

KYMENLAAKSON AMMATTIKORKEAKOULU
University of Applied Sciences
Degree Programme in Design

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ADD-ON CONCEPT FOR AIDING THE USE OF PRAMS IN SNOWY CONDITIONS

Bachelor's Thesis 2013

ABSTRACT

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Add-on concept for aiding the use of prams in snowy conditions

Bachelor's Thesis

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This Bachelor thesis aimed at discovering a way to aid the use of prams during snowy seasons by creating a concept which includes skis that will be attached to the underside of the prams.

The target group of the concept, parents with a young child, suffer every winter from the lack of upkeep of the walkways in Finland. The modern prams with small turning wheels are in no way designed to work in snow, rather they are designed to be used in shopping centres that always have clean and even floors.

The idea of adding skis to the pram wheels is not a new one and even commercial applications of this idea exist. However every single one of the existing models has to be removed from the prams when the snow underneath the prams runs out.

For these reason it was seen worthwhile to embark on to this design study and try to find a concept that would allow the skis to be attached to the prams for the whole duration of winter.

TABLE OF CONTENTS

LIST OF TERMS AND ABBREVIATIONS	5
1 INTRODUCTION	7
2 NEED IDENTIFICATION	7
2.1 Internet questionnaire	7
2.2 Answers to the Internet questionnaire	8
3 SIMILAR PRODUCTS	11
3.1 History of pram skis	11
3.2 Modern competition	12
3.2.1 Axso pram skis	13
3.2.2 HTSuksee Vaunusukset	13
3.2.3 Premiere Ski	14
3.2.4 Safe start stroller skis	16
3.2.5 Wheelblades	16
3.2.6 Seed pram ski	17
3.3 Overview of the competition	17
3.4 Other products that answer to the same problem	18
3.4.1 Kick sled	18
3.4.2 Sled	19
3.4.3 Toboggan	19
3.4.4 Baby carrier	20
3.4.5 Baby wrap	21
4 FIRST DRAFTS OF THE DESIGN CONCEPT	22
4.1 Quantity of connection and ski ideas	23
4.1.1 Skis that contains new wheels	24
4.1.2 Ski connected with rolling spools	25
4.1.3 Ski connected to the axle via a plain bearing	27
4.1.4 Ski connected to the axle via a support cane	28
4.2 Direction of concept	29

5 THE CONNECTOR CONCEPT	30
5.1 Most common nominator	30
5.2 The connection location	31
5.3 The connection concept	32
6 SHAPE OF THE SKIS	34
6.1 Wheel location compared to the ski	34
6.2 The buoyancy or lift of the skis	35
6.3 Concerning directional stability	36
6.4 Other types of skis in other uses	37
6.4.1 Snow landing skis for planes	37
6.4.2 Seaplane skis	38
6.4.3 Snow mobile skis	38
7 SELECTED PARTS FOR THE PRODUCT	40
7.1 Results of ski shape	40
7.2 Results of connection designs	41
8 COMBINING THE SKI AND THE CONNECTION	43
8.1 Making it look pretty	43
8.2 Possible manufacturing method and the consequences to the design	43
8.2.1 Injection moulding	43
8.2.2 Rotation moulding	44
8.2.3 3D printing	45
8.3 testing of the prototypes	45
9 CONCLUSIONS AND FINAL RESULTS	47
LIST OF REFERENCES	49
LIST OF FIGURES	50
APPENDICES	55

LIST OF TERMS AND ABBREVIATIONS

3D printing — Additive manufacturing or 3D printing is a process of making three dimensional solid objects from a digital model. 3D printing is achieved using additive processes, where an object is created by laying down successive layers of material. 3D printing is considered distinct from traditional machining techniques (subtractive processes) which mostly rely on the removal of material by drilling, cutting etc. (3D Printing. 2013)

Axle — **1.** A supporting shaft or member upon which a wheel or wheels revolve. **2.** The spindle of an axletree (Morris 1969-1979. 93)

End user — For the duration of this paper the term end user is used for someone who uses baby prams.

Injection moulding — Injection moulding is the most commonly used manufacturing process for the fabrication of plastic parts. A wide variety of products are manufactured using injection moulding, which vary greatly in their size, complexity, and application. The injection moulding process requires the use of an injection moulding machine, raw plastic material, and a mold. The plastic is melted in the injection moulding machine and then injected into the mold, where it cools and solidifies into the final part. The steps in this process are described in greater detail in the next section. (Injection Moulding. 2013)

Plain bearing — Any of various bearings, not containing rolling elements, that present to the shaft or axle they support broad areas of corresponding form, usually segments of a cylinder. (Plain bearing. 2013)

Rotation moulding — Also known as rotocasting or rotomoulding, is a low pressure, high temperature manufacturing method for producing hollow, one-piece plastic parts. (Crawford, Kearns)

Spool — A cylindrical object that is wider at the ends and thinner in the middle.

Tangent — 1. A line, curve, or surface touching but not intersecting another line, curve, or surface. (Morris. 1969 - 1979)

The designer — For the use in this paper the creator of the concept and the writer of this thesis, Markus Heikkilä.

Universal — 6. Mechanics. Adapted or adjustable to many sizes or uses. (Morris. 1969 - 1979)

1 INTRODUCTION

The aim of this bachelor's thesis was to create a concept for helping the use of baby prams during snowy seasons. Other applications, mainly pram skis, to aid the use of prams in snow or slush do exist but nearly all of them have to be disconnected from the pram when the snow under the skis runs out. This, as anyone can see, is not ideal as slush or snow does not pile evenly. For this reason, it was seen that, it is beneficial to create a concept for an winter add-on that can be left to the prams even when the snow underneath runs out.

