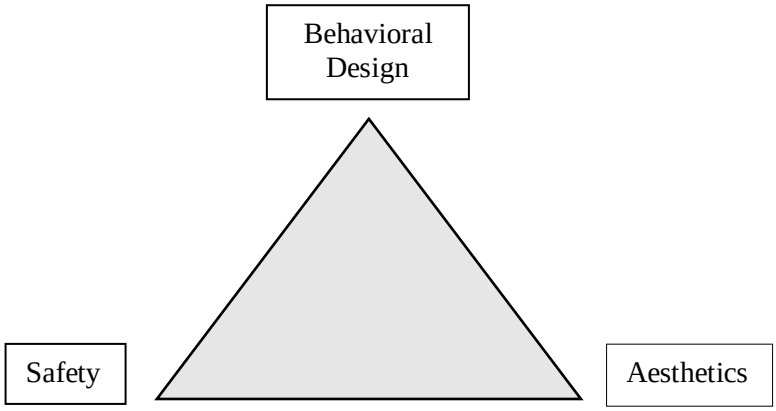

Figure 2.2 Project triangle of this project.

The stroller used as an outset for this project is called “Thule Sleek” and is a city stroller released by Thule in 2018 (Thule Group, 2017). Although the project presupposes from Thule Sleek, it is of high importance that the solution will be compatible with future stroller models as well.

The target audience is parents with small children (0-5 years) who lives in cities and need extra visibility. The solution aims to make Thule’s strollers more competitive on the market and offer their customers an optional solution for better safety and comfort in a stylish way.

In the end different concepts will be presented with a final choice. The final choice will then be prototyped to show where and how it will interact with the stroller.

1.4 Delimitations

Thule Sleek has thirteen different configurations making it adaptable for more than one kid. The final solution aims to fit future stroller models as well as the different configurations, except the ones including the car seat. The reason is that this part is completely different than a regular stroller and would therefore be hard to apply on future models.

If the final solution includes more expensive parts such as lights or batteries, these will be sold as an accessory to Thule’s strollers. The solution should in that case make it possible to attach and detach the lights in an easy way. Manufacturing and selling the strollers with lights included would make the stroller too expensive and not competitive on the market.

2 Methodology

In this section the approach and overall methods for the project are presented.

2.1 Design process

The overall approach to the project was chosen to be the Double Diamond Design Process. It was developed by the Design Council in 2005 as a graphical way of describing the design process (Design Council, n.d.). This model includes four different phases; discover, define, develop and deliver. The first phase aims to explore and collect information about the problem, while the second phase defines what is important to consider when continuing forward. The third phase focus on creativity and to generate ideas while the last phase aims to choose the best concept and finalize. The approach is illustrated in figure 2.1 where the double diamonds four phases become clear (Design Council, n.d.).

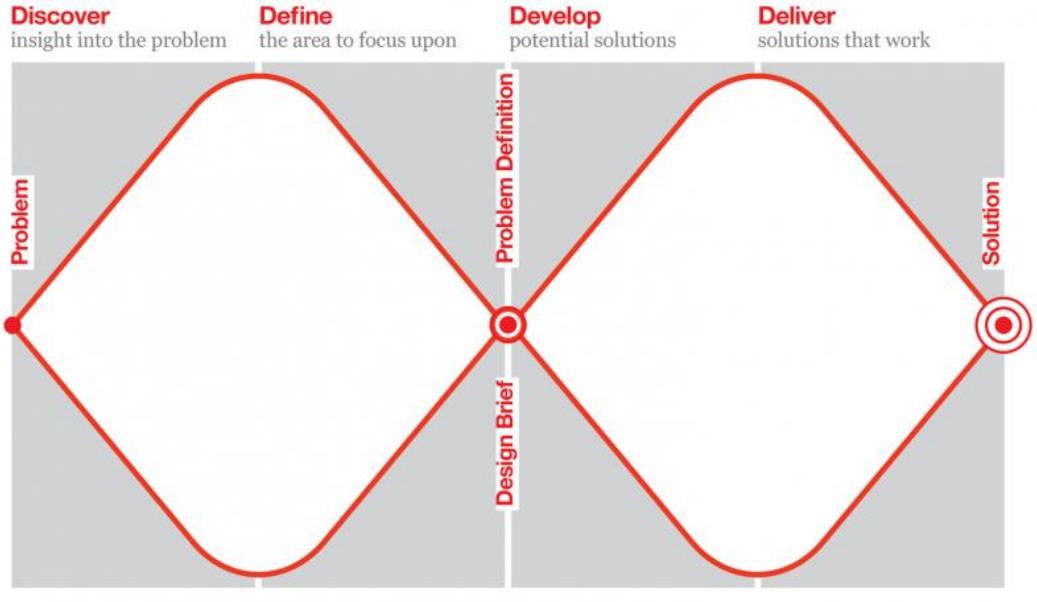

Figure 2.1 Double Diamond design process. (Design Council, n.d)

3 Discover

During the discovery phase knowledge about the users, relevant products and the market was gathered to get a deeper understanding of the problem. This section contains the performed research and explains the methods used to gather information. The key findings are presented in section 3.6.

3.1 Process

3.1.1 **Terminology- strollers**

To understand how a stroller works and what it consists of, an explanation about the different parts are presented together with a picture showed in section 3.2. The terminology will be used throughout the report.

3.1.2 **Theory**

To get an overview of the problem and get basic knowledge about seeing and being seen in darkness, theory including statistics and methods for improving visibility were established.

3.1.3 **Benchmarking**

To be aware of the existing products on the market and to gather inspiration, a benchmarking session was performed. Benchmarking means that information about competitors and their products is collected (Ulrich & Eppinger, 2012, p. 146). This was accomplished by visiting both physical- and online stores and comparing products from different brands. Looking at integrated solutions, accessories and home-made solutions.

3.1.4 **User study**

To understand what the user wants and needs, a triangulation of different methods such as interviews, surveys and observations was performed. Triangulation is a word for describing that different techniques were used for collecting data. (Preece, Rogers & Sharp, 2016). To improve the user-experience, it is important to know what the experience consists of and understand how it could be improved.

3.2 Terminology- strollers

The stroller used in figure 3.1 is called Thule Sleek and is Thule's first four wheeled stroller, released in 2018 and designed for city adventures. It is also the stroller used as a starting point and base for this project. Figure 3.2 shows the backside of the canopy.

Figure 3.1 Thule Sleek + Thule Sleek Bassinet. (Thule, n.d.)

Figure 3.2 Thule Sleek Canopy. (Thule, n.d.)

Thule Sleek has different configurations depending if you want a single, duo or a twin mode. In total there are thirteen different configurations shown in figure 3.2 but since one delimitation for this project was not to include the car seat, there will be ten different configurations to consider.

Figure 3.3 What kind of configurations can I build? (Thule, n.d.)

3.3 Theory

40% of all the accidents where pedestrians are involved happens when it is dark outside, even though less people are out walking during this time (Trafikverket, 2010). Also, in Sweden more than twice as many accidents where pedestrians are involved happens in November when it is dark compared with June (Kroon, 2016). The statistics are clear but still most of the stroller manufacturers do little or nothing to increase the visibility of the strollers, even though they carry small babies and children. Using reflectors are an easy and cheap way to prevent accidents, but many people believe that reflectors are not needed when walking in cities because of the streetlights. But as a matter of fact, most accident occur in cities and as much as 30 % of the accidents where a pedestrian is involved occurs on a crosswalk, most likely because they think it is a safe place to cross the street and are less observant (Körkortonlines.se, 2017).

3.3.1 **Reflectors**

3.3.1.1 What is a reflector?

A reflector consists of a material that reflects the light in the same direction in comes from. It often consists of a sphere-shaped lens but could also consist of prisms. A simplified explanation of the prism is explained in figure 3.4, where the light is being reflected twice and always goes back the same way. A white surface reflects the light back in all directions while a reflector sends all the light back to the light source (Nationellt resurscentrum för fysik, 2019).

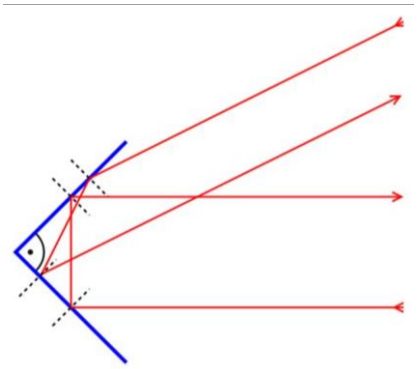

Figure 3.4 Explanation of the prism. (Nationellt resurscentrum för fysik, 2019)

3.3.1.2 Specifications

Figure 3.5 shows the visibility of a pedestrian in the dark with and without reflectors. Although, the reflectivity always depends on how dark the surroundings are, how big the reflecting surface is and the strength of the light (IF säkerhet, n.d.).

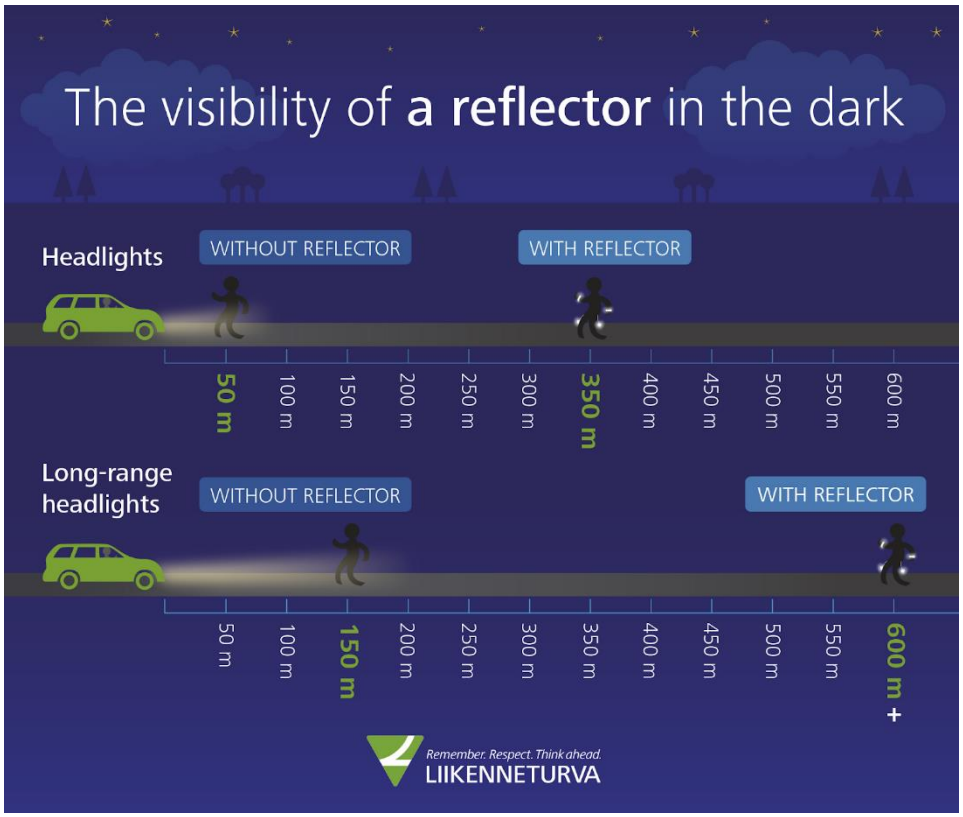

Figure 3.5 The visibility of a reflector in the dark. (Finnish road safety council, n.d.)

According to konsumentupplysning (n.d.) there are four statements that characterize a good reflector:

- The reflector should be at least 15 cm^2 big to give enough reflection.
- The reflector should be CE marked, which means it meets the safety requirements from EU.
- There should be a mark showing who has given the reflector a certification. In Sweden, SP (Swedish technical research institute) test and certify reflectors for pedestrians.

- The reflector should have a high CIL- value (at least 400) which is a measurement for reflectivity.

According to Lotta Hedin at Testfakta (2015) a reflector should be seen from at least 125 m distance when using the low beams. Of course, it is better to have small reflectors than none, but it is important not to overestimate the visibility since this can lead to a false feeling of safety. A reflector is easiest to detect when it's moving and should therefore be placed on moving parts or hang loose on a string. It is also a good idea to place it on a low level since this improves the visibility in low beams (konsumentupplysning, n.d.).

3.3.1.3 Service life of a reflector

Reflectors should be handled with carefulness since it is an optic product. It could be damaged by heat or water and loose its function, if not waterproof. Therefore, a reflector should not be kept in hot places such as a car during a hot summer or in direct sunlight. It can also be damaged from scratches and should not be kept in a pocket together with sharp objects such as coins or keys. Also, soft reflectors should not be washed more than fifteen times, something that should be considered when integrating reflectors in fabrics and soft materials (If säkerhet, n.d.). Even when handled with caution a reflector loses its reflecting ability after time, depending on the reflector, and should be replaced. A hard reflector is the best one and the usual effective time is three years. Although it should be remembered that the impact lag can largely vary, and many organizations encourage users to change the reflectors every year (Fagerström, n.d.).

3.4 Benchmarking

3.4.1 **Integrated solutions**

When checking the market for existing solutions, different web shops such as babyproffsen, baby world and Yollyroom was visited to get a better idea of the assortment. To compare Thule Sleek with other strollers on the market, the latest release from four different brands were gathered. The brands were Emmaljunga, Stokke, Britax and Bugaboo which are four of the most popular brands in Sweden. The strollers picked for comparison was:

Bugaboo- Fox Stellar.
Bugaboo is a Dutch company started 1994. *Fox Stellar*, see figure 3.6, is one of their latest releases and is a special edition designed to be seen in the dark. It has got reflecting material on several parts of the stroller providing 360 degrees visibility.

Figure 3.6 Bugaboo- *Fox Stellar.* (Bugaboo, n.d.)

Britax Go Next [2]
Britax is a company with German and British heritage. The company was founded in 1930s, but it was first in 1966 they started to focus on child safety. Their stroller *Britax Go Next*[2,] shown in figure 3.7, was released in 2018 and has a reflector attached to the basket (Britax Römer, n.d.).

Figure 3.7 Britax Go Next ^{2}. (Britax römer, n.d.)

Emmaljunga 2019 nxt90

Emmaljunga is a Swedish brand founded in 1925. The stroller Emmaljunga nxt 90 in figure 3.8mwas first released in 2017, but have been updated every year since (Emmaljunga, n.d.). It has small strings of a reflective material on the basket.

Figure 3.8 Emmaljunga nxt90 F. (Emmaljunga, n.d.)

Stokke Xplory6 2018
Stokke was founded 1932 in Norway but they did not launch their first stroller until 2003. Stokke Xplory, shown in figure 3.9, was their first stroller and it has been updated several times since then. Stokke Xplory6 is the latest version and was released in 2018 and has a reflective string on the canopy. (Stokke, n.d.).

Figure 3.9 Stokke® Xplory® 6. (Stokke, n.d.)

3.4.2 **Comparison**

The visibility of the strollers was compared in diagrams, based on the placement of the integrated reflectors. Figure 3.10 shows the overall visibility from the different angles while figure 3.11 and 3.12 compares where the reflectors are attached on the strollers. The strollers were compared to get an overview of how and where reflectors are attached, how well Thule is doing compared with the other brands and which areas could be improved. The result showed that Thule provides more visibility than many other strollers but could still be improved in some areas, such as the front view.

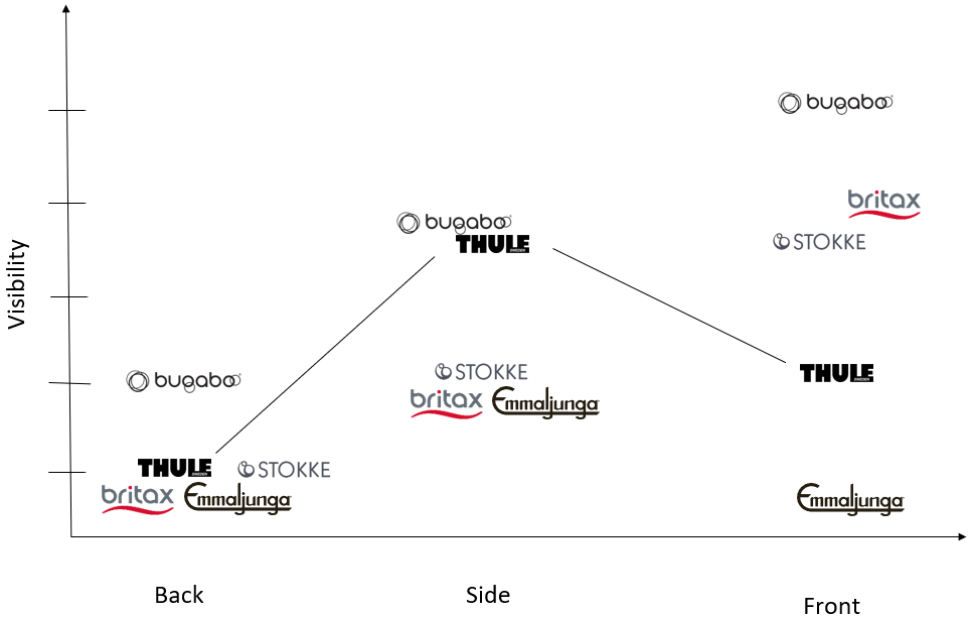

Figure 3.10 The visibility from different views.

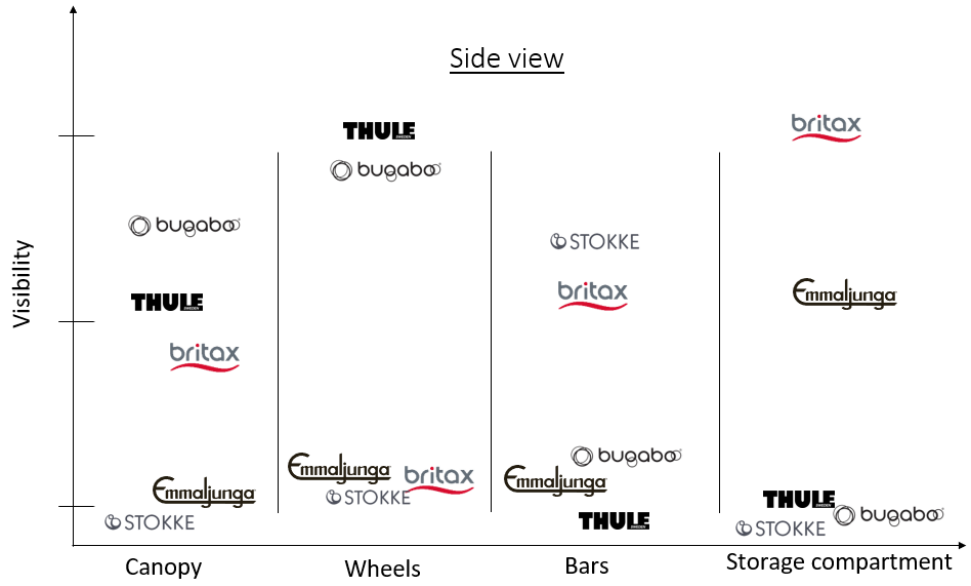

Figure 3.11 Visibility, side view.

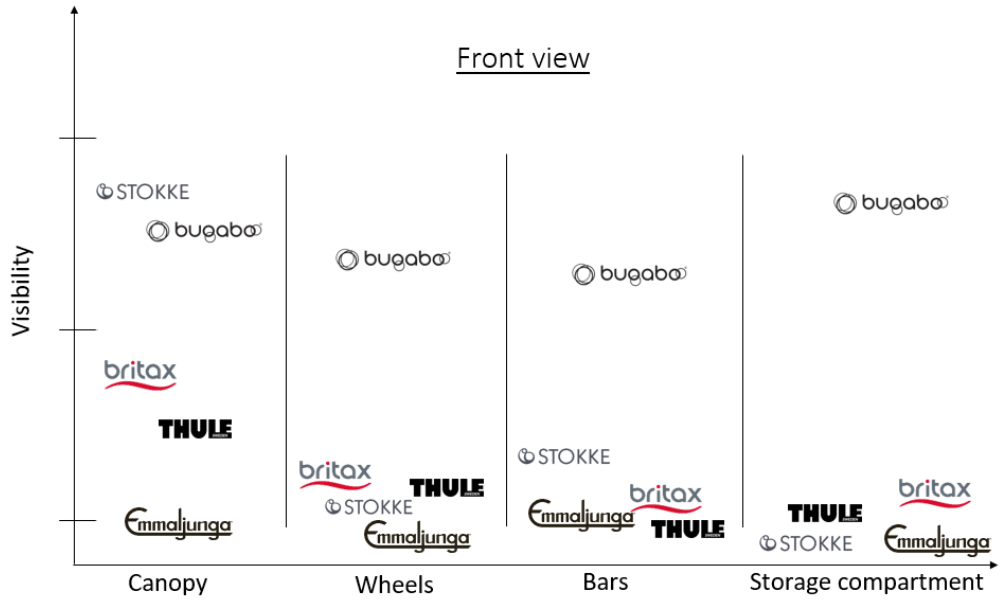

Figure 3.12 Visibility, front view.

3.4.3 **Accessories for strollers**

In the section below, accessories created for improving the visibility and usability of the stroller is presented.

Pogu- Reflective stickers for strollers
These are claimed to be a highly reflective, waterproof sticker which is discreet in daylight but reflects from 360 degrees angle when shone upon. Easy to detach compared with other stickers and visible from 200 meters. See figure 3.13. (Syskonhuset, n.d.).
Price: 79 SEK

Figure 3.13 Pogu- Reflective stickers for strollers. (Köpbarnvagn, n.d.)

Reflective Canopy
This is a reflective cover for the canopy which is waterproof and fits most strollers. See figure 3.14 (Clas Ohlsson, n.d.).
Price: 120 SEK

Figure 3.14 Reflective Canopy cover. (Clas Ohlson, n.d.)

Reflective sleeping bag
The reflective sleeping bag is a universal solution that should fit all strollers. See figure 3.15 (Köpbarnvagn, n.d.).
Price: Between 200-600 SEK depending on thickness.

Figure 3.15 Reflective sleeping bag. (köpbarnvagn, n.d.)

Reflective elastic band
The reflective elastic band can be adjusted and is therefore a universal solution. Depending on the stroller it can be attached in different ways, wherever it fits best. See figure 3.16 (Babyshop.se, n.d.).
Price: 60-135 SEK

Figure 3.16 Reflective elastic band. (Babyshop.se, n.d.)

Protector Led reflex for strollers
The led-reflex is shown in figure 3.17 and exist of a fabric with six integrated led lights. It improves the visibility and is said to be visible from up to 500 meters (Barn på väg, n.d.).
Price: 199-299 SEK

Figure 3.17 Protector Led reflex for strollers. (Barn på väg, n.d.)

Stroller lights
Led stripes in a package, figure 3.18, that allows the user to attach the lights with double sided tape wherever they find it necessary. Comes with seven strong colors that could be switched between through a rechargeable battery (third kind, n.d.).
Price: 500 SEK

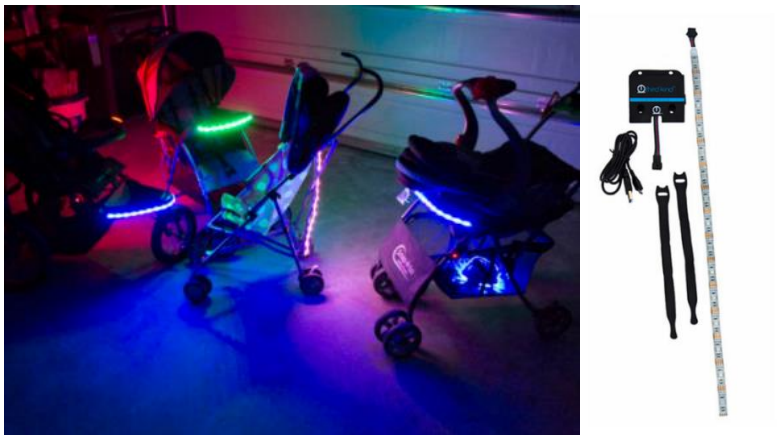

Figure 3.18 Protector led reflex for strollers. (third kind, n.d.)

3.4.4 **User solutions**

This section presents products that are not designed for strollers but still used for them. For example, bike accessories or all-around products that parents use for their strollers.

Textile reflex-spray
A series of sprays that can be sprayed on different materials and fabrics, see figure 3.19. Lotta Hedin (2015) writes that the spray works from close distance but from 125 meters it is hard to distinguish. She also explains that the spray does not work on slippery material which many jackets and canopies are made of. The text on the container says it is environmentally damaging and explains that it could be washed away in the machine.

Figure 3.19 Reflective spray. (Albedo1, n.d.)

Slap-wrap
A high reflective band that users often put around pipes on the stroller, see figure 3.20. It can be stretched out but curls up when it is slapped against an object, therefore the name. Much of the reflective surface becomes hidden when it curls up around a small pipe (adlibris n.d.).

Figure 3.20 Slap-wrap. (adlibris, n.d.)

Bicycle lights

Bicycle lights are a classic solution for strollers that need more lightening, both inside and outside the stroller, see figure 3.21. If placing the red color in the back and the white color in the front, surrounding traffic can see what direction the stroller is heading (Kjell & Company, n.d.).

Figure 3.21 Bicycle lights. (Kjell&Company, n.d.)

Hanging reflectors

The hanging reflectors are highly reflective, easy to bring and attached with a pin, see figure 3.22. This is a small and cheap reflector that moves around which increases the visibility (Sydsvenskan, 2017).

Figure 3.22 Hanging reflectors. (Sydsvenskan, 2017)

Mini led
Connecting small led lights to the zipper shown in figure 3.23, is an easy way of getting some extra visibility (JULA, n.d.).

Figure 3.23 Mini led. (JULA, n.d.)

Reflective clips with lights
Clips that combines the reflective effect with lights. It is attached near an edge through integrated magnets. See figure 3.24 (nusses, n.d.).

Figure 3.24 Reflex clips with lights. (nusses, n.d.)

3.5 User study

3.5.1 **Interviews**

To get a better understanding of the users' needs, three interviews were conducted. The interviews took between 20-30 minutes and were performed over phone or through a face to face meeting. The participants were chosen based on their location as an attempt to get opinions from different perspectives. One that walks in places with good lighting, one that lives on the outskirts of the city where the there are no streetlights and one that has tried both and works with testing and reviewing strollers. During the interviews, notes were taken and the calls were recorded, making it possible to relisten to them several times. The persons who were interviewed were;

A woman 30-40 years old

- Four kids
- Lives in Stockholm
- Runs a Swedish blog about strollers. She is testing strollers and accessories on daily basis and evaluate 35 strollers in one year which she then writes about
- Usually walks in the city where there are street lights, but also on the countryside during the summer where there are no lights.

A woman 25–35 years old

- One baby ca. 2 years old
- Lives outside of Lund
- Usually chooses to walk in places with streetlights

A woman 25–35 years old

- One newly born baby ca. 3 months
- Lives outside Helsingborg
- Usually walks where there are no street lights

The questions prepared for the interviews together with a summary of the answers can be find in appendix A and appendix B.

3.5.2 **Questionnaires**

Questionnaires are a good way to get both qualitative and quantitative data, get answers to specific questions and reach out to lots of people fast (*Preece, Rogers, & Sharp, 2016, p. 345).*

To get an overall picture of the users' opinions, electronic questionnaires were used. gathered. The questionnaire included questions about how the responders make themselves visible in the dark and what they think about the market today. The questionnaire can be found in appendix C. Before starting, a pilot test was performed which is a trial run of the main test (*Preece, Rogers, & Sharp, 2016, p. 354).* This was made by sending the questionnaire to a woman specialized in strollers. A pilot test is a She gave feedback to how to make the questionnaire more understandable and added relevant questions

The final questionnaire included nine questions combining both open and closed ones. It also included "Likert scales" which is a type of rating scale used to measure beliefs, opinions and attitudes (*Preece, Rogers, & Sharp, 2016, p. 348)*. It was posted in a discussion board about strollers on social media and 157 answers were collected. This gave a wide picture of the users' opinions in both qualitative and quantitative data. A summary of the answers can be found in appendix D

3.5.3 **Observations**

Observations were performed in two sessions. One during two hours at lunchtime in the center of Lund city since this is a busy time of the day when many parents are out walking with their strollers. The other session took place in Lund's city park during two hours in the evening. The park was chosen because there are less lights than in the middle of the city and therefore a better place to detect if someone is using lights on the stroller. It is also a common place for people to take a walk in and was therefore considered a good place for observations. The observations were performed as a complement to the interviews and questionnaires to see if the collected information correspond to the observations. Notes from these sessions can be found in appendix E.

3.6 Key findings

3.6.1 **Research on the web**

The risk of getting hit by a car is three times bigger when it is dark outside, and it increases even in the dawn. Most accidents where a pedestrian is involved occurs near a crosswalk often because crosswalks create a false feeling of safety and makes pedestrians less observant. Konsumentupplysningen (n.d.) recommend people to use reflectors that can be seen from at least 125 m distance.

3.6.2 **Benchmarking**

There are few integrated solutions for improving the visibility of strollers today, except for special editions that are designed for a specific purpose. Thule Sleek has relatively good visibility compared to many other strollers, especially when viewed from the sides which is good when approaching a crosswalk. Further up around the canopy Thule Sleek has a small reflective string attached with a good placement, but it is a bit too small. The area concerning visibility from the front seems to have a low priority when it comes to integrated solutions on the market but appears to be important for the users. Especially when walking alongside the road, facing a car in places with small roads and bad sidewalks. An area that most strollers on the market do not cover at all is the visibility from the back, most likely because the driver of the stroller will cover this area when walking. There are some good solutions to improve the visibility if looking at accessories and home-made solutions, but regarding the usability e.g. lights inside the stroller, there appears to be less to choose from. Most users attach bicycle lights or use a head light, which could disturb the baby.

3.6.3 **User study**

Through the interviews and questionnaires, it became clear that almost everyone tried to do something to improve the visibility of their strollers because they believed the integrated reflectors were not enough. But one thing that separated users living inside and outside the city was that lights were needed and appreciated more outside the city. This is mainly because there is not always good lightening alongside the streets. Areas mentioned for improvement was light to improve the sight in front of the stroller, lights that allow the user to see their baby and lights to improve the visibility in the basket. When comparing the users' answers with the existing products on the market it becomes clear that there are few products designed for the inside of the strollers. The users must come up with their own

solutions such as using head lamps or bicycle lights, using the flashlight on their phone or even having somebody else light up the way with a flashlight. Often resulting in either blinding or disturbing the baby, not having enough hands to both hold a light and drive the stroller or getting irritated when not finding things in the basket.

Analyzing the quantitative data, it became clear that the appearance and aesthetics is important for most users. Lots of people buy expensive strollers both for functionality but also for the appearance and status that comes with it. Therefore, they do not want to hide the stroller under a massive reflective vest. During an interview a mom explained that she is more likely to use reflectors if they look good. The chance of leaving them on permanently is higher and could thereby prevent the user from forgetting about them, which was also mentioned as a problem. This indicates that there is a value in creating an attractive solution from an aesthetic point of view.

The questionnaires showed that 52.2 % thought that the supply of products, designed to improve the visibility of strollers, were bad. Which shows that there are areas of improvement regarding solutions designed specifically for strollers.

4 Define

After having gathered knowledge and insights about the problem during the Discovery phase, the information had to be sorted out to create a clear path forward for the project. Formulating user needs and prioritize them as well as highlighting important functions was necessary before entering the development phase. A summary of this section can be found in 4.7.

4.1 Methods

4.1.1 **User needs**

To define the user needs, thoughts and quotes can be interpreted into a list of needs. They should be phrased in terms of what the solution *ought* to do and not *how* to do it. They should be specific, have positive formulations and be expressed as a quality of the product. The words "shall" and "must" should be avoided since these words express the importance of the need, something that will be taken care of later (Ulrich & Eppinger, 2012, p.126).

4.1.2 **Function analysis matrix**

The function analysis matrix is a list where the most important functions are defined and prioritized. This is a way to later evaluate different concepts from an objective view and be sure that no important function is forgotten. New thoughts and considerations can appear during the process that affects the list and it can therefore be complemented as the project develops (Landqvist, 1994, p. 45).

4.1.3 **Mood board**

To communicate what feeling the final solution ought to express but also to gather inspiration, a mood board can be used. This is a collage of pictures, images or sketches and can be seen in section 3.4 (Nilsson, Ericson & Törlind, 2015, p. 101).

4.1.4 **Scenarios**

The goal with scenarios is to develop criteria for the interaction between the user and the product (Wikberg Nilsson, Ericson & Törlind, 2015, p. 141). When developing an accessory, it is important to be aware of the main product´s functions and consider them during the development process. If not, the solution could prevent the main product from functioning properly. Therefore, a list of daily scenarios that could affect the success of the solution is presented.

4.2 User needs

Ulrich & Eppinger (2012, p. 81) demonstrate how important *quotes* can be directly interpreted into customer needs through a table. The method is a good way to understand the meaning of the quotes and the underlaying problem. This table with quotes can be found appendix F.

Table 3.1 is a summarized list of the user needs formed from the quotes, but also other insights gained from the research and user study.

Table 3.1 Summarized list of user needs.

	User needs
Basic function	The solution ought to make the stroller visible in the dark The solution ought to be useful no matter what constellation The solution ought to improve the user experience of walking in dark environments
Secondary functions	The solution allows the parent to see the baby when its dark The solution allows the user to see better in front of the stroller The solution allows the user to see better in the basket The solution should be easy to clean The solution should be easy to place and remove The solution ought to allow the user to decide when to use it. The solution should be small and easy to bring The solution should be easy to hide The solution should be waterproof The solution ought to be visible from all angels The solution makes the stroller visible from 125 m distance
Ease of use	The solution should be easy to use The solution should be easy to attach to the stroller The solution ought to be easy to find The solution should be easy to reach The solution should be easy to understand The solution should be easy to turn on/start using The solution ought to work even with the rain cover on The solution ought to minimize the effort of the user The solution should be easy to change/charge

Security	The solution should be seen from 125 m distance
	The solution allows the user to feel safe
	The solution ought to encourage the user to be more visible in the dark
	The solution ought to help others to see the stroller in the dark
	The solution minimizes the risk of someone hitting the stroller accidently
	The solution allows the user to check the baby
	The solution ought to help the user avoid obstacles on the road
	The solution ought to be out of reach for the baby
	The solution ought to minimize the chance of forgetting about the visibility
	The design ought to minimize the risk of being stolen
	The design of the solution ought to not disturb a sleeping baby
	The design of the solution ought not to disturb the night vision for the user
Aesthetics	The solution ought to signal status
	The solution ought to look solid and sustainable
	The solution ought to express quality
	The solution ought to make the user proud of using the stroller
	The solution gives the stroller an impression of design
	The solution ought to express durability
	The solution should not leave permanent marks on the stroller

4.3 Function analysis matrix

The research showed four areas that was recognized as important for improving the experience of walking with a stroller in the dark.
These were:

- Making the stroller visible in the dark
- Being able to see in front of the stroller
- Being able to see inside the basket
- Being able to see the baby

These will be marked with an "A" for "areas of improvement" in the function analysis matrix shown in table 3.2. The solution should aim at fulfilling as many of these as possible in cooperation with the three ground corners of the project triangle; safety, behavioral design and aesthetics. As mentioned before some functions may have to be excluded in order to maintain a balance of the three areas.