I gained the overall idea or premise of this thesis when I found that the modern prams are in no way made for snowy roads. This realization happened during the winter 2011-2012 and at that time the market seemed to be void of any add-ons to help the use of prams in snow.

2 NEED IDENTIFICATION

There has to be a need for a product for the product to exist, as Chitale & Gupta (2007, 2) express in Product design and manufacturing

“A design must be in response to individual or social needs, which can be satisfied by the technological status of the time when the design is to be prepared.”

For an winter add-on used with prams a social need exists. The prams are used all around the world even in snowy conditions where the roads may not be in ideal conditions. Thus the need for add-ons to help the users to push the prams forward exist. This was furthermore proven by a small questionnaire given to the users of the Facebook group BabyLife.

2.1 Internet questionnaire

The internet questionnaire was conducted using the Google docs application. The questionnaire contained both qualitative and quantitative questions that could prove, or disprove, the need for a new concept. The link

to the questionnaire was posted in BabyLife group on Facebook on 27th of January and the results of the questionnaire were collected four weeks later on 24th of February. The group at the time had 114 members and 29 members of the group answered to the questionnaire. BabyLife group is an invitation only group on Facebook for parents of small children or babies. So everybody who answered to the questionnaire was a possible member of the end user group of the concept. The answers to the questionnaire were originally given in Finnish (see appendix 2) and translated into English.

2.2 Answers to the Internet questionnaire

The numerous problems that the users face when using prams during winter time include;

“The snow walls that snow ploughs leave behind next to crosswalks.”

“The unplowed pedestrian ways causes challenges, also the use of travel trolleys during winter is impossible.”

“Occasionally too much snow and the prams will not go properly.”

“The pram wheels will not run properly because of the unplown snow.”

“Snow gets stuck to the front wheels and between the fenders and stops them from running.”

“The unploughed roads or snow banks that the prams won’t go over.”

“Too small wheels that don’t go through the snow banks.”

“The bad upkeep of pedestrian walkways. Not plough properly or at all, or just from a narrow part of the road. Also because of the use of

road salt the roads are often full of mushed snow that makes pushing of the prams hard.”

“Pushing the prams in snow takes strength. Especially this winter when the snow has come in bursts and the city upkeep hasn’t been able to keep up.”

“Snow isn’t ploughed properly from sidewalks and large snow banks are left in front of walkways.”

These are just a few quotations from the questionnaire. As can be seen in Figure 1, more than half of the respondents said that they had had problems in the winter use of prams.

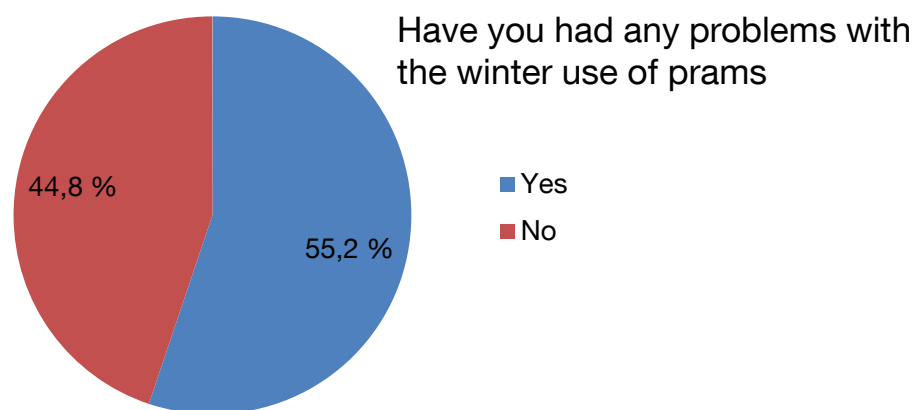


Figure 1: Answers to the first question show that the end users have problems with their prams during snowy seasons (Heikkilä 2013)

Some solutions for the problems that the end users had, they have come up their own solutions that include:

“When you tie the dog leash to the pram you get nice pulling help.”

“Locking of the front wheel.” “I’ve decreased the use of prams, and increased the use of baby carrier.”

“I keep my own shovel in the prams that I can use to shovel snow banks out of the way.”

The few that had used some of the current ski solutions had the following to say:

“Seems kind of troublesome back and forth these current solutions.”

“The bike carrier Chariot Cougar have skids. When used with skiing they work well while pulling. Pushing would not work because the flexibility of the connection. The front end would drop to the ground (when stopping). Also they could not be used while using busses.”

Because quite a few of this kind of answers were received the idea of having a ski that does not need removing when the snow underneath runs out was selected as an aim of this thesis (See figure 2).

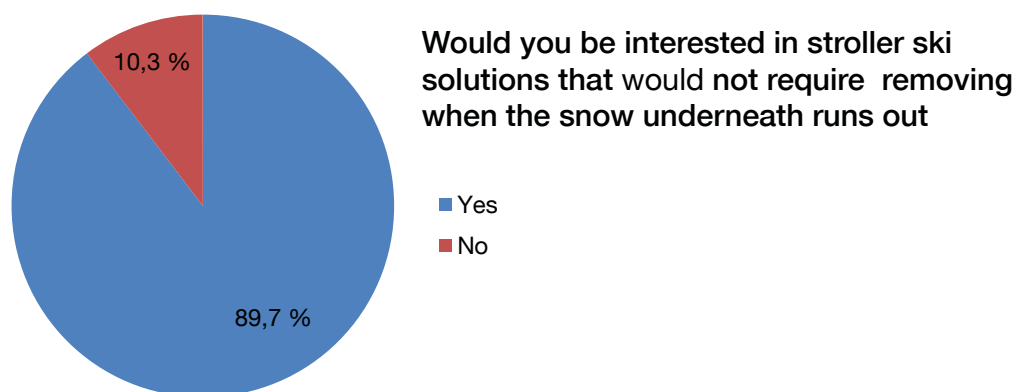


Figure 2: The end users would be interested in a product that is more versatile than the ones on the market at the moment (Heikkilä 2013)