HF- Head function **A**- Areas of Improvement **N**- Need **W**- Wish

Table 3.2 Function Analysis Matrix

The solution ought to:	
Improve the users experience of walking with a stroller in a dark environment	HF
Make the stroller visible in the dark	A
Offer visibility in the canopy	A
Offer visibility in front of the stroller	A
Offer visibility in the basket	A
Offer easy attachment	N
Offer easy detachment	N
Be waterproof	W
Be visible from all angles	W
Be simple	N
Work with the rain cover on	W
Be easy to change/charge	N
Be small and easy to bring	W
Useful no matter model or constellation	N
Avoid disturbing a sleeping baby	N
Minimize the risk of disturbing the user's night vision	W
Express quality	W
Avoid leaving permanent marks on the stroller	W
Be durable	N
Represent Thule	N
Have a reasonable cost	N
Be sustainable	W

4.4 Mood board

The mood board in figure 4.1 was created to mediate what feeling the final solution ought to express. Since the aesthetic factor was an important part of the project, it was important that everyone involved had the same picture of what the final concept might look like.

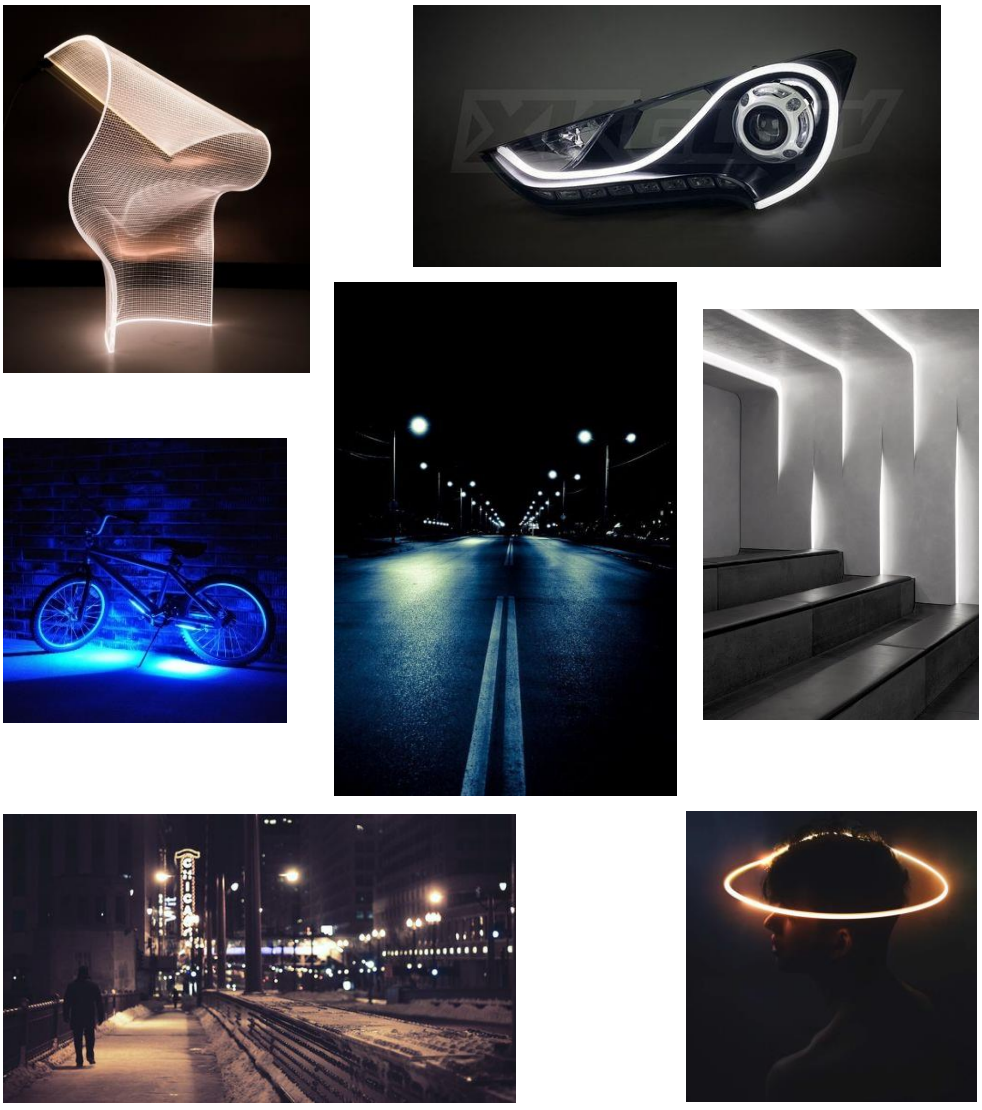

Figure 4.1 Mood board (Pinterest, 2019)

4.5 Scenarios

The five first scenarios presented below are scenarios which include basic functions of the stroller. To not affect the basic functionality of the stroller these needs to be considered when designing the final concept. The last two represent future scenarios which should also be considered in order to maximize the usability.

- When folding and unfolding the canopy
- When folding the stroller
- When it is raining
- When using the rain cover
- When washing the fabric
- When attaching and detaching the solution
- When and how to change battery/reflectors

4.6 Light VS Reflector

Lights and reflectors are the two main areas used for improving the visibility and usability in the dark. Therefore, it is important to know the difference between them and sort out their strengths and weaknesses. This makes it easier to decide where and why to include them in the design and be aware of the affects and consequences they might bring.

The advantage of using a light

- It can be seen even if it is not illuminated it, which makes the stroller visible for drivers of bicycles and other vehicles
- You can change color on it to send different messages, e.g. signal what's front and back
- It can be seen from different angles and around obstacles since it lights up the surrounding
- It lights up the environment so the user can see better
- Adds an aesthetic effect in the dark

The advantage of using a reflector

- Battery is not needed
- Cannot stop working when out on a walk
- Less expensive
- Does not break as easy
- Easier to hide
- Takes up less space

- Better for environment

4.7 Design brief

To get an overall description of the requirements and clarify what is expected from the solution, a design summary was compiled. Including important aspects and functions as well as things that need to be kept in mind when proceeding on to the developing phase.

To provide safety and facilitate the use of Thule's strollers in the dark, a detachable product will be developed. The main reason for it to be detachable and sold as an accessory to Thule's strollers is because it is too expensive to include in every stroller and could be perceived as unnecessary for users living in brighter areas. Therefore, it will be a stylish accessory to add for users who would like some extra safety and usability when it is dark.

The product ought to focus on three main areas; safety, behavioral design and aesthetics. To meet the safety recommendations the product should be visible from at least 125 meters and preferably from all angles. All parts should be kept out of reach from the baby or securely fastened and it should not affect the baby's vision or ability to sleep. It is important that the solution will work no matter model or configuration.

When comparing reflectors with lights it becomes clear that reflectors are a cheap, simple and environment friendly way to improve the visibility in the dark. But to improve the usability, lights are necessary since they light up the environment and improve the sight for the user. Therefore, it is a good idea to use lights in positions where the purpose is to improve the sight and reflectors if the purpose is to increase the visibility.

Regarding the user experience, the solution should be easy to attach and detach and if not used it should be easy to bring along in case it is needed later. The solutions should not make it harder for the user to clean or wash the clothing of the stroller and if the product acquires electricity it has to be easy to charge. Depending on the placement the solution needs to be waterproof since it will be used outside, partly under rainy circumstances and should preferably be compatible with a rain cover. Research showed that being able to see the baby is important for many users and therefore the ability to see inside the bassinet and the seat is of great value as well as see inside the storage basket and the road when walking in dark areas.

Even if safety comes first the aesthetics is an important part of the design according to the research. And in addition to this, Thule is known as a global premium brand who stands for safety, quality and style. Therefore, it is important that the solution express this through the aesthetics of the design.

5 Develop

This chapter describes the methods used for development of concepts. It also presents the outcome of it through pictures and individual descriptions and in the end a selection is made. The most suitable concept will then continue and be further developed in the delivery phase.

5.1 Approach

During the development phase the knowledge and insights from the previous steps were integrated in the process. Brainstorming, sketching and prototyping were used in parallel, mainly because the solution is small enough to create mock-ups on and because the project is all about testing what works and find the right places to attach the solution. A constant mix of divergent and convergent thinking was used. Divergent to stay open for new ideas and seek creative solutions and convergent to summon up thoughts and get a direction to work in (Nilsson, Ericson & Törlind, 2015, p. 118).

5.2 Methods

5.2.1 **Brainstorming**

Brainstorming is a method for producing ideas. The method was developed by Alex F. Osborn and consist of many different embodiments. There are four principles that should be followed when brainstorming; Never criticize, aim for crazy and wild ideas, combine and improve the ideas and aim for quantity instead of quality. (Nilsson, Ericson & Törlind, 2015, p. 125).

5.2.1.1 Mindmapping

Mind mapping is a brainstorming technique used to express and generate ideas. It is a way of getting all ideas down on a paper without evaluating the relevance of the solution. It is performed by writing down a word or a theme in the middle of a paper

and then fill the empty space around it with thoughts, comments, drawings etc. Anything that comes to mind (Science buddies, n.d.).

5.2.1.2 Six thinking hats

Six thinking hats is a method developed for looking at problems and solutions from different perspectives. It aims to maximize the production of ideas, highlight possibilities and problems in a systematic way and avoid conflicts between the participants. The method exists of six imaginative hats in different colors which represent different ways of looking at a problem. The white hat focus on facts while the black hat focus on difficulties and negative aspects. The red hat focus on feelings and intuitions while the green hat focus on creativity and possibilities. The yellow hat focus on positive aspects while the blue hat keeps track of the process, making sure the steps are being followed and keeps the goal in focus. It is a way of structuring the creativity (Nilsson, Ericson & Törlind, 2015, p. 145).

5.2.2 **Sketching and prototyping**

Prototype is a word for describing a physical model used for testing a concept. Prototyping is the verb of it, meaning that prototypes are built to gain knowledge about a concept and understand how the design process should continue forward. Sketching is a simple way of prototyping where a paper and a pen is used to draw and express an idea (Nilsson, Ericson & Törlind, 2015, p. 155).

5.2.3 **Workshop**

A workshop is a creative meeting where a group of people gather to discover a new area. The workshop varies depending on the content, but it usually includes “hands-on” experience (Nilsson, Ericson & Törlind, 2015, p. 155). While performing a workshop the participants can be divided into several groups to work parallelly. Parallel prototyping is a method for minimizing the risk of limiting ideas by avoiding the members to be influenced by each other, i.e. not letting the different teams look or talk to each other during the session (Martin & Hanington, 2012).

5.3 Process

5.3.1 **Brainstorming**

At first a general brainstorming session took place, including mind mapping and writing down ideas that had arisen during the previous phases. This worked as a start-up to get the creativity flowing and generate ideas that could later be helpful when combining concepts. After this, brainstorming sessions within the areas of improvement, presented in section 4.3, were performed.

5.3.1.1 Mindmapping

In this project one mind map including attachment techniques and one including hiding techniques were created by the developer of the project. This was a way of getting the creativity going but it also gave lots of ideas of how to use existing parts and details on the stroller for attachment of an additional accessory.

5.3.1.2 Six thinking hats

This method was performed by six persons from different backgrounds that were not related to the project from the beginning. The session lasted for one hour and the subject was; attachment possibilities for accessories to Thule Sleek and different ways of improving the visibility and usability of the stroller. The different hats helped evaluate the solutions and ideas that came up.

5.3.2 **Sketching and prototyping**

Sketching and prototyping was performed in parallel to get a feeling of which ideas could work and at the same time be good from an aesthetic point of view. It was of big importance to have Thule Sleek at hand when prototyping, being able to test and see how different concept looked from different angles and in different lighting.

5.3.3 **Workshop**

A workshop was arranged at Thule's development department where seven people, including four of Thule's concept designers and two design students, worked in teams to come up with concepts and build mock-ups. The teams were provided with different types of lights and reflectors, together with material such as tape, fabric

and paper. Parallel prototyping was used to avoid that the different teams were influenced by each outer. The mock-ups were based on the four areas of improvement defined earlier in the process and tested in a dark room.

After the work-shop with Thule´s concept designers it became clear that the most important area that this project should continue to focus on was the light in the canopy. This did not only increase the visibility of the stroller but also resulted in a big improvement from an aestethic point of view. The second area to focus on was the light under and in front of the stroller, basicly for the same reasons. Light inside the basket improves the usability and therefor came on third place while adding reflectors for visibility became less prioitized. The reason was because the lights covering the other areas also improved the visibility when lighting up the stroller and there are more solutions for reflectors on the market today than for lights. This means that a product containing lights would be more unique pn the market. In addition to this, Thule already has some reflectors integrated on their strollers.

5.4 Concepts

The following concepts were considered the most promising ideas and were developed during the brainstorming, sketching and prototyping sessions by the developer of the project. Since part of the brainstorming was performed within the areas of improvement, some of the final concepts will only be focusing on one area. The idea was to combine different concepts or leave them as separate solutions depending on the customers´ need.

5.4.1 **A. The light bar**

The light bar is an external solution made of plastic. It allows the user to see in front of the stroller and partially improves the visibility of it. It is attached to the bar between the front wheels and does not need any modification of the existing stroller. It is easy to attach and will most likely be compatible with futures models. Figure 5.1-5.3 show the concept through sketches and a prototype.

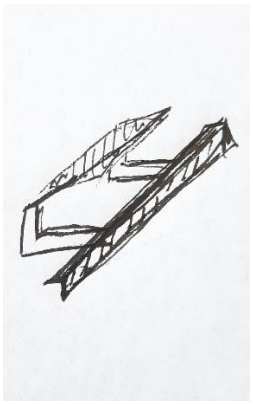

Figure 5.1 Sketch, a

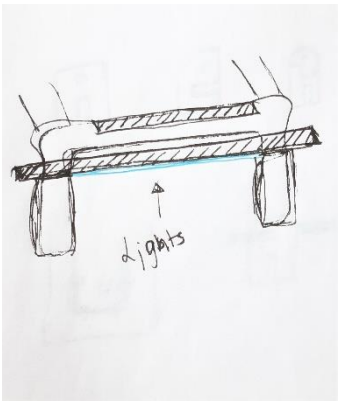

Figure 5.2 Sketch, b.

Figure 5.3 Prototype.

5.4.2 **B. Velcro tape**

The Velcro tape solution is an external accessory for attaching lights inside the canopy. It consists of Velcro tape and a light guide. By pressing the two sticky sides of the Velcro tape against each other, while having the meshed fabric on the canopy in the middle, they stick to the canopy but can also be moved around depending on where the user needs the light to be. A small light tube will be sewn on to the side of the tape facing the baby. Figure 5.4-5.6 show the concept through a sketch and a prototype.

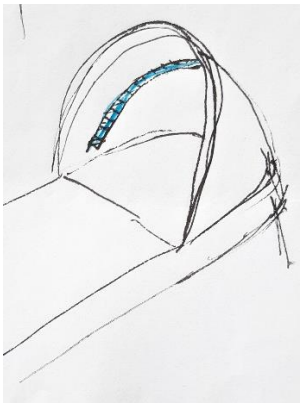

Figure 5.4 Sketch.

Figure 5.5 Prototype, a.

Figure 5.6 Prototype, b.

5.4.3 **C. Elastic band**

The elastic light-band is an external accessory for attaching lights to various places on the stroller, preferably under the basket or around the bassinet/seat. It consists of two hooks on each end of an elastic band, which has a light tube attached to it. By hooking the band to two different places on the chassis as shown in figure 5.9, it will be securely attached and provide the stroller with visibility and light in front of the stroller. Figure 5.7 and 5.8 show the concept through a sketch and a prototype.

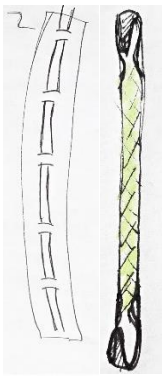

Figure 5.7 Sketch.

Figure 5.8 Prototype, a.

Figure 5.9 Prototype, b.

5.4.4 **D. Magnet sensor**

The basket on Thule's strollers contain magnets for closing the opening. Attaching a light with a magnet sensor next to the opening will result in having the lights turned on when opening the basket but turned off when the door closes. The position of the light in the upper right corner is a good place for spreading the light, allowing the user to see properly. A solution that will need a small adjustment on the basket where the light can be attached. Figure 5.10 is a sketch showing the placement of the light in the basket. Figure 5.11 and 5.12 show the concept through a prototype, where the light is on when the basket is open and off when the basket is closed.

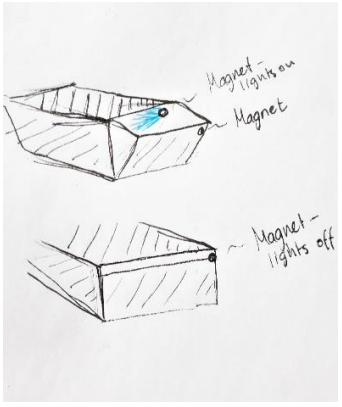

Figure 5.10 Sketch.

Figure 5.11 Prototype, on.

Figure 5.12 Prototype, off.

5.4.5 **E. Meshed net**

A meshed net with integrated lights is attached under the basket, spreading light both under and in front of the stroller. It is fastened with strings around the same hangers that holds the basket and will light up the stroller from underneath. Figure 5.13-5.15 show the concept through a sketch and a prototype.

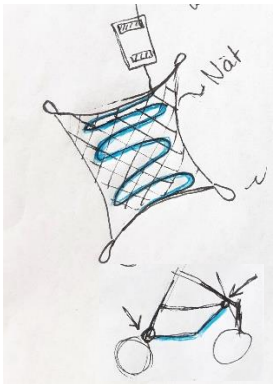

Figure 5.13 Sketch.

Figure 5.14 Prototype, a.

Figure 5.15 Prototype, b.

5.4.6 **F. Elastic light-reflector**

This solution will cover three areas of improvement. Providing light in the canopy and in front of the stroller but at the same time improves the visibility thanks to reflective bands in the front. It consists of two elastic bands with a cylinder-shaped

light on each side and is attached around a hook on the inside of the canopy and one attached underneath the bassinet. The concept only fits the bassinet and if chosen to proceed with this one, a solution for the seat will be necessary as well. Figures 5.16-5.18 show the concept through a sketch and a prototype.

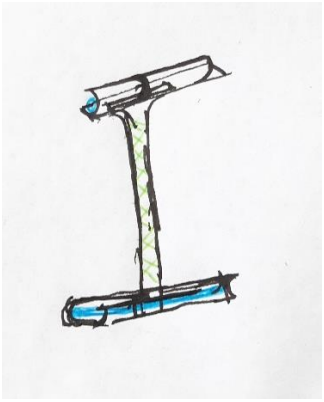

Figure 5.16 Sketch.

Figure 5.17 Prototype, a.

Figure 5.18 Prototype, b.

5.4.7 **G. Pin solution**

As the name reveals, the pin solution exists of pins with a light tube attached between them, holding the solution together. The pins are being pressed through the fabric on the canopy. They are then fastened by adding a "hat" on the other side. Pre-made holes will guide the user where to place the pins and this solution can be placed wherever Thule wants it to be as long as there is fabric, i.e. both inside and outside the canopy as well as inside and outside the basket. It works two ways depending on what side the pins are placed, providing light in many areas. Figure 5.19 and 5.20 show the concept through sketches.

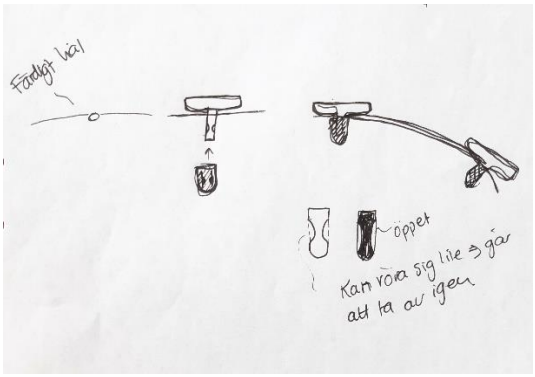

Figure 5.19 Sketch, a.

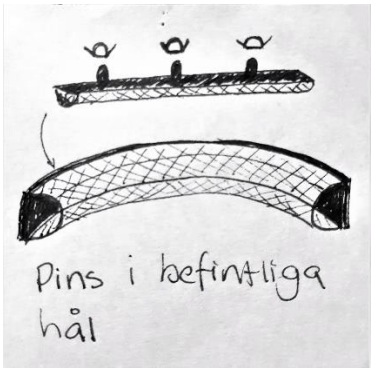

Figure 5.20 Sketch, b.

5.4.8 **H. Meshed trail**

This solution consists of meshed fabric formed into a trail which is attached to specific parts of the stroller. A light guide is then inserted through an opening in the end of the trail and is easily slid into place. This solution can be placed wherever there is fabric and therefore provide light both in the canopy and in the basket. Figure 5.21 shows how a light guide is inserted into trails in the bottom of the basket while the battery is placed in a pocket on the side. Figure 5.22 shows how the concept is placed in the canopy.

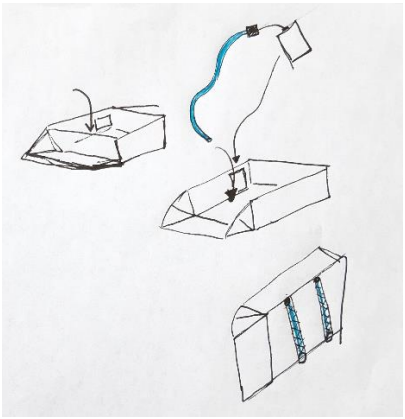

Figure 5.21 Sketch, a.

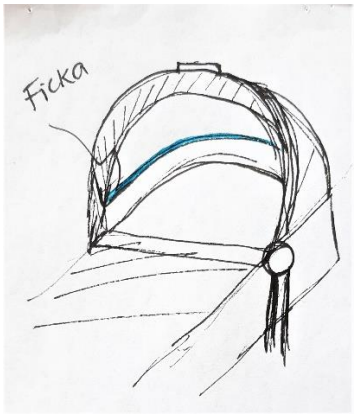

Figure 5.22 Sketch, b.

5.4.9 **I. Plastic trail**

The plastic trail has the same principal as the previous concept “meshed trail”. The only difference is that it consists of a plastic profile shown in figure 5.24. In the profile a plastic piece, formed to match the cavity in the profile, will be fitted. In that way a light tube attached to the plastic piece can easily be slid into place. The profile will be sewn or glued on the existing fabric on the stroller. Figure 5.23 and 5.24 show the concept through a sketch and a 3D-prototype.

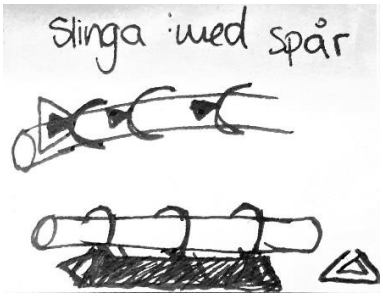

Figure 5.23 Sketch.

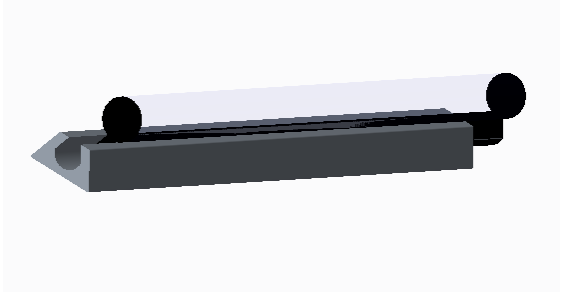

Figure 5.24 3D-prototype.

5.4.10 **J. Clips**

This concept exists of clips that will be purchased in a package together with a description where the lights can be attached. There will be different shapes of the clips shown in figure 5.25, that will fit different parts of the stroller. It aims to provide the users with lots of freedom, letting them decide by themselves where to place the lights. If attaching all the clips they provide light in the canopy, in front of the stroller and inside the bassinet. Figure 5.26 and 5.27 show the concept through prototypes.

Figure 5.25 Prototype, a.

Figure 5.26 Prototype, b.

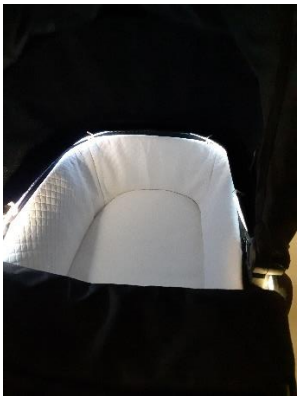

Figure 5.27 Prototype, c.

5.5 Evaluation

5.5.1 **Concept selection**

To select what concept should be further developed a concept designer representing Thule was consulted. Highlighting the pros- and cons of the different concepts and hearing opinions from Thules point of view was important for choosing which concept to proceed with. The most favorable concept from the designer´s point of view was concept G- the "Meshed trail". The reason was the confidence of the design showing the user exactly where to put the light by having a special trail integrated in the stroller from the beginning. It is a solution that is thought through and express quality. It was also the simplicity of attaching and detaching the lights and the fact that it could work for future models that made this concept favorable.

5.5.2 **Evaluation matrix**

To choose what concept should be further developed, a concept selection matrix was created, showed in figure 5.28 . The relevant criteria from the function analysis were ranked of importance and interpreted into the matrix. Every concept got a score from 0-5 depending on how well they fulfilled the need. This was performed to make sure the right concept, based on the user needs, was chosen. The five concepts to score the highest points were concept E, F, G, H and I where concept G and H were viewd as superior.

2	Selection Criteria	Rank	Weight	A- L.b	B- V.t	C- E.b	D- M.s	E- M.n	F- E.r-f	G- P.n	H- M.t	I- P.t	J-C
3	Make the stroller visible in the dark	A	3	2	1	3	0	3	5	3	4	2	3
4	Offer visibility in the canopy	A	3	0	5	0	0	0	5	5	5	5	5
5	Offer visibility in front of the stroller	A	3	5	0	3	0	3	5	0	4	4	3
6	Offer visibility in the basket	A	3	0	0	0	5	0	0	0	5	5	0
7	Offer easy attachment	N	4	5	3	2	3	2	2	2	4	4	2
8	Offer easy detachment	N	3	5	4	4	4	2	3	2	4	4	3
9	Be waterproof	W	2	4	3	3	3	3	3	3	3	3	3
10	Be visible from all angles	W	3	3	0	3	0	3	3	1	3	3	2
11	Be simple	N	3	4	4	3	4	3	3	2	4	4	5
12	Work with the raincover on	W	1	5	5	5	5	5	0	5	5	5	5
13	Be easy to change/charge	N	4	Depends on the light and battery									
14	Be small and easy to bring	W	1	1	3	3	5	2	4	5	3	3	5
15	Useful no matter model or constellation	N	5	3	2	4	5	4	0	5	5	5	2
16	Avoid disturbing a sleeping baby	N	4										
17	Minimize the risk of disturbing the users night vision	W	1	Depends on the light									
18	Express quality	W	3	2	1	2	3	2	3	3	5	4	1
19	Avoid leaving permanent marks on the stroller	W	1	5	5	5	5	5	5	5	5	5	5
20	Be durable	N	3	3	2	3	2	4	3	3	5	5	1
21	Represent Thule	N	4	3	2	2	3	2	3	2	5	5	1
22	Have a reasonabel cost	N	4	3	4	3	2	3	2	3	3	1	4
23	Be sustainable	W	2	2	3	3	2	3	2	3	3	2	3
24	Net score			137	122	136	136	132	137	137	215	196	134
25	Rank			3	7	4	4	6	3	3	1	2	5

Figure 5.28 Selection Matrix

6 Deliver

After deciding to proceed with concept G- the meshed trail solution, details such as what lights and battery to use, attachment technique and the exact placement of the solution were determined.

6.1 Detail concepts

When having decided upon a solution, ideation about how to develop and improve the concept started. Looking at different materials and sewing techniques resulted in five more detailed concepts.

6.1.1 **Concepts**

1. Having two seams to form the trail, making the lights come closer to the fabric without hanging out. See sketch in figure 6.1.

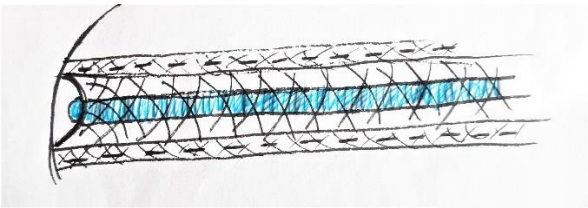

Figure 6.1 Sketch two seams.

2. Having only one seam creating a loop where the light tube will hang. See sketch in figure 6.2.

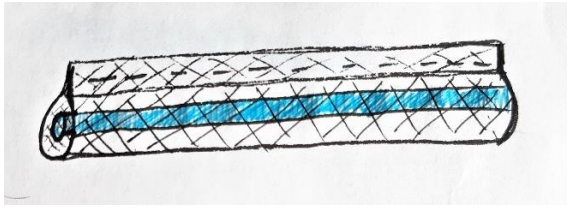

Figure 6.2 Sketch one seam.

3. Having a meshed net all the way through, making the light visible from two sides. See sketch in figure 6.3.

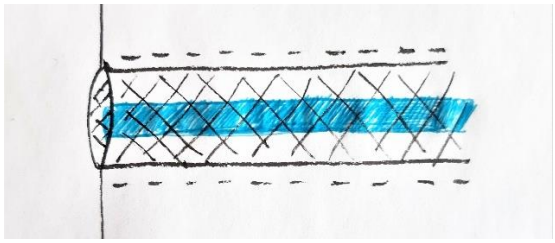

Figure 6.3 Prototype meshed fabric.

4. Having a plastic material all the way through, making the light visible from two sides. See prototype in figure 6.4.

Figure 6.4 Prototype plastic fabric.

5. Having a plastic material and a meshed net layered on each other, adding a visual effect and making the light visual from two sides. See prototype in figure 6.5.

Figure 6.5 Prototype meshed and plastic fabric.

The idea of concept 3-5 is that the light could work on two sides, letting the light be useful for more than one area. For example, using it in the basket would give light both inside and outside the basket which covers two areas of improvement listed in the function analysis matrix. If using it in the canopy it would give light both on the inside letting the user see the baby, but also improving the visibility of the stroller from the outside.

6.1.2 **Selection**

When talking to the sewer at Thule, advice was given of how to attach and place the fabric from a manufacturing and cost perspective. Regarding the basket she saw a problem of having a meshed fabric under the stroller since this could easily get dirty on rainy days and be hard to get clean. Therefore. concept four or five with the plastic material was better. The difference of these concepts was that the first one only had a plastic fabric and the second one had both a plastic and a meshed fabric. The only reason for having two fabrics is the aesthetic factor of letting the trail blend in better. But talking to the sewer she was convinced that the cost of having two fabrics instead of one for the same function, would not be approved from a cost perspective. Therefore, concept four was chosen.

Regarding the light in the canopy the best concept from a safety and user-friendly perspective would be to have lights both on the inside and the outside of the canopy. If placing lights on the outside, the best position would be to put it on the edge between the canopy and the back rest, see figure 6.6 and 6.7. The reason is because the lights can then be seen both when the seat is in an upright- and horizontal position.

Figure 6.6 Reflector on seat

Figure 6.7 Reflector on bassinet.

Concept 3-5 would unfortunately have to be placed further up on the canopy to avoid the meshed net on the inside, preferably in connection to the plastic peekaboo window to save cost and effort. But the window would then have to be re-designed to fit the light tube, making the manufacturing cost higher. And since using light on the stroller most likely would not be necessary for all buyers, this change might be too costly.

When testing concept 2 on the outside of the canopy it became clear that this was not the best solution from an aesthetic point of view. Therefore, a trade-off had to be made with help from the project triangle. When looking at the project triangle in figure 6.8, the solution would be placed further to the safety corner with the trail on the outside. The orange dot represents the concept in relation to the project triangle. While if choosing to not add the trail, the solution would look better and be placed closer to the aesthetic corner. Since the lights inside and under the stroller still would contribute to the visibility the solution, illustrated with an orange dot in figure 6.9, would still be in reasonable range of the safety corner. Another argument for not placing the light on the outside of the canopy is because Thule already has a reflector in this area, shown in picture 6.6 and 6.7, which makes the idea of placing a light there redundant.

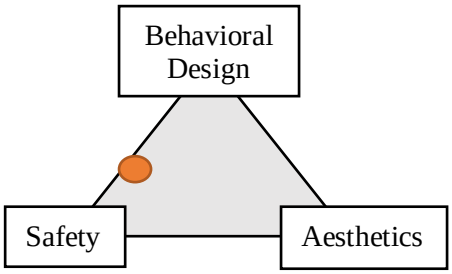

Figure 6.8 Project triangle 1: Lights outside of the canopy.

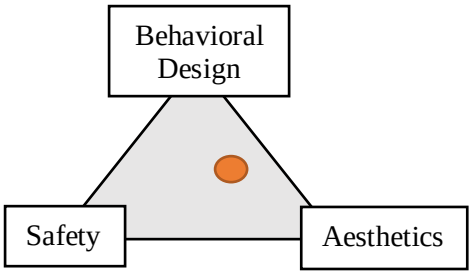

Figure 6.9 Project triangle 2: No lights outside of the canopy.

A choice was made to limit the use of light to the inside of the canopy. And when choosing between concepts one and two the second one would be better according to the sewer. The reason is because a loop of meshed fabric could be sewn directly into an existing seam and therefore not add any extra cost for the attachment.

Placement

6.1.2.1 Canopy

The lights should not be too far down in the canopy, since this could affect the user's night vision and throw light out from the canopy instead of down on the baby. The canopy also has a meshed net for letting air in. The solution should be placed either above or beneath the net to avoid affecting other functions or letting the solution depend on the net if future models will not have it included. The solution should be sewn in with an exciting seam to minimize the cost and therefore the solution will be placed above the net, next to the existing seam as shown in figure 6.10.