3 SIMILAR PRODUCTS

The problem that prams get stuck in snow is not a new one: therefore other concepts of adding skis to prams, thus turning them into a sleigh, exist. However there just happens to be a place for improvement of the products patented and or on the market. Further more the questionnaire proved that the existing products have not been found by the end users (See figure 3). This raises the need for new concept that could be launched to the minds of the end users.

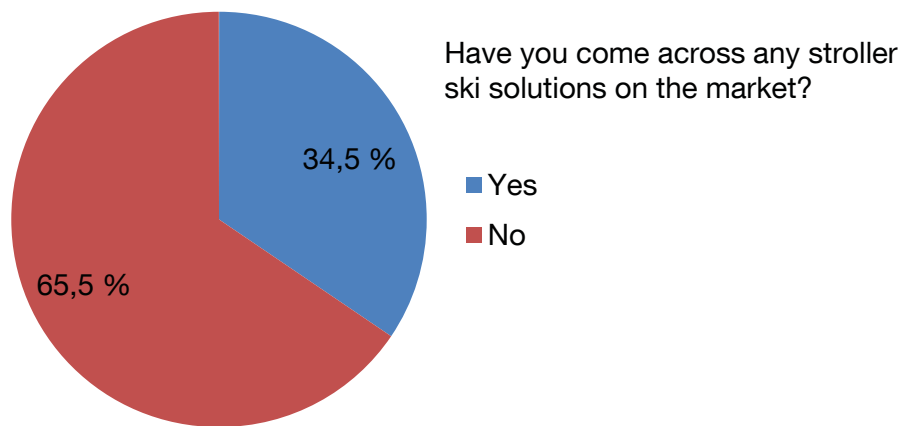


Figure 3: The end users have not found the existing ski concepts in large numbers (Heikkilä 2013)

The idea of adding skis directly to the wheels by the means of straps might be useful and more practical in more rural environments but as more and more of the population of the world live in urban areas the need for skis might not be continuous.

3.1 History of pram skis

The idea of adding skis to the wheels of baby prams is in no way a new one. The first found mention of such a contraption is the patent application by Emanuel. R. Morando (1942) that was filed on February 5th 1942. Since then numerous patents concerning different new invention to help strollers in snowy conditions have been made. In most of the patents, that were found, the skis have been attached directly to the wheels preventing

the wheels from turning or running. The only concept that seem to have thought that the wheels of the prams should not be stopped from running by the skis is the patent by Key, Theodore and Key, Melinda (2002). Their patent have skis that can be rotated around the wheel when necessary (See figure 4).

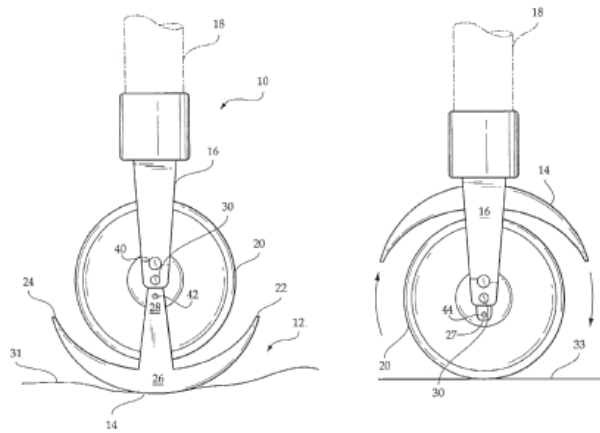


Figure 4: Patent picture by Key and Key showing the idea for a stroller ski that rotates around the wheel (Key & Key 2002)

While this change alone from the rest of the ski concepts is towards an ideal solution the end user still needs to get his, or her, hands dirty with snow, slush, and dirt every time the conditions under the wheel, or ski change. Also depending on how wide the skis in Keys' patent were thought to be, this dimension can not be seen from his patent application picture. The surface area that they add compared to the wheels alone is not so great because of the round bottom of the ski.

3.2 Modern competition

The modern versions of the pram skis seem to continue in the dissolution that when it snows the snow goes everywhere and stays evenly, or then the creator of the modern skis has been trying to create a true universal solution to maximize the possible client base. Because of this all of the skis on the market at this time rely on connecting themselves directly to the wheels by straps or other devices that prevent the wheels from running. In the next five chapters the modern competition and their main pros and cons will be looked at.

3.2.1 Axso pram skis

The Axso pram ski is the closest competitor to the idea behind this thesis, because it is relatively small, it fits to most of the prams on the market, it has forms that will not compete with the forms of the prams themselves, and the manufacturer even ships them with a bag that they can be slipped into when not in use. Also the creator of Axso pram skis was aware that when using prams in snowy conditions the largest problem concerns the front wheels, as they are the point of the most force diverted to, and thus sink more than the rear wheels. The small size of the Axso pram skis makes them an ideal size for city use. The Axso pram skis are shown in Figure 5.