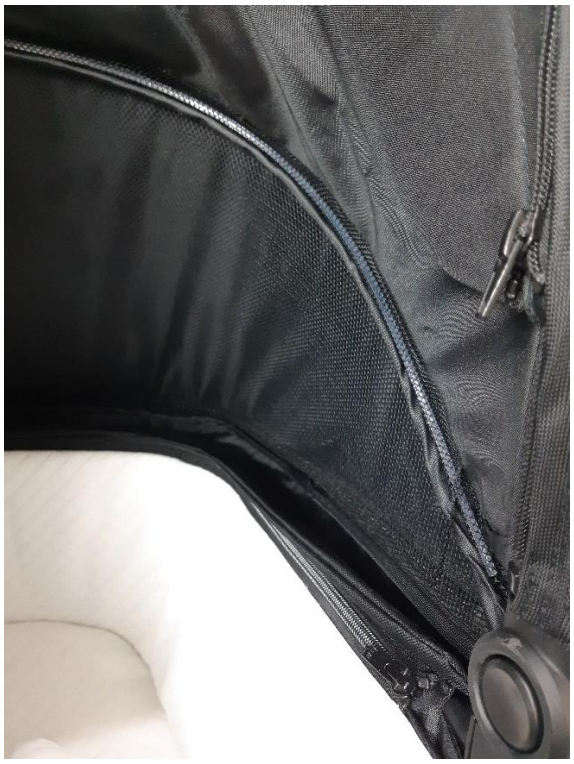

Figure 6.10 Placement of light in canopy.

6.1.2.2 Basket

The solution of having a plastic fabric to give light on the inside as well as the outside, requires the right placement. The composition of the basket consists of a black fabric with plastic plates in the bottom which makes the bottom flat and good

for storage but also enables easy folding. The plastic trail will be placed between the plates to keep the simplicity of folding and not affect the tenability of the material.

To get an idea of what is kept in the basket, research was done by looking at pictures on social media as well as asking three users. It showed that the basked is commonly used for carrying bigger things such as an extra blanket, nursery bag or a rain cover. The smaller items usually end up inside the nursery bag, so they won't get lost. When going to the grocery store the basket often serves as a shopping bag, which means there can be hard and heavy items such as a package of milk or canned food.

Placing light in the bottom of the basket could be a bad idea since it will most likely be covered with things. Therefore, the solution ought to be placed more on the sides. Thule's basket is shaped with an angle in the back, see figure 6.11, which makes it the perfect surface to place the light. It is not only a better position for providing light inside the basket, but also makes the lighting in front of the stroller better. Still, having light in the back of the basket will not be helpful if there are much storage blocking the view. Therefore, another light source will be placed near the opening and light up the storage from the user's perspective, see figure 6.12.

Figure 6.11 Tilting basket.

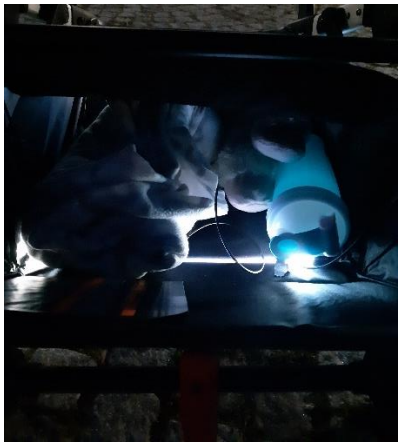

Figure 6.12 Lights inside basket.

6.2 Lights

6.2.1 **Requirements**

When looking for the right light there are certain requirements that need to be fulfilled.

No blue light - Studies at Harvard shows that blue light can affect the sleep and should therefore be avoided near a sleeping baby (Harvard health publishing, 2018).

Tolerant - As mentioned before its common to use the basket for loading groceries. Therefore, the light cannot be fragile.

Right amount of light- Since the solution needs to fit Thule's strollers, the amount of light guides and their length need to be adjustable or specifically designed for this purpose.

Right light strength- The strength of the light needs to be right, both for the canopy but also for the basket. If it is too bright the baby will be blinded and the user's night vision could be affected. But if it is too dimmed there will not be enough light in front of the stroller.

Flexible- The light needs to be flexible enough to follow the meshed trail around the bend of the canopy.

Aesthetic- Since the user will be looking directly at the light it needs to be a stylish light tube that indicates quality to match the values of Thule.

6.2.2 **Market research**

The following section presents four different lights that could be of interest to include in the final concept. The lights are presented with a description together with a picture. The final decision can be found in section 5.4.

Led strip light

The Light Emitting Diod (led) strip light is flexible, tolerant and can be controlled with a remote. It can, however, not be looked directly upon because of the intense

spotlights. It is more expensive than most light guides and will be hard to insert in a loop because of the flat shape. The light can change color whith a remote. (FLEXFIRELEDs, n.d.). The led strip light is shown in figure 6.13.

Figure 6.13 Led strip light (AliExpress, n.d.)

Led rope lights

The led rope light shown in figure 6.14, contains light on one side. It has an even light that is easy to look at and is flexible. (Superbrightleds.com, n.d.).

Figure 6.14 Led rope light (superbrightleds.com, n.d.)

Light-Diffusing Fiber

The Light- diffusing fiber shown in figure 6.15, has a smooth lighting that can be looked directly at. It has a consistent light distribution along the light guide and is flexible, tolerant and waterproof which means it can be washed together with fabric. It also comes in different sizes (CORNING, 2018).

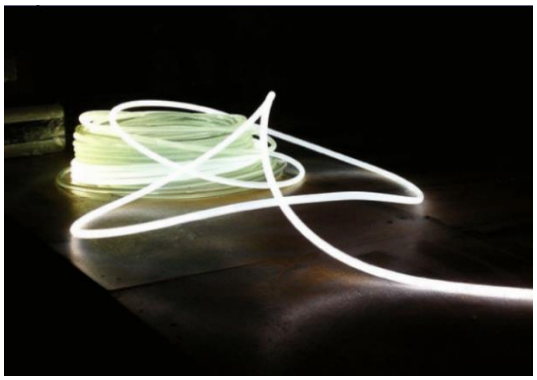

Figure 6.15 Fiber Optic Solid Core Side Glow (wiedamark n.d.)

Led tube

The led tube shown in figure 6.15, is a flexible, tolerant and waterproof solution, often used outdoors in the garden. The light can be looked directly at and has small dots of lighting inside the tube (Ooga lights, n.d.).

Figure 6.15 Led neon rope tube light (EXIT15, n.d.)

6.3 Battery

6.3.1 **Shape and placement of battery pocket**

To avoid having cables between the canopy and the basket a choice was made to have two batteries, one for each area. This enables the user to choose in what area to add lights, if not wanting both.

The basket has a lot of space for adding a battery pocket and the bassinets canopy already has a hidden pocket on the side. Therefore, the size of the battery should be designed with the seat canopy in mind where the space is more limited.

In section 4.5 scenarios likely to occur often were defined and need to be considered when placing and shaping the battery and its pocket. The scenarios include:

- Folding and unfolding the canopy
- How to charge the battery
- Folding the stroller
- Using the rain cover
- Attaching and detaching the solution (understand the first time)
- Washing the fabric

These have been taken into consideration during the process and ideation phase but is important to remember when designing the details as well. To be able to fold the canopy without removing the battery, it must be placed behind the sun cap (see figure 6.16), since this is the only area that is not folded. According to a concept designer at Thule this part will likely be included in future models as well. It is also good if the battery is tucked away under the sun cap since this makes it harder for the baby to get hold of it. The battery should be placed as close to the light as possible to avoid long cables and at the same time be easy to remove when needed to be charged.

Figure 6.16 Pocket behind sun cap

The original idea was to have the pocket specially designed to fit the battery. But when discussing it with the sewer at Thule she advised to put the pocket between the seams in figure 6.17, to minimize the cost. By leaving an opening in the bottom of the pocket, the cables from the light guide can go straight up to the battery, minimizing the length of the cables.

Figure 6.17 Battery pocket in seat.

Regarding the pocket in the basket, shown in figure 6.18, it could not be added to a seam since the sides does not have any. This means the cost of adding a pocket there will be a bit higher. The pocket is placed between the two plastic trails where the light guides will be inserted and has a hole in the downright corner. This enables the cables to go straight to the power bank placed inside the pocket.

Figure 6.18 Battery pocket in basket.

6.3.2 **Requirements for battery**

Since the battery will be placed on the side of the canopy, behind the sun cap, it will be standing with the short side down. If placing the USB- port on this side, the cables between the light trail and the pocket can be shortened as much as possible.

Since the battery will be placed in reach of the baby, it is important that it is large enough not to suffocate on. The Swedish standard institute (2014) describes how big objects should be to eliminate the risk of suffocation by showing a cylinder with specific measurements, see figure 6.19. Whatever fits in the cylinder is small enough for a child to choke on and since the battery will be in reach of the child it should be wider than 31,7 mm and longer than 57.1 mm.

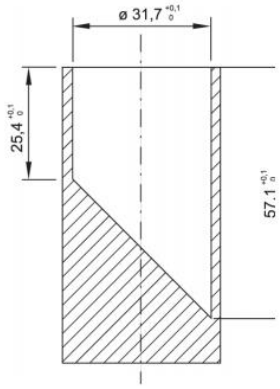

Figure 6.19 Cylinder for testing children's goods by SS-EN 71-1 (Swedish Standards Institute, 2014 p. 6)

Another important aspect is how powerful the battery needs to be. When testing a power bank with 2500 mAh, a system with two light guides worked for approximately four hours and fifteen minutes, which means a user walking one hour at a time needs to charge the battery after four walks. The more powerful the battery is the more expensive it will be. Therefore, if the battery will be included in the package a trade-off between strength, size and cost has to be made.

Another feature wished to be included in the battery is an on/off button. This would make it more efficient for the user to turn the lights on and off instead of inserting and pulling out the USB-cable every time. Especially since the USB must be inserted a specific way.

6.3.3 **Market search**

To get an idea of what it would cost to buy power banks, a battery study was completed, see table 6.1. Including nine different manufacturing companies and what they would charge per piece for 500, 1000 and 10 000 units. The result showed that ordering from Chinese companies (lower half in the table) is cheaper than ordering from a Swedish or European retailer. But it is important that the Chinese manufacturers have all the licenses and tests needed for the European market. The companies included in the table were approved.

Manufacturer	mAh	kr/pce, 100 pcs	kr/pce, 500 pcs	kr/pce, 1000 pcs	Comment
T&S reklam	2200	51	48	46,49	
Profilexpress.se	4000	118	100	85	Cable + iphone adapter incl.
Profilservice	4000	195,3	176,1	171,7	On/Off, indicator & microUSB incl.
Alltryck.se	4000	118	111	99	
Shenzhen Golf & Shengchuang Technology Co. Ltd	4000			30	
Dongguan Shirui Battery Co. Ltd Power Bank Division	6000		100		
Shenzhen Bluetimes Technology Co. Ltd	6000			60	Display
Shenzhen Caibo Technology Co. Ltd	5000	1			
Shenzhen Toptai Technology Co., Ltd.	5200		50		

Figure 6.20 Result from battery study

6.4 Selection

6.4.1 **Lights**

When choosing lights it is important that they are certified by EU. The cost is also of importance but since the lights will be customized to fit the prototype it is hard to know how much they will cost. Therefore, the requirements were the most important factor when choosing lights

The light that matched the requirements best was the Fibrance Light-Diffusing Fiber. A request for special designed lights was sent to OSRAM who is a manufacturer of lights and a company that Thule has had contact with during earlier projects.

To make it as easy and efficient as possible for the users, the light for the canopy was designed to fit both the bassinet and the seat by compromising the length of the cables and light guides. OSRAM could also provide the solution with an on/off switch connected to the light system. The switch could turn the lights on and off but also make them blink. After discussing it with a concept designer at Thule, it was decided that the blinking effect was not desirable, but according to OSRAM a feature to dim the lights would be developed soon. This on the other side, would be a highly desirable function that enables the user to dim the light around the baby, but maximize it in front of the stroller. The drawings and measurements of the desired lights can be found in appendix H.

The lights were tested in the dark to see if the intensity and placement of the light would give a satisfying effect. This was made through taking the stroller with the lights attached, outside when it was dark. The goal was to make sure the light was not too bright and affected the user's night vision. It was also tested from 125 meters distance, which was the minimum distance a reflector should be seen from

according to the research in 2.5.1. The stroller was placed on a street with streetlights to imitate a real-life scenario. A person was then placed 125 meters from the stroller too see if the stroller could be visible. The solution provided enough visibility and could clearly be distinguished from the angles where the lightguides could be looked directly at.

6.4.2 **Battery**

The battery was shaped from the requirements and when deciding on the size and shape, aspects such as the placement in the canopy, being large enough to contain 2500- 3500 mAh and being shaped to eliminate the risk of suffocation were considered. The drawing of the battery in appendix H, is a desirable prototype of a battery and it should, to avoid any concerns or accidents, preferably be waterproof. The most efficient solution would be to order power banks from the same manufacturer as the lights, i.e. OSRAM. But they only had one standard battery for sale and could not do any special designed power banks.

OSRAM's standard power bank will be used for demonstrating how the solution works. But if this product would continue to production, Thule should consider choosing another manufacturer or sell the solution without a power bank which would lower the price on the product significantly. OSRAM could offer an on/off switch connected straight to the light system which means an on/off button will not be needed on the power bank.

6.5 Patent

To make sure the concept does not interfere with an existing solution, a patent search was conducted. The result showed that there is currently no active patent blocking the concept from being produced and sold. There are however a few other patented solutions for attaching lights to a stroller. These can be found in appendix I.

6.6 Cost estimation

To make the stroller as cost effective as possible to produce, an external accessory meaning that it can be attached without making any changes on the stroller, would be preferred. But part of Thule's mission is being able to show the user where and how to place the accessory through good design. This gives the impression of a confident brand that knows what the best solution is and makes it easy and efficient

for the user to place it exactly where it should be. But this requires an integrated attachment detail, which means extra material will be added on the original stroller making it more expensive. To get a hint of what this concept would cost to produce, a template for the bill of materials was established and is shown in table 6.2. Due to inability by OSRAM to quote a price for their equipment within available time frame, the estimated cost could not be included in this Thesis. This data e.g. cost regarding the power bank, material cost for the integrated solution and manufacturing cost can, however, be added later. The thought about using material that is already integrated on the stroller and therefore already exists in Thule's assortment, is also a way to save money and effort.

Canopy seat					
Part	Quantity	Material	Amount	Price of material	Cost
A. Fiber optic led package w. battery	1				
B. Light trail	1	Meshed fabric (exists)			
D. Battery pocket	1	Grey fabric (exists)			
Assembly		Thread			
Work time					
Canopy Bassinet					
A. Fiber optic led package w. battery	1				
B. Light trail	1	Meshed fabric (exists)			
Assembly		Thread			
Work time					
Storage basket					
A. Fiber optic led package w. battery	1				
B. Light trail	2	Plastic fabric (exists)			
D. Battery pocket	1	Meshed fabric + elastic string (exists)			
Assembly		Thread			
Work time					

Figure 6.21 Template for the bill of materials

7 Final concept

In this section the final concept is presented with pictures and a description of the different parts and their functions.

Figure 7.1 Thule Sleek with final solution.

The final concept, see figure 7.1, improves the experience of using a stroller in the dark, by lighting up the inside and provide visibility from the outside. The solution operates in two areas of the stroller, the canopy and the basket. It consists of lights and batteries bought as an accessory, that can be attached to the stroller through integrated details. The solution is therefore bound to Thule's strollers and cannot be used on other strollers. The integrated details are presented below.

7.1 Canopy

Figure 7.2 Lights in the two different canopies.

Figure 7.2 shows the two different canopies (seat and bassinet) with the lights turned on. As shown in figure 7.3, there is a meshed trail sewn into a seam on the canopy. The trail is open in one end and closed in the other, allowing a light guide to slide in and stay in place.

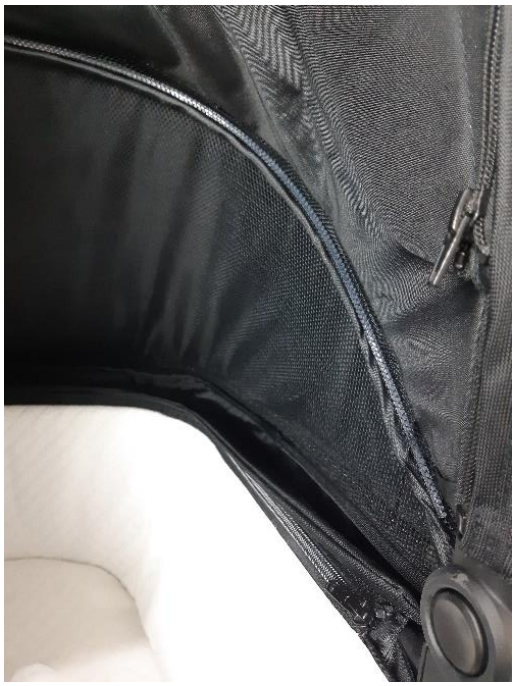

Figure 7.3 Meshed trail in canopy.

The lights are powered by a small battery with a USB-port which is placed in a hidden pocket behind the sun cap, see figure 7.4. The lights can easily be turned on and off thanks to a switch connected to the battery.

Figure 7.4 Hidden pocket under sun cap.

7.2 Basket

Figure 7.5 Light inside the storage basket.

The storage in the basket is illuminated from two sides making it easier to see inside, see figure 7.5. Two trails made from the same plastic material as in the peekaboo window are placed in the front of the basket and on the tilting back, see figure 7.6. This allows the light to come through from both the inside and the outside of the basket, lighting up storage as well as the road ahead of the stroller while keeping dirt and water out. The plastic trails will be integrated in the stroller during the manufacturing process and will therefore be a part of the new design of the basket, no matter if the user wants to attach lights in it or not. The lights are easily inserted from the inside of the basket while the battery is placed in a side pocket big enough to fit more items as well, see figure 7.7.