Figure 5: The Swedish made Axso pram ski with and without the pram wheel inserted into the ski (Axso 2012)

On the other hand because of the small curvature in the back of the skis the Axso pram skis look like they might get caught in snow if the user is pulling the prams backwards - which is the easier way of moving prams in snow, or uphill. The end user will have to remove the skis every time the snow runs out underneath, and the connection is made from straps that the user will have to touch every time.

3.2.2 HTSuksee Vaunusukset

At the other end of the usability curve the HTSuksee vaunusukset are mostly what the end product of this thesis hopes not to be. The internet page of the HTSuksee (2013) company describes through a story that the skis are mainly done for taking your baby to areas without roads. So their

idea is mainly to replace the use of toboggans or sledges for hikers. The skis are also connected with straps again forcing the user to get his or her hands in slush. Furthermore the size of the skis is unsuitable for the basket of the prams, this size problem can be seen in Figure 6.



Figure 6: The huge HTSuksee pram skis showing the adorable pink colour and the connection requiring several straps per ski (HTSuksee 2013)

On the positive side though, because of the huge size of the skis most prams can be attached to them. However even the company web page admits that the skis might not be able to run straight with prams that do not have their wheels in a direct line. Thus almost negating the positive effect of the huge skis.

3.2.3 Premiere Ski

The Premiere Ski add-on is probably the most versatile pram ski on the market at the moment. The ability to connect the skis from the large running pram wheels or to the small double wheel prams is quite a remarkable achievement (See figure 7). The only wheel type that the manufacturer does not recommend using their add-on with is if the wheels have fenders that prevent the ski from rotating freely (See figure 8). Also once again the skis are attached by the use of straps that can not even be changed once they wear out.



Figure 7: The Canadian Premiere Ski showing the wide variety of wheel sizes, and types the skis that can be attached to them (Premiere Ski 2012)

The initial installation of the Premiere skis is quite complex requiring the end user to have an screwdriver, markers, and helping hands. The installation guide says the future re-installations will be easier but that will not help if the end user cannot even get the first installation done.



Figure 8: This quite usual front wheel fender type prevents the use of Premiere Skis (Premiere Ski 2012)

3.2.4 Safe start stroller skis

The safe start stroller ski has one of the more complex connectors requiring the end user to place the straps support bits around the outside of the wheels (See figure 9), and in this case the bits have to be adjusted every time the product is taken into use. The skis can be attached to various sized wheels, and they even can be fitted to double wheels making the suitable wheel selection quite large. Strangely though the safe start stroller skis are mainly marketed for downhill skiing not for getting through snowy roads.



Figure 9: Safe start stroller ski in use in various sized wheels (Babeaze 2013)

3.2.5 Wheelblades

The German manufactured Wheelblades were designed by a quadriplegic person so that he could once again enjoy the outside life during winter (Wheelblades 2012). He at the time felt that the products offered for persons in wheel chairs lacked in mobility and flexibility. While the product itself is not designed for prams the idea, and the problem that led to the invention are basically the same that this thesis is all about.



Figure 10: While designed for pushchairs the Wheelblades aims at resolving the same problem; small front wheel get stuck in snow (Wheelblades 2013)

The Wheelblades can be adjusted to house a wheel between 1.8 to 6.0 cm in width, and the clamp lock mechanism limits the height of the wheel axle to be quite low. Furthermore, compared to the products targeted at prams the Wheelblades are quite expensive, costing approximately €100.00 per pair.

3.2.6 Seed pram ski

The Seed PLI pram ski is the only pram ski that is designed specifically to a certain brand of pram. Even when the designer of the product is aiming at the product to be used with one type of pram, the Seed PLI, they have still gone with the strap connection option rather than trying to find a more robust connection way (See figure 11). The Seed PLI stroller skis are also so long that one cannot connect more than two skis per stroller. While it has been stated that only two skis per pram is most likely enough (Axsolution, 2012) the back ends of the Seed skis are so low that one can come to the conclusion that pulling the pram backwards will most likely end up with the skis sinking into snow.



Figure 11: The Seed PLI prams showing the two strap per ski to wheel connection (Designapplause 2010)

3.3 Overview of the competition

Considering what was discussed above when using any of the competing products at least half of the wheels on the prams will be unusable. This

will result in the need to remove the skis anytime the user needs to move the prams on a snowless surface. On short snowless paths the user can of course lift the wheels with skis into the air by pushing down on the handlebar. Unfortunately, this will not work in a situation where there are elevation differences, such as when stepping on to a bus.

3.4 Other products that answer to the same problem

If using prams during winter is so hard it is surprising that there are no other solutions to meet the need to transport babies during winter. Well some actually do exist, such as kick sleds, sleds, toboggans and so on. Unfortunately, none of these products offer the same flexibility that the modern prams do. Thus modifying the prams to work in winter time is justified.

In the following chapters the pros and cons of these innovations will be discussed to see if there are some innovations that could be implemented to the new concept idea.

3.4.1 Kick sled

From figure 12 it is possible to see the most obvious flaw of kick sleds. The bench of the kick sled requires the passenger to have enough strength to hold on to, a skill that smaller child might not have.



Figure 12: Traditional kick sled for one passenger plus one pusher (Äkäs-lompolo Sport Shop 2013)

However in rural environments where the upkeep of roads is not the key interest of the local government, the kick sled can be an ideal way to transport larger kids or even small cargos, but it too suffers from the problem that it needs a continuous packed snow coverage for use. There are kick sleds with wheels underneath but they suffer from the same main problem that pram suffer; the wheels sinking in to snow.

3.4.2 Sled

A sled is one of the most used and cheapest solution to transport small children in snow. Unfortunately it easily stops even from one layer of sand on the road. The average sled is more a toy than a transportation device.

A wide variety of different kinds of sleds have been designed over the course of history, some more complex than others. The Orthex sled for smaller children or babies, shown in figure 13, have a backrest to absorb the jerking movement caused by the pulling from the cord, and handles that the passenger can hold onto.



Figure 13: Sled for smaller children or babies (Orthex group 2013)

3.4.3 Toboggan

The toboggan is a sturdier and larger version of a sled with the addition of a waist wrap for pulling the load. The metallic skids under the main hull make it possible to pull the toboggan in harder terrains, but even toboggan will grind to a halt if the road has been cleaned of the snow completely.



Figure 14: Toboggan in use (Hit Ky 2006)

As can be seen from figure 14 the average toboggan is quite large making its everyday use a chore. For hiking purposes in rougher terrain the toboggan is however a clearly the product to use.

3.4.4 Baby carrier

Baby carrier, seen in figure 15, is an easy way to transport the smallest babies. While using a baby carrier the hands of the user remain free to do other tasks. Using of a baby carrier gets harder when the baby grows and gets heavier. The longevity of use relies fully on the strength of the user.



Figure 15: A modern baby carrier that can be carried on the back or in front of the user (Pursepage.com 2013)

The space required for storing a baby carrier is relatively small compared to other child moving apparatuses making it an ideal choice for small urban households.

3.4.5 Baby wrap

The baby wrap is a more versatile product compared to the baby carrier for carrying smaller babies as depending on the way the baby wrap is bound it can be used even for carrying toddlers (see figure 16).



Figure 16: The baby wrap i use (Carry Me Away 2013)

While offering more ways in which to carry the baby the baby wrap suffers from the same restriction that the baby carrier suffers from. Furthermore depending on the skill of the user the bounding of the baby wrap can be quite difficult.

4 FIRST DRAFTS OF THE DESIGN CONCEPT

The designing of this concept was started, like most other concept ideas, with a pen and paper as the tools of the designer, the first sketch of the concept can be seen in figure 17, and the prams googled as the goal on which to base the design to. Most of the ideas in the beginning relied on the idea that the add-on could be attached directly next to the wheels with the same knob that the wheel is attached to the axle or with a connector that would be slipped between the axle and the wheel without any difficulties.

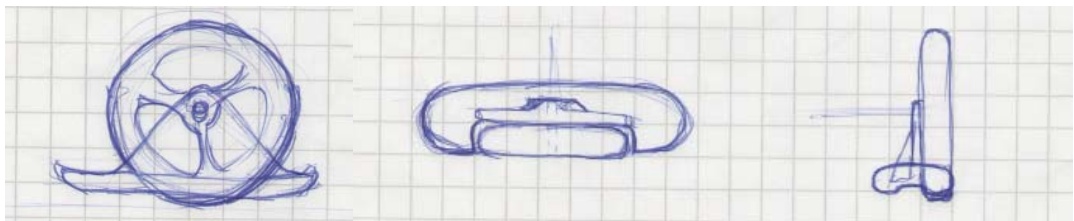


Figure 17: The original sketch that was the starting point of this thesis project. Showing a one piece ski connected next to the wheel (Heikkilä 2013)

At this early point of the project, the background gathering was still uncompleted so these ideas seemed plausible. However after some more serious background research it was noticed that most of the prams on the market have some sort of quick release mechanism (See figure 18) on the outside of the wheel or the connection between the axle, and the wheels, are in most cases covered, which prevent such connections from being used.

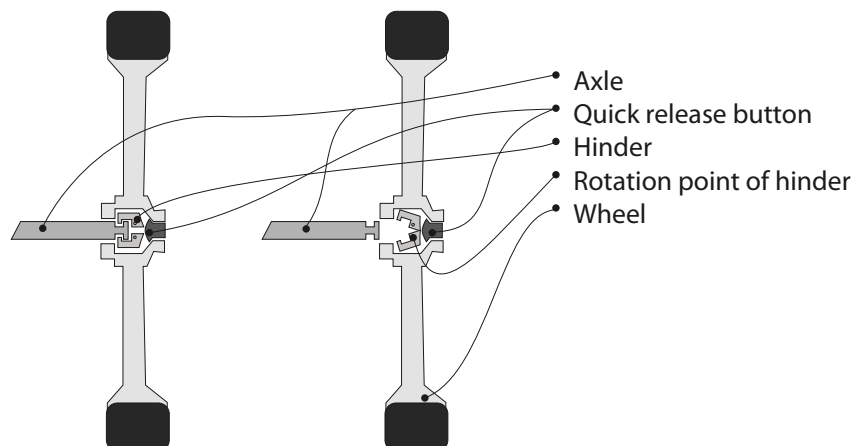


Figure 18: A simplified cross section of a quick release system, locked on left, and open on right (Heikkilä 2013)

At the beginning of the process one main idea that was also toyed with was the idea of creating a more snowboard-like concept that would occupy most of the space between the wheels. Nevertheless as the number and distance of the pram wheels is not standard the idea was quickly abandoned.

Most of the early concept ideas had the wheel passing through the ski through an opening in the ski itself. This idea was used to keep the additional space around the prams that the skis would take to a minimum.

As one of the main problems in the existing pram ski solutions is the need to keep touching possibly dirty skis the initial direction was set in the idea that the user should not have to do anything to the skis after installing them once. Because of this decision, the orientation of the design was set to the idea that the bottom surface of the skis will hang above the level of the bottom of the pram wheels. This way the skis will contact the road only when needed — when the wheels have started to sink into snow. This also removes the need to design some complex lever mechanism to the skis which would move the ski only after the end user has used the lever.