Figure 7.6 Plastic trails for light guides.

Figure 7.7 Battery pocket in the basket.

When looking at the solution from far away, figure 7.8 and 7.9, it gives Thule Sleek a glowing effect that improves the visibility of the stroller. It enables Thule's customers to once again travel safely, easily and in style, even when it is dark.

Figure 7.8 Final solution seat.

Figure 7.9 Final solution bassinet.

8 Discussion and conclusion

In this chapter a discussion about the project will be presented, including gained experiences, difficulties, things that should have been done differently but also improvements of the concept that can be made in the future.

8.1 Design process

In the beginning of the project it was hard to know what to focus on since the project included both visibility and usability of the stroller. But thanks to the user study, the process was divided into the four areas of improvement which was of big help during the development phase. Mostly because the creative thinking could be directed to one function in one area at time, instead of several functions all over the stroller.

One method which did not give as much as hoped for, was the observation sessions during the user study. Observing is a good way of getting insights without disturbing the user and thereby get an honest and genuine result. But in this case the observations did not give as much as expected, since it was hard to catch a user in a moment when he or she interacted with the stroller other than walking with it. Therefore, the observation notes mainly exists of what the user had attached to their stroller before walking and not how they interacted with it. If more and longer observations, and maybe in other places had been performed, maybe the result had been different.

The interviews were performed on three women where two of them were friends to the author and therefore easy to get in touch with. The third owns a blog about strollers and had lots of knowledge to share. After three interviews it did not feel necessary to continue with additional interviews. Mostly because the large amount of answers collected from the questionnaire gave a good understanding of the users' opinion, but also because no new information could be drawn from the last interview. Also, at some point the project needs to continue due to the time frame, but it could have been a good idea to include a male participant as well, to see if the opinions differed.

During the design process the manufacturing cost was considered, but it was difficult to get an exact number of the cost. Partly because of the uncertainty of how the final concept would turn out, but mainly because the parts that should be bought in from another manufacturer than Thule, could not give an estimated cost. Since this is of major importance for the company and necessary data for a business case, it could have been more prioritized.

8.2 Final concept

The final concept does not only provide light in the basket and canopy, but it also lights up the street ahead and gives the stroller a welcoming, warm glow. Thanks to the meshed and plastic trails it is easy for the user to attach the light guides. This makes it a simple and user-friendly solution which improves the visibility and usability of the stroller when using it in the dark. By using water-resistant lights and by placing the battery on the inside of the canopy, the solution is somewhat protected from water. Although, using a rain cover is always a good idea to minimize the risk of getting the canopy soaked which could affect the battery.

Since part of the solution, i.e. the light guides, needed to be ordered from abroad it took time to finish the prototype which made it difficult to let users test it within the given time frame. This is something that needs to be done in order to truly know if the user experience is improved. However, it could be argued that the user experience has been improved, since the areas of improvement defined by the users have been successfully accomplished. Although, it is up to the user to decide *how* good the solution is and *how* well the concept fulfills the set goal.

As mentioned in section 3.3 the project came to focus on four “areas of improvement” and the solution should aim to fulfill as many of these as possible. The final concept fulfills all the requested functions up to a certain level, without compromising the aesthetic factor or behavioral design. The visibility in the canopy is improved thanks to the light guide inserted in the meshed trail on the inside of the canopy. The visibility in the basket is improved through the light guides that are slid into the plastic trails in the bottom of the basket. They are placed both near the opening and in the opposite end, throwing light on the storage from two directions. Thanks to the plastic material the same light guides provide light under and in front of the stroller which solves he third area of improvement. The last area includes making the stroller visible in the dark. And because of the trade-off presented in section 6.1.2, the final concept might not provide the user with the *ultimate* visibility. It is however improved thanks to the lights attached inside the canopy and under the stroller which creates a glow. Although, it is important that the user is aware of the limited visibility so that he or she does not think the visibility is better than it is. As mentioned in the research, some of the existing solutions on the market

creates a false feeling of safety. The user believes he or she is more visible than he or she is and could therefore be in greater danger because of the unawareness.

A weakness of the concept is the battery placement in the canopy. Placing it in reach of a baby could appear as insecure from a parent's perspective even though the risk of a power bank exploding is small. One way of handling this could be making sure the batteries are bought from a trustworthy manufacturer who perform tests developed from specific standards. Another solution is letting the user provide the solution with their own power bank which they might rely more on. Another disadvantage is that the user needs to bend down and open the lid to get hold of the on/off switch in the basket, which could be perceived as annoying. Although, having a remote to control the lights would make the solution significantly more expensive. It is also important to be realistic about the effort required from the user. The battery needs to be charged and it is the user's responsibility to make it happen. On the one hand, it can be compared with a bicycle light which many people have a hard time remember even though it is mandatory to use when it is dark outside. On the other hand, the stroller is mostly brought inside after a walk, which means the battery is more accessible and easier to remember. Especially if using it daily and can be likened to charging a headset or a mobile phone. It would be a good thing if the user could see how much time is left before the battery needs to be charged, but this is a feature that would make the battery more expensive and maybe too expensive to sell in a package. In this case it might, as mentioned earlier, be better if the user gets to provide the solution with their own power bank and can thereby choose what features they want.

The most important factor that will decide if the concept will be further developed or not is the manufacturing cost. The most expensive part of the solution is adding the plastic fabric into the storage basket, since this will be added to the original stroller no matter if the user wants lights in it or not. This means extra cost for material but, above all, a cost for extra work. Finding out how much extra it costs to add the solution per stroller is the key of knowing how much extra each stroller will cost the user, and thereby possibly create a business case.

8.3 Further development

Due to lack of time, some things were not included in the project. If the concept were to be further developed the things presented in the list below should be considered.

- A decision regarding the battery needs to be done. Where to buy it from, how much it will cost and if it can be custom made to fit the solution. Things to have in mind when doing this is to be aware of

the different requirements and licenses needed to meet the European and American standard.

- Depending on the final choice of power bank, the battery pocket in the basket might need to be adjusted. Right now, it is a side pocket made of a meshed fabric, without any consideration to a special designed battery. It might also be too expensive to include a battery in the package and in that case, it could be a good idea to sell the solution without the battery, letting the customer use his or her own power bank. In that case the pocket needs to be a "universal" pocket that could fit several designs.
- The light guide systems in the final solution includes an on/off switch to make it efficient for the user to turn the lights on and off without having to pull the cable out. But OSRAM is currently developing a function where the light can be dimmed when pressing and holding the button. This is something that should be included in a future concept, offering the user to customize the light after need. For example, lower effect in the canopy but high intensity in front of the stroller.
- The light attached to the angled surface in the basket, can be seen from ahead of the stroller except if looking from approximately 5-20 meters. When looking from that distance the plastic bar on the chassis covers the sight, making the stroller less visible in the dark. Therefore, it would be a good idea to place the light higher up. Unfortunately, that is not possible with the current design since the lights are placed between the seams and the fabric stops further up. But it is something to have in mind if developing the concept further.

8.4 Time management

When the project started a quite detailed time plan was created and the reason was to make sure no crucial moments would be forgotten along the way. Even though the planning and the outcome matches quite well, there are some things that did not turn out as planned.

The cost estimation turned out to be a difficult part of the project, mainly because of the unique light guides that were special designed to fit the final solution. These were not decided until the very end and even by then an estimated number could not be received from the manufacturer. The cost was however considered throughout

the development phase and selection, trying to assure that the chosen concept would be kept within reasonable costs.

Figure 7.1 and 7.2 describes the initial time plan and the outcome of it. When comparing them it becomes clear that the development phase (yellow color) became more iterative than planned and the prototyping and testing were performed alongside the ideation. It also shows how the defining phase (blue color) and final selection were done quite rapidly, which seems like an intelligible outcome since all the facts should be presented before entering that stage.

Things that have been added along the way was the date for opposition which was not known from the beginning. The travels to Thule's development center in Hillerstorp was also decided along the way and depended on the projects progression and when there was a need for a visit.

If the project had continued for a longer time, the proceedings would have been:

- Testing the prototype on users
- Performing a profound study on batteries to see if they should come with the solution or if the user needs to provide that part.
- Making a cost analysis after receiving an estimated cost from the manufacturer to see if there could be a business case.

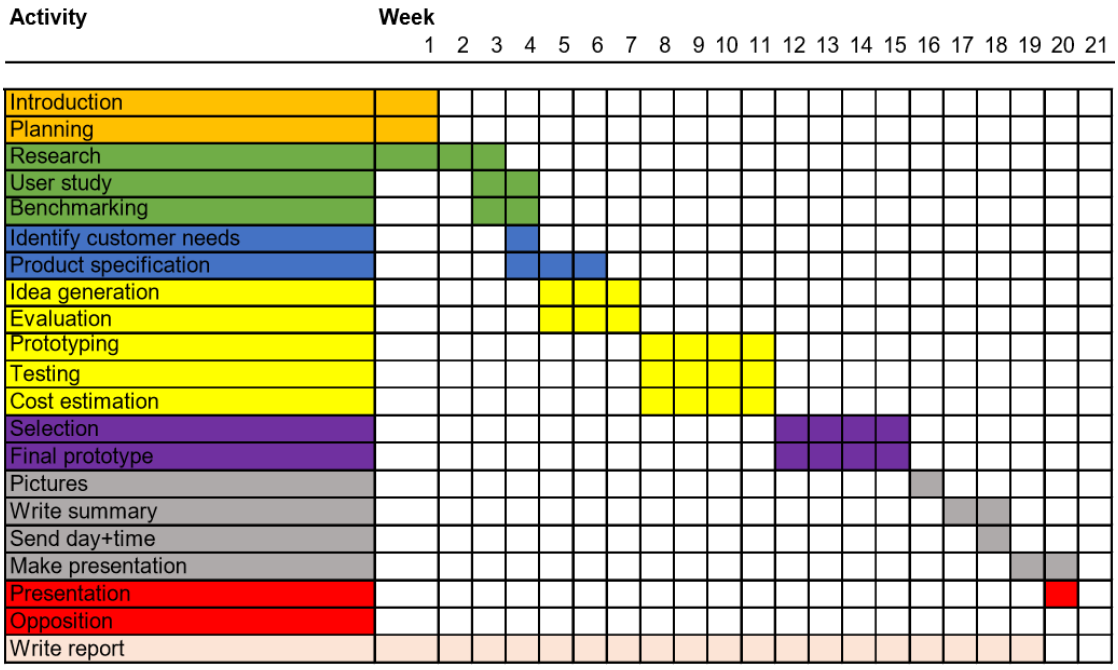

Figure 7.1 Initial time plan.

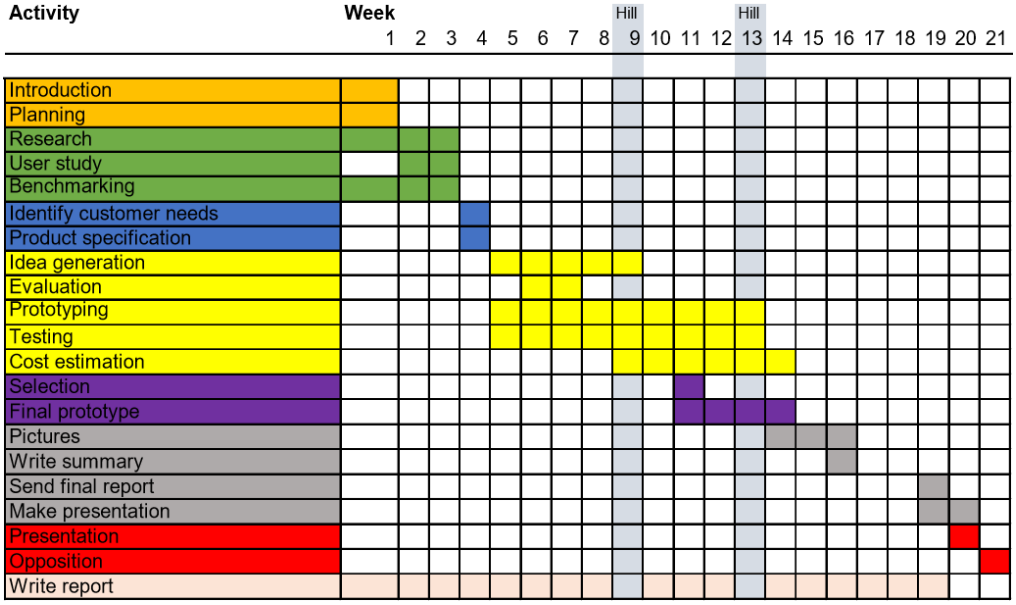

Figure 7.2 Time plan- out come.

8.5 Conclusion

The stroller is a tool for facilitate the caring of a baby. It should be easy, safe and comfortable to use but when it gets dark outside it can be difficult to see. Not finding things in the basket, not being able to see the baby's face, not see the bumps in the road and not be visible for people in the surroundings are four things that makes the user experience of walking with a stroller in the dark, poor.

In this project the four areas which affect the user experience has been noticed by talking to users and improved by adding light to the stroller. Safety, usability and aesthetics are important factors for creating a successful product. These have been of big importance throughout the process but finding a balance between the three has been difficult. A trade-off had to be done where the visibility *inside* the stroller became the biggest focus, even if the visibility *of* the stroller also was improved.

The final concept consists of a meshed trail sewed into the fabric on the inside of the canopy. A light guide bought as an accessory can then be slid into place and spread light inside of the canopy, making it easy for the parents to care for the baby. A plastic trail was also sewed into the bottom of the basket making an attached light guide, shine up both the inside and outside of the basket. This makes it easy to find things in the basket but also to avoid pumps in the road.

The solution lights up the stroller and gives it an aesthetic glow which contribute to the visibility of the stroller. The functional and easy design is believed to match Thule's assortment and will hopefully be further developed and integrated in future stroller models.

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Appendix A – Interview questions

Intervjufrågor:

- Rör du dig mest i stadsmiljö eller på landsbygden när du går med din barnvagn?
- Hur gör du för att synas bra i mörker när du är ute och går med din barnvagn?
    - Hur fungerar det?
    - Vad är bra?
    - Vad är dåligt?

- Har du några reflexer?
    - Egna eller integrerade i vagnen vid köp?
    - Kollade du om reflexerna uppfyllde några speciella krav innan du köpte dem?

- Har du några tankar kring vad du skulle köpa om du skulle skaffa en reflex idag?
- Har du några andra knep för att förbättra användningen av vagnen när det är mörkt ute? (ex: lampor om de inte förstår frågan)
- Skulle du vilja ha lampor på din vagn? Och isåfall i vilket syfte?
- Vill du kunna sätta på och ta av/ gömma reflexer och lampor beroende på ljuset utomhus och säsong?
- Hur viktigt är det att reflexerna är estetisk tilltalande/ att de bidrar till att göra vagnen snygg?
- Övriga tankar?

Appendix B – Interview notes

Answers from the interviews.

Intervjufrågor person 1.

Vad har du för barnvagn?
emmaljunga super nitro

Rör du dig mest i stadsmiljö eller på landsbygden när du går med din barnvagn?
landsbygden, ingen belysning bara hus.

Hur gör du för att synas bra i mörker när du är ute och går med din barnvagn?
köpt på biltema, reflextejp på rulle och tejpat på chassit och stängerna. Har reflexväst själv och reflexer på benen. Försöker gå lite vid sidan om vagnen om en bil kommer bakifrån så jag täcker hela vagnen, då föraren kanske inte ser att jag har en barnvagn framför mig. Svårt med reflexer då stängerna är böjda. Vill hänga mer reflexer som rör sig. Vi har provat att lysa med lampa på reflexerna.

Egna eller integrerade i vagnen vid köp?
Nej inget. Möjligtvis något på ryggen av suffletten ser jag nu men inget jag tänkt på.

Kollade du om reflexerna uppfyllde några speciella krav innan du köpte dem?
Nej,

Har du några tankar kring vad du skulle köpa om du skulle skaffa en reflex idag?
Något som blinkar. Får inte bli för mycket så man blir störd av det (De man möter). Vill ha typ en cykellampa. Kan sitta nere vid hjulen så är de inte i vägen eller går sönder. Eller något man klickar på. Bra med hängande då de rör sig. Bra om de sitter fast hela tiden så glömmer man dom inte.

Har du några andra knep för att förbättra användningen av vagnen när det är mörkt ute?
Har lampa med, (mobillampa). Filip pannlampa bra när man går där det är gropigt.

Har du funderat på att skaffa lampor till din vagn? Och isåfall i vilket syfte?
Nice att ha en så man ser vägen också.

Har du några tankar kring att ha en lampa i liggdelen för att se barnet?
ja läste nyligen att deras barn hade kräkts i vagnen utan att de såg så den va helt blå. Så det är bra att ha något! Har tänkt att jag vill ha det. Brukar lysa ner med mobillampan lite då och då. Vissa bebisar störs av ljus så kanske inte ska vara tänt hela tiden men någonting hade varit bra.

Vill du kunna sätta på och ta av/ gömma reflexer och lampor beroende på ljuset utomhus och säsong?
Dragkedjor som man kan packa in myggnät med mer. Någon funktion att dra ut reflexer. Beror på vad det är för reflexer, hade nog velat gömma dom lite grann.