4.1 Quantity of connection and ski ideas

Multiple ideas were brought up with various methods of how the skis could be attached to the prams. The number of skis and the connection point varied wildly in the beginning. From the quantity of ideas the ones seen more likely to work were drawn again and again to fine tune the idea closer to a working concept. This level could be seen to have been the feasibility study of the product design process as described by A. K. Chitale, and R. C. Gupta:

“the purpose (of a feasibility study) is to achieve a set of useful solutions to the design problem”. (2007, 7)

While the purpose of a feasibility study is to produce useful solutions some of the solutions not chosen to go any further in the design process still offer some interesting ideas that should not be completely forgotten

during the rest of the process, some of the se early ideas can be seen in figure 19.

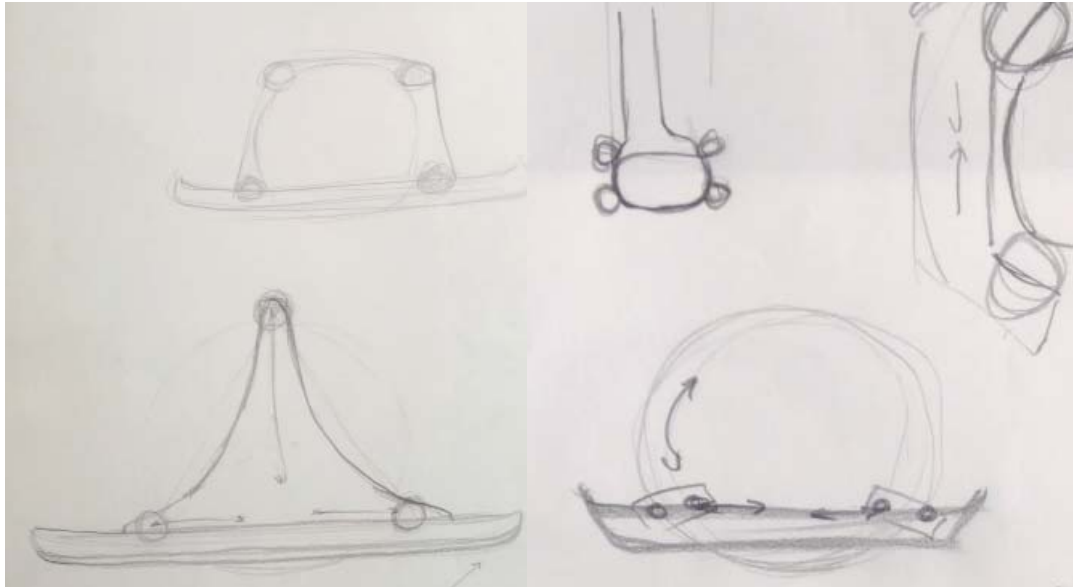


Figure 19: An early sketch showing ideas of how to connect the ski to the wheel by the use spools or ball connectors in various configurations (Heikkilä 2013)

After some design rotations of sketching the most seemingly working, or feasible ideas were selected for continued development, to the preliminary design phase (Chitale & Gupta 2007). The aim of this phase is to select the main ideas that will be used in the final concept.

4.1.1 Skis that contains new wheels

While at first the idea of adding new wheels to a ski that is already connected to a wheel might seem somewhat far-fetched the idea was kept alive because this way the wheel would always be on the correct level compared to the ski bottom. Also the new wheel idea would allow the added wheels to be designed so that the snow would not clump to them. Further more if the added wheels could use normal roller skate bearings then the need to design new complicated bearing systems would be removed.

In addition, the new wheel system could also be designed so that it attaches itself to the wheels and by making this connection as versatile as possible the new concept could very well be the most universal pram ski add-on on the market.

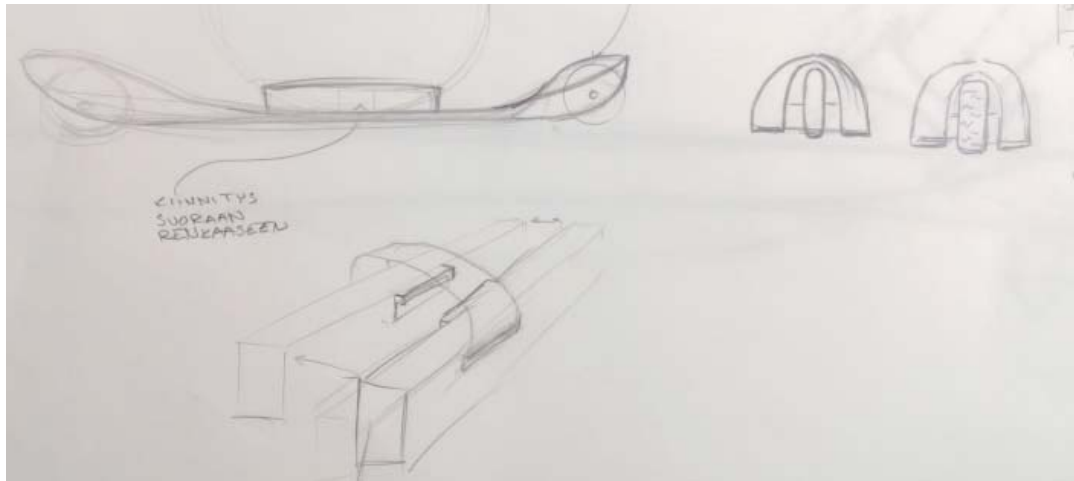


Figure 20: A sketch showing a promising idea of adding the wheels again to the base of the ski add-on (Heikkilä 2013)

In figure 20 can be seen the main ideas used in the ideation of the concept that would add new wheels to the bottoms of the skis, the smaller wheels, and the connection straight to the sides of the wheels.

4.1.2 Ski connected with rolling spools

A rolling spool connection was seen as a very flexible way of attaching to the exterior surfaces while still allowing the wheels to run in the middle of the spools. The number of spools and the connection from the spool to the ski differed from one concept to the next. Two main ideas for the connection using spools were brought to the preliminary phase. At this phase in both of the spool designs one critical flaw was seen that is, how to keep the ski from constantly hitting the road underneath. While the spools would probably let the wheel run without a hinge the ski would most likely first try to rotate with the wheel, then bounce to the other direction and bounce from the ground again.

In the first rolling spool connection idea, the spools are in a horizontal position around the wheel which would be located in the middle of the ski in an opening that would let the wheel through to the ground underneath. In this kind of cane supported spool connection the minimum amount of spools needed is three. However, by adding one extra spool, for a total of four spools, the size of the wheel could vary more.

On the down side this type of connection could not be used with wheels that have fenders attached to them. Secondly, depending on the size of the wheel, the canes might have to be placed on the exact same path as the axle of the wheel making the connection dysfunctional on some wheel sizes. In figure 21 the four cane solution suffers from this exact problem.

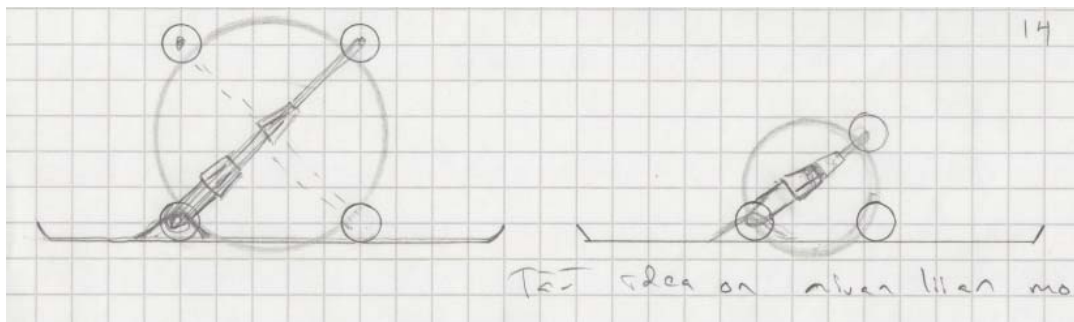


Figure 21: A sketch showing a four and three spool connection of the ski to the wheel via two or one adjustable support canes (Heikkilä 2013)

In the second type of spool connection the spools rigs would be connected to the ski via a rail on both sides of the wheel, and the vertical angle of the spools could be adjusted perpendicularly to the tangent of the wheel. This type of spool connection once again would offer a great flexibility of the wheel size. The flexibility of the wheel size would probably be even larger than the first type of spool connection described earlier. Again the spools could use standard roller skate bearings to keep the manufacturing and designing costs on a reasonable level.

This second spool type connection would be quite universal as the connection would not interfere with the axle of the wheel nor with the possible fenders that the wheel might have attached over them. As a negative side effect this type of connection would require quite complex

rails for the bases of the spools to move to fit the wheels, see figure 22 for the basic construction concept. Also to reach a spool shape that would fit to most wheel sides could become a huge task by itself. In addition, the construction would require multiple different materials to work.

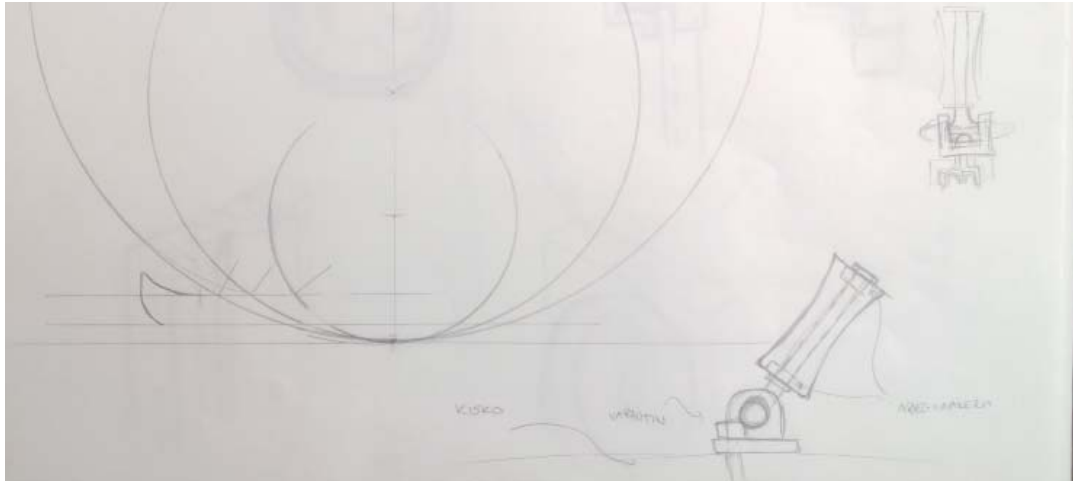


Figure 22: A 2D sketch showing the possible variable wheel sizes and the possible construction of the spool rig (Heikkilä 2013)

4.1.3 Ski connected to the axle via a plain bearing

The third connection method selected to the preliminary design phase was a plain bearing solution. In this solution a plain bearing would be fitted around the axle of the prams. And then the skis would connect to the plain bearings via a vertical support structure, see figure 23 for the basic idea.