Hur viktigt är det att reflexerna är estetisk tilltalande/ att de bidrar till att göra vagnen snygg?
Viktigt. Tror nog många andra tycker det är viktigt. Går på funktion men också utseende på vagnen när man köper den.

Övriga tankar?
Lampa och reflexer på vagnen bra så man har det om man glömmer att ta på sig egna

Intervjufrågor person 2:

Vad har du för barnvagn?
Emmaljunga viking

Rör du dig mest i stadsmiljö eller på landsbygden när du går med din barnvagn?
Vägar med belysning.

Hur gör du för att synas bra i mörker när du är ute och går med din barnvagn?
Finns inga integrerade. Sätta dit själv. Väst, på regnskyddet tror jag det finns. Har hemma men har inte använt dom. Går i belysning, önskar det fanns på tyget. En barnvagn kostar ändå mycket och då borde reflexerna finnas redan. Inte vacker med en gul reflexväst på sin fina vagn.

Hur fungerar det?
Vad är bra?
Vad är dåligt?

Har du några reflexer?

Egna eller integrerade i vagnen vid köp?

-Kollade du om reflexerna uppfyllde några speciella krav innan du köpte dem?
Ja, man ser i beskrivningen att den CE märkt.

Har du några tankar kring vad du skulle köpa om du skulle skaffa en reflex idag?
Kollade på reflexer när vi hade pratat. Genomskinliga reflexer som fästs med klister, Pogu. Hade velat ha något som sitter på tyget.

Har du några andra knep för att förbättra användningen av vagnen när det är mörkt ute? (ex: lampor om de inte förstår frågan)
nej, gå där det finns belysning. När han va liten och låg ned då hade det varit bra.

Har du funderat på att skaffa lampor till din vagn? Och isåfall i vilket syfte?

Vill du kunna sätta på och ta av/ gömma reflexer och lampor beroende på ljuset utomhus och säsong?
Nej

Hur viktigt är det att reflexerna är estetisk tilltalande/ att de bidrar till att göra vagnen snygg?
Nej, bryr mig inte så mycket, hellre bra användbarhet. Men klart bra om produkter uppfyller det med.

Övriga tankar?
Tänka på vilken sorts ljus man använder. Ex inte blått inne vid bebisen påverkar sömn.

Intervjufrågor person 3- Bloggerska:

Har du småbarn idag? Hur många? Ålder?
4 barn, Ålder 10, 8, 5, 2

Hur länge har du varit intresserad av barnvagnar?
alltid, barnvakt första barnet 10,5 år sedan

Ungefär hur många barnvagnar har du testat? Köper och testar?
köpte egen del och skrev om det. Sedan 2012 haft kontakt med tillverkare så nu behöver ej köpa själv. Bloggen enbart barnvagnar och tillbehör till det.

När du testar eller använder barnvagnar, rör du dig mest i stadsmiljö eller på landsbygden då?
Bor i Stockholm, bor i förort till Stockholm så går mycket i elljusspår och på Gotland. sällan i djupaste skogen.

Hur gör du för att synas bra i mörker när du är ute och går med din barnvagn/ testar barnvagnar?
Hänga på egna reflexer med liten kedja, Reflexklistermärken på chassit och de svarta är bra som inte syns så mycket.
Testat: mest reflexer ibland kommer jag inte ihåg det provat 35 stycken på ett år.
Klister fastnar inte efter klistermärkena. Innan köpte begagnade vagnar och då fanns ofta märken efter reflextejp jättesvårt att få bort! fastnar ludd och damm- kemisk bensin vissa tål inte. Förstått rätt åldras reflexer.
Pogu- satt ett par år, skulle sälja och ville ta bort lite slitna. Värmer upp dom och dra av.
Reflexspray försvinner snabbt, regnar bort

Hur fungerar det?
Vad är bra?
Vad är dåligt?

Har du några reflexer?

Egna eller integrerade i vagnen vid köp?
om ja -vilka då?
-Kollade du om reflexerna uppfyllde speciella krav innan du köpte dem?
Nej, Fox Stellar fick frågan om livslängd angående inbyggda reflexer.

Inte så många, kronan har längst ut på suffletterna söm, hel reflexsufflett-nackdel tråkig i dagsljus.
Thule Sleek-
Bugaboo- navkapslar, suffletter
Åkpåse,
regnskydd - en del bra,

Har du några andra knep för att synas i mörkret?

Har du några andra knep för att förbättra användningen av vagnen när det är mörkt ute? (ex: lampor om de inte förstår frågan)
nej, någon gång använt lampor cykel. Lyser upp lite på vägen men inte mycket. Gatubelysning så behövs inte så mycket. Gotland ingen belysning. Annat tänk om hon bodde någon annan stans.

Skulle du vilja ha lampor på din vagn? Och i så fall i vilket syfte?

Bra/dåligt med att ha lampor inne så man ser bebisen?
Belysning i vagnen- ledljus bra om barnet tycker det är läskigt, tittar på barn och ska se utanför vagnen tappar mörkersyn utanför vagnen.

Har du några tankar kring vad du skulle köpa om du skulle skaffa en reflex idag?

Vill du kunna sätta på och ta av/ gömma reflexer och lampor beroende på ljuset utomhus och säsong?
Ja tror det, bottnar i att hört att reflexer inte ska användas i solljus men vet ej om det är sant. Större reflexer tar bort. skönt att det är smidigt.

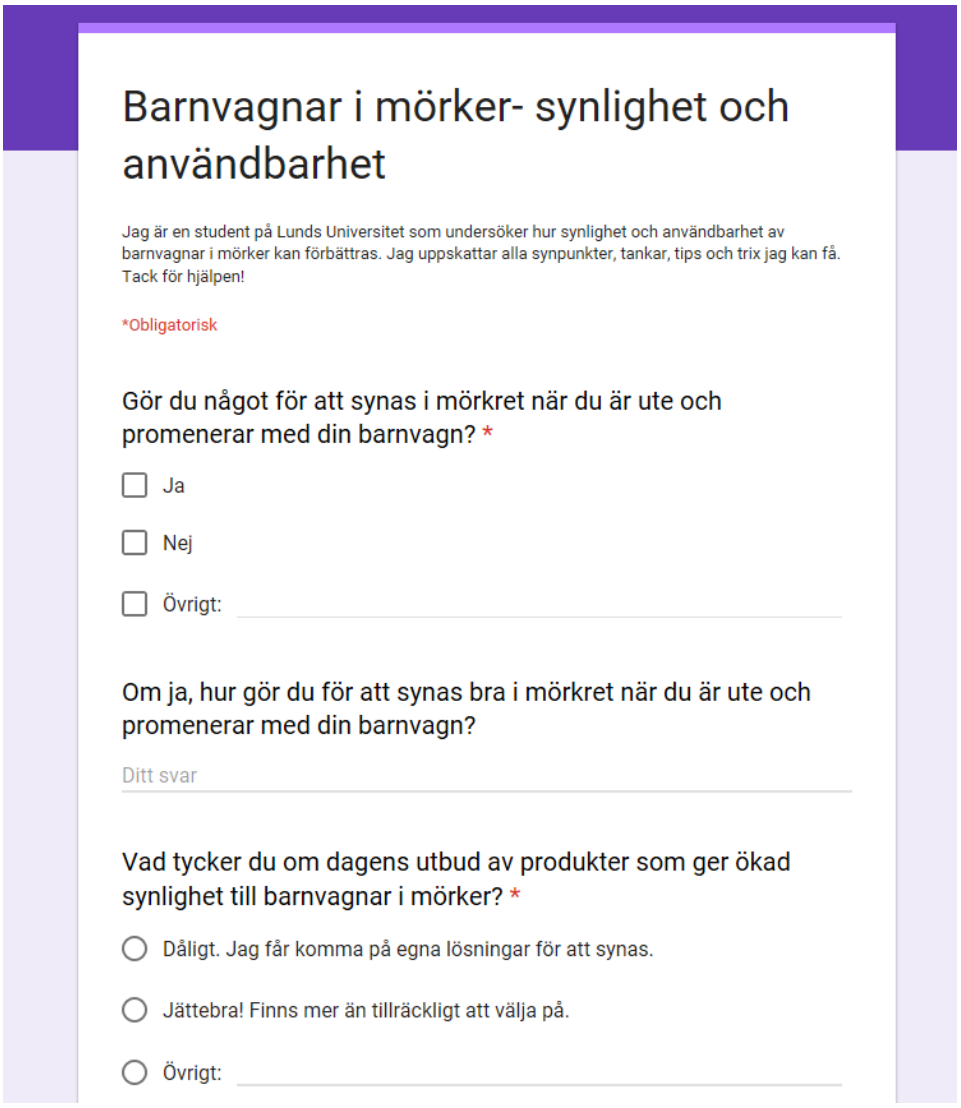
Hur viktigt är det att reflexerna är estetisk tilltalande/ att de bidrar till att göra vagnen snygg?
Ja det är viktigt. mycket pengar på vagn kul att ha något fint. Diskret så mer benägen att använda dom. Betala mer för dom också

Ser du något i alla dina tester osv. som du tycker skulle kunna förbättras?
Finns reflexer så sitter de ofta på sidan av vagnen och bra om man korsar vägen men inte om man går längs vägen. Det skulle vara bra.

Övriga tankar?
Teori om varför det inte är prioriterat. Tillverkas för global marknad och inte så mörkt som här uppe i Sverige. Kortare perioder och använder i köpcentrum. Så många kanske inte tänker på och prioriterar i andra länder. Emmaljunga som har majoriteten här i Sverige konstigt. Stella som har så var det nordiska länderna i åtanke.

åker bil i USA
En del av problemet, få tillverkare att vilja göra förändringen
Här vill man ha stora hjul som ska fixa snö.

Appendix C - Questionnaire



Barnvagnar i mörker- synlighet och användbarhet

Jag är en student på Lunds Universitet som undersöker hur synlighet och användbarhet av barnvagnar i mörker kan förbättras. Jag uppskattar alla synpunkter, tankar, tips och trix jag kan få. Tack för hjälpen!

*Obligatorisk

Gör du något för att synas i mörkret när du är ute och promenerar med din barnvagn? *

- [ ] Ja
- [ ] Nej
- [ ] Övrigt:

Om ja, hur gör du för att synas bra i mörkret när du är ute och promenerar med din barnvagn?

Ditt svar

Vad tycker du om dagens utbud av produkter som ger ökad synlighet till barnvagnar i mörker? *

- ○ Dåligt. Jag får komma på egna lösningar för att synas.
- ○ Jättebra! Finns mer än tillräckligt att välja på.
- ○ Övrigt:

Har du några knep för att kunna se bättre i eller utanför vagnen/ öka användningen av vagnen när det är mörkt? *

Ditt svar

Vad skulle du helst vilja använda en lampa till? *

- ◯ Att synas bättre i mörkret
- ◯ Att lysa upp vägen så jag ser var jag går
- ◯ Att lysa upp förvaringsutrymmen så jag hittar mina saker bättre
- ◯ Att lysa upp så jag ser min bebis
- ◯ Övrigt: _____

vad tycker du är viktigt när du köper en reflex? *

- ☐ Att den är tillräckligt stor för att synas på långt håll
- ☐ Att den går att ta av när det är ljust
- ☐ Att den är snygg och passar utseendet på min vagn
- ☐ Att den är certifierad och CE märkt
- ☐ Övrigt: _____

Hur viktigt är det för dig att kunna ta av och sätta på reflexerna? *

	1	2	3	4	5	
Inte alls viktigt	◯	◯	◯	◯	◯	Jätteviktigt

Har din barnvagn någon inbyggd reflex eller lampa och isåfall, på vilket sätt? *

Ditt svar

Hur viktigt är det för dig att reflexerna är snygga/ gör vagnen snygg? *

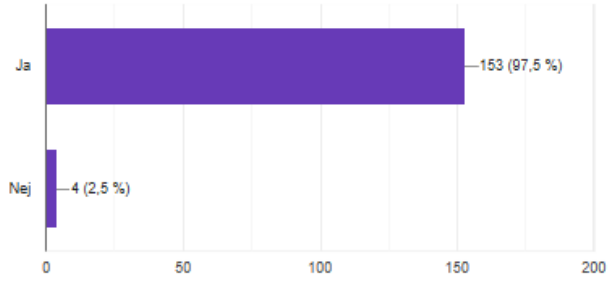
	1	2	3	4	5	
Inte alls viktigt	○	○	○	○	○	Jätteviktigt

SKICKA

Appendix D – Result Questionnaires

Gör du något för att synas i mörkret när du är ute och promenerar med din barnvagn?

157 svar



Om ja, hur gör du för att synas bra i mörkret när du är ute och promenerar med din barnvagn?

152 svar

Reflexer
Reflex
Reflex
Reflexer och cykellampor
Reflexväst
Reflexer
Reflexer på vagnen
Reflexväst
Lampor och reflexer
Bra reflexer
Använder en reflexsufflett
Reflexer och cyckellampor

Vad tycker du om dagens utbud av produkter som ger ökad synlighet till barnvagnar i mörker?

157 svar

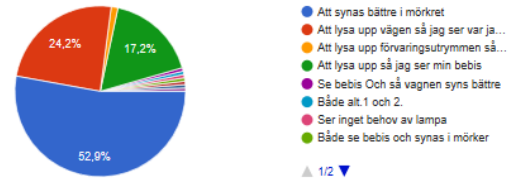
Har du några knep för att kunna se bättre i eller utanför vagnen/ öka användningen av vagnen när det är mörkt?

157 svar

Nej
Tyvärr inte
Nej
Nej.
Lampor
-
Mobillampa
Tyvärr
Nej.
Stark lampa för att se på marken
Ljuslinga
Njae, använder mobilen isf

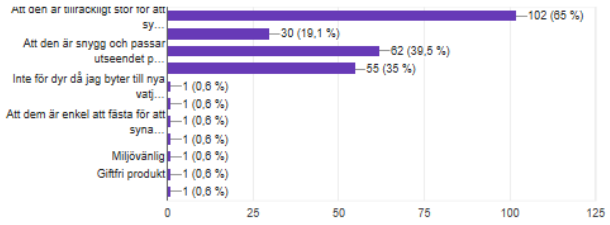
Vad skulle du helst vilja använda en lampa till?

157 svar



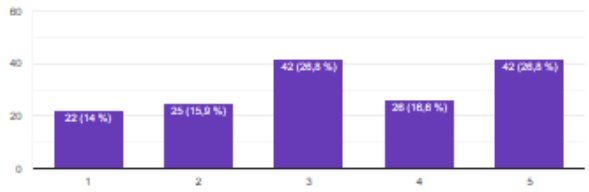
vad tycker du är viktigt när du köper en reflex?

157 svar



Hur viktigt är det för dig att kunna ta av och sätta på reflexerna?

157 svar



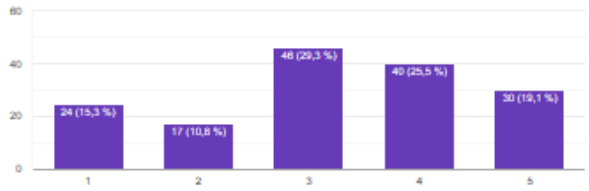
Har din barnvagn någon inbyggd reflex eller lampa och isåfall, på vilket sätt?

157 svar

Nej
Nej
Ja påsydd reflex
Små reflexband på aufletten
Små reflexer finns på aoflatten men inte alls tillräckligt.
Reflexer
Ja men den är för gammal för att funka. Inaytt 'band' i aufletten.
Ja på varukorgen
Reflex på varukorgen.
Ja, sydda reflexband runt vagnen.
Nej inte på min donkey2 men min Emmaljunga nxt har på chassit
Några reflexer på xchassit

Hur viktigt är det för dig att reflexerna är snygga/ gör vagnen snygg?

157 svar



Appendix E - Notes from observation

Lots of people attach reflectors on the canopy so they can be visible from the front.

Several strollers (often older versions) does nothing for the visibility

Few have lights on, seems to be mostly for visibility (red bicycle light in the back, and white in the front)

Reflectors attached with pins are mostly attached on the canopy

Reflectors attached with glue/tape are mostly placed on the chassis

Slap-Wrap popular solution but often around a small bar meaning it doesn't show much.

Most strollers have dark colors on the fabric which means the visibility is bad.

During the observations it became clear that lots of people feel the need of attaching reflectors on the front of the stroller. Reflectors on the sides are usually attached if there are no integrated reflectors on the stroller. Not a lot of big reflectors such as reflective vest or reflective sleeping bags.

Appendix F – Interpret data

Question	Statement	Interpret need
Vad gör du för att synas bra i mörker?	Reflexer på både barnvagnen och mig! Många reflexer på vagnen som syns från alla olika vinklar och hål	Det är viktigt att vagnen syns från alla håll
	Reflexer överallt på barnvagnen och försöker komma ihåg att ha på mig själv också	Ibland är det svårt att komma ihåg att sätta på reflexer
Vad tycker du om dagens utbud av reflexer till barnvagnar?	Ont om snygga lösningar. Nu har jag fula reflexer på. Funktion före design men lite synd är det	Jag vill kunna synas när det är mörkt och ändå ha en fin vagn
	Det finns en del men hade varit bättre om vagnen redan kom med reflexer	Jag vill synas i mörkret men inte behöva tänka på det
	Jag skulle önska något att sätta på suffletten tillfälligt.	Jag skulle vilja ha en snabb lösning för mycket synlighet

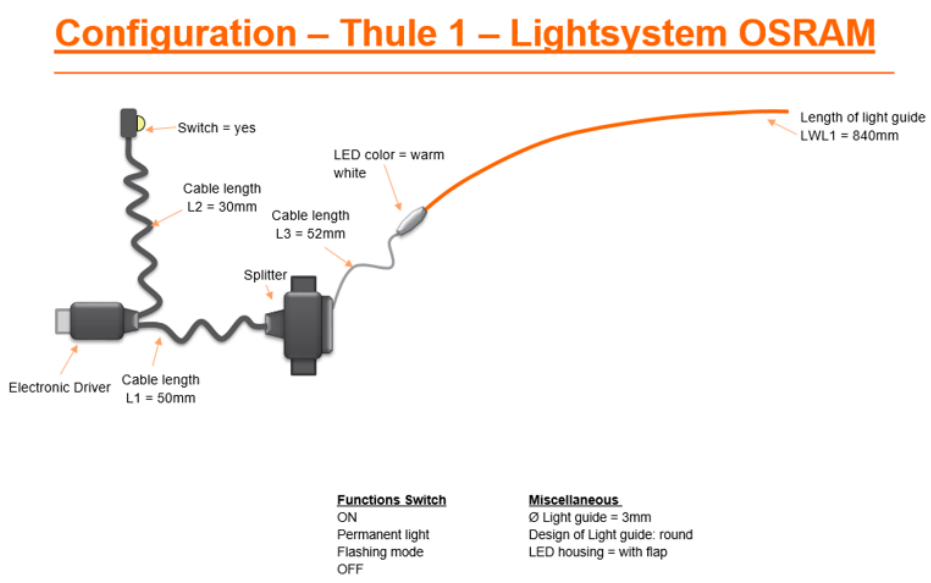
	Nu lägger jag på en reflexväst!	
	Reflexspray ger en falsk trygghet tycker jag då det försvinner när det regnar och det är inte alla som vet det.	Det är viktigt att lösningen går att lita på och håller i alla väder.
	Hade gärna sett fler produkter som inte känns så otympliga	Det är viktigt att lösningen är smidig och inte tar så mycket plats
	"särskilda barnvagnsreflexer" är så dyra att man väljer att köpa annat	Lösningen måste vara prisvärd
Har du några knep för att kunna se bättre i eller utanför vagnen/ öka användningen av vagnen när det är mörkt?	Jag sätter "cykellampor" som lyser vitt framåt och rött bakåt och fäster på chassit	Jag vill att andra trafikanter ska veta vilken riktning jag rör mig åt
	Jag går där det finns gatubelysning så jag ser	Jag vill ha bra uppsikt när jag är ute och går
	De lampor jag lagt på vagnen lyser också upp vägen lite, men mest	Jag vill kunna se vägen när jag går

	bara neråt. Treåringen brukar få hålla i en ficklampa men lyser mest upp i himlen	
	Nattlampa på batteri i vagnen så jag ser dottern	Jag vill kunna se mitt barn
	Batteridriven ljusslinga inne i vagnen. Dock svårt då dottern vill dra i den hela tiden	Jag vill kunna se mitt barn utan risk att hen får tag på lösa delar
	Pannlampa funkar sådär då det bländar barnet! Men nu är storasyster 3.5 år och håller en ficklampa framåt så vi ser och syns	Jag vill kunna se vägen utan att behöva hålla i något och utan att det stör min bebis

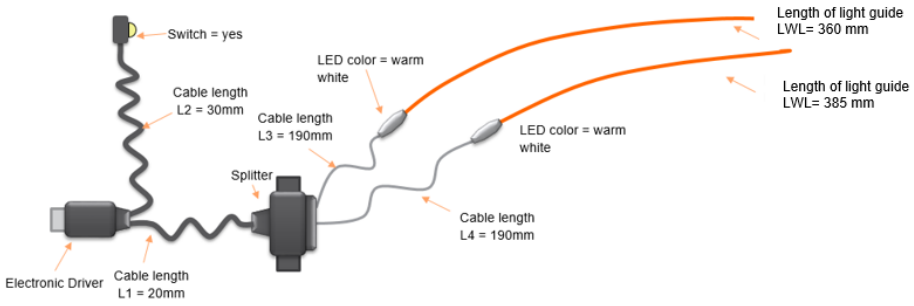
Källa: Ullrich and Eppinger

Appendix H – Drawings

Drawing- Light systems

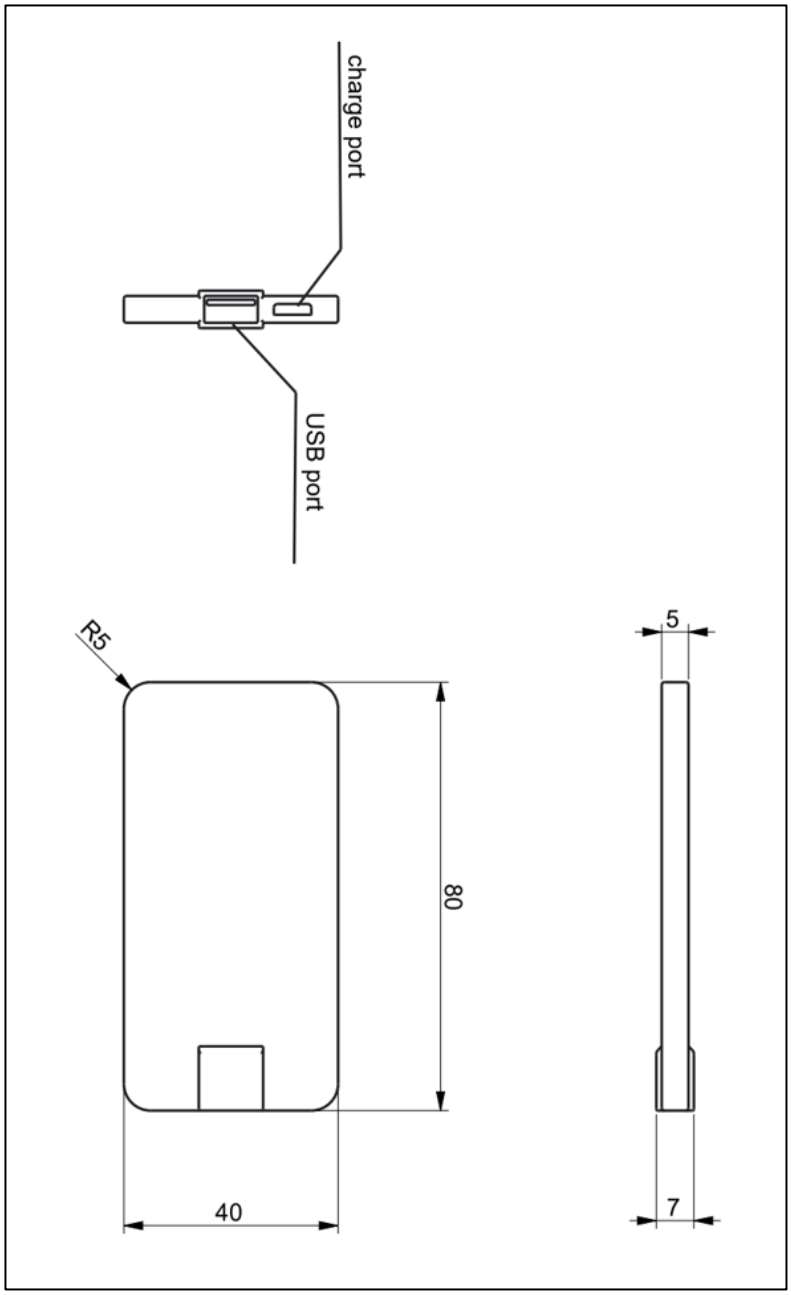


Configuration – Thule 2 – Lightsystem OSRAM



Functions Switch	**Miscellaneous**
ON	Ø Light guide = 3mm
Permanent light	Design of Light guide: round
Flashing mode	LED housing = with flap
OFF	

Drawing- battery

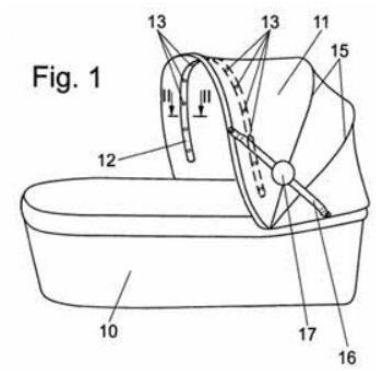


Appendix I – Patent search

Result:

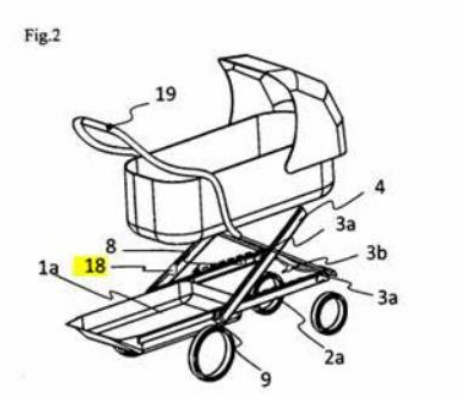
The document "**DE202007010272**" of assignee "*TEUTONIA KINDERWAGENFABRIK GMBH*" discloses a stroller. A stroller with a chassis, a seat and recliner on which a hood is mounted, which consists essentially of at least one top stirrup and a cover and which is provided in the interior with an interior lighting, which can be acted upon by a voltage source with electrical energy is. **The object is achieved by the interior lighting is designed in the manner of a multiple light sources having light string, and is fixed to a roof bow or the cover of the top and extends at least over the arcuate portion of the top. Since the interior lighting now consists of several light sources, the interior of the top is optimally illuminated, whereby the arrangement of the light sources ensures that the child lying in the seat and lying insert is not dazzled.** By means of suitable holding elements, the interior lighting designed as a light string can then be attached either to a top bow or to the cover. For illuminating the interior, it is sufficient if the interior lighting extends over the upper area of the hood. **In the dark, the interior lighting could be constantly switched on. However, it is also possible that the interior lighting by means of a switch on and off, so that the interior lighting is turned on only when needed to care for the child or for control.**

Classification(s): (B62B9/14)



The document "**DE202014008588**" of assignee "*FEINDLER, NICO, KREUZWIESER, ANDREA*" discloses luggage compartment on a stroller. An electrical sensor [8] is integrated with the frame, which detects the position of the luggage compartment (open / closed). Known sensors are, for example, Hall sensors or contact sensors, which generate a signal when reaching or releasing the locking unit. **In addition, a lighting device [18] is shown, which illuminates the luggage compartment.** The light source is in this case preferably on the frame and may be secured in further embodiments on the luggage compartment or the sitting or lying unit.

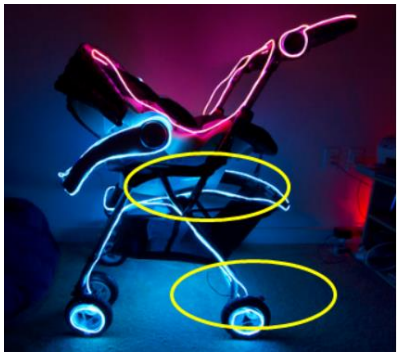
Classification(s): (B62B9/26; B62B9/005)



The NPL document "**THE STROLLER KIT**" discloses **weather-resistant solutions for taking walks with your family in the early morning, dusk, or evening. The safety of you and your children will no longer be compromised while using stroller lights from Baby be Bright. Our LED lights are so powerful that drivers can see you from blocks away. Additionally, our installation guide walks you through the steps to ensure the light beams flow out and under your stroller, and not into your little one's eyes.**

Observations: *The images are also showing that the lighting device is powerful enough to illuminate the luggage compartment as well.*

The NPL document “**STROLLER UPGRADE**” (**link2**) discloses a stroller with lighting devices. It can be inferred from figure that the lighting devices are place on the canopy and on the luggage compartment as well. Whereas, the lighting devices are also illuminating the below and in front of stroller as well.



The document ”**DE10147262**” of assignee ”*MERLAKU, KASTRIOT*” discloses baby perambulator with illumination device. A illumination device for illuminating interior of perambulator and/or path in front and/or behind perambulator. A stroller headlight is created, which consumes very little energy and still very strong lights. **The interior lighting also benefits the child such as good ambient lighting during dusk or night, this headlight can be additionally attached to various locations and devices or simply used as a flashlight, the interior lighting calms the child, etc. This headlamp consists of a small housing 1 in which the white LEDs 2, a switch 3 and a plug 4 or a power connection to the battery 5 are mounted.** As a variant, a 9 V battery docking point 6 or clip can be attached. A battery or battery bay is not integrated or provided. A 9V block battery or 9V block battery can

be easily docked outside the case to the 9V battery dock or clip. Then you can remove this headlight and use it as a flashlight. **The interior lighting can also consist of a fluorescent tube 7 or multiple light emitting diodes. The variant with LEDs, can produce different colors. With a control unit, the light colors can be controlled according to a programmed pattern or at random.** This quickly calms the child. A combination with sound effects can be even more interesting for the child.

Classification(s): (B62B9/00; B62B9/005)

Similar Patent: (**DE20115791**)

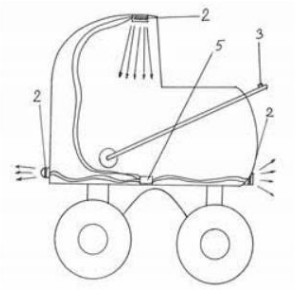
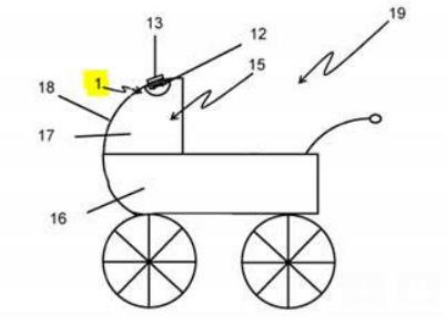


Fig. 3

The document "**DE102014105138**" of assignee "*BETZING, DENNIS, CASPAR, DENNIS*" discloses lighting device for the interior of a transport device for children. **A lighting device for the interior of a transport device for a child with a housing having an at least partially transparent housing portion, a power supply, arranged in the housing and electrically connected to the power supply and a switch, the so with the Power supply and the lamp is electrically connected, that the switch acts on the current flow through the lamp.**

Classification(s): (B62B9/005; F21V21/0965)



The document "**US6394633**" of assignee "*PEREZ ANGEL L*" discloses guidance and safety illumination for baby carriages. **A baby carriage or stroller is provided with a built-in illumination electrical system, powered by a replaceable or rechargeable battery or by a solar panel. A headlamp or headlamps at the front illuminate the intended pathway of the carriage. Side lamps and a rear or tail lamp or lamps may be provided. The side and rear lamps are typically red as warnings. An interior or baby-illuminating lamp may be provided. One switch controls the interior light and another switch controls the other lights. An "interior" lamp 4 is provided. This is independently operated by switch 2. The lamp 4 is provided on the inside of the hood or otherwise supported in a position so that the baby's face and body are illuminated.** Parents and others push baby carriages on walks on sidewalks and streets. At times, **these strolls or walks may be in conditions of diminished visibility, as at dusk, or night, or in rainy or otherwise inclement weather. Quite apart from the question of enhancing visibility of the carriage to others (which is nevertheless is an aspect of this invention), a most important and critical aspect is throwing a field of light ahead of the carriage**

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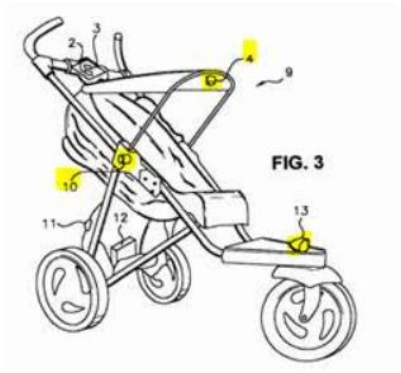

The document "**US2016009219**" of assignee "*GILBERT SEAN*" discloses baby stroller lighting system. **A stroller lighting system, comprising a light strip fasten able to the underside of a stroller;** a power supply fasten able to a handle of the stroller; a wiring harness, fasten able to a frame of the stroller and configured to electrically connect the light strip to the power supply; and **a switch electrically connected between the wiring harness and the power supply** to activate and deactivate the light strip whereby, when the light strip is activated, ground beneath the stroller is illuminated. **The light strips 106 may be fastened to a stroller 200 to any appropriate part of the underside 202 of the stroller 200, such as the axles or the horizontal braces at the front and rear of the frame 204, to project light downward.** The light strips 106 may be fastened to the stroller with any appropriate fastener, such as zip ties 114 (FIG. 3), double-sided tape, clamps, hook-and-loop material, among others, or a combination of fasteners for additional security. Alternatively, or in addition, **light strips 106 may be fastened to or around the sides, front, and rear of the stroller 200 and project the light outward.** In other embodiments, light strips 106 may be embedded in the stroller 200 material during manufacture. **The lighting system 100 may be provided with additional features. For example, a controller 116 in the housing 104 may allow the user to select different lighting modes, such as continuous, flashing, or sequential. The power supply 102 may be a replaceable or rechargeable battery, such as a single 9 volt battery or a battery pack with multiple 1.5 volt batteries. If the battery or battery pack is rechargeable, it may be recharged by plugging a conventional wall charger into the housing 104 at home.** Alternatively, or to supplement a wall charger, the battery or battery pack may be recharged using one or more solar panels 120 mounted on top of the stroller 200 (FIG. 4). A small generator mechanically connected to a wheel 210 may also, or instead, be used to charge the battery or battery pack. An LED mounted in the housing 104 may provide an indication of the charge state of the power supply 102.

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