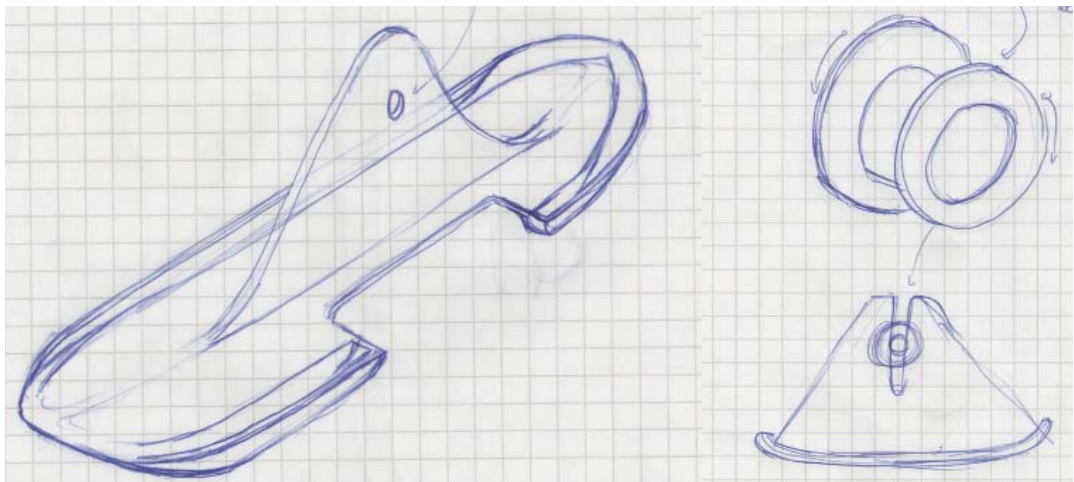


Figure 23: Early sketches showing the possibility of using a plain bearing around the axle of the pram to position the connection (Heikkilä 2013)

The plain bearing solution would most likely allow the whole ski, and the attachment, to be made from the same material. The sizes of wheel that would fit the plain bearing design depend on the height of the vertical support structure and on the groove in the structure to which the bearing is fitted into. This method of connection was mechanically the simplest solution in the preliminary design phase.

Depending on the girth of the axle, the whole plain bearing would have to be changed for every pram. The reason for this is that, unless the bearing precisely fits the axle, and thus grabbing onto it, the whole structure would be allowed to move freely from side to side along the axle.

4.1.4 Ski connected to the axle via a support cane

In the support cane version of the connection, seen in figure 24, the number of the connector canes, and the horizontal position of the canes from the ski to the pram axles differed from one idea to the next. The number of canes varied between one to three canes.

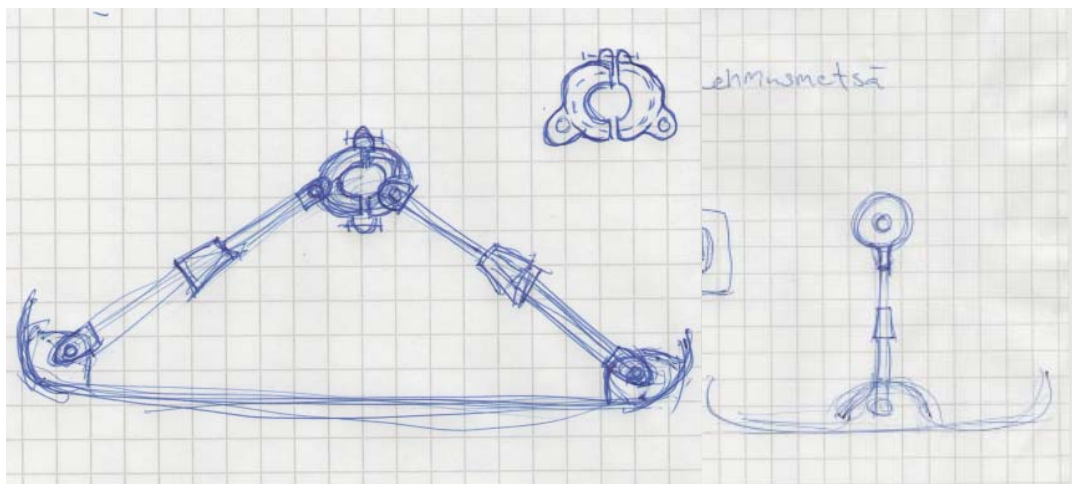


Figure 24: Two sketches of the ski concept with a support cane as the connection method (Heikkilä 2013)

The main idea in the support cane connection was that the length of the cane should be adjustable so that the wheel size of the connected prams could be varied. Because of this, the construction of the canes was designed to be telescopic, with a locking mechanism that enables the user to lock the length of the support cane to suit the target prams.

The support cane method of connection could actually be seen only as a secondary version of the plain bearing connection. That is because the support canes were connected to the axles via a plain bearing. So basically the support cane was merely a replacement for the vertical support structure in the earlier presented plain bearing connection. The differentiating feature between the bearings was that the bearing in the plain bearing version was built from two halves that screw themselves together and in the support cane option the halves of the bearing were bolted together.

4.2 Direction of concept

From the four different connection methods, the plain bearing solution was selected as the working concept for continued development because it was considered the most uncomplicated and economically viable option. The two different kinds of plain bearings from the plain bearing solution, and the connector from the support cane solution were fused to create a more flexible type of plain bearing during the continued development.

The three main ideas from the preliminary design phase that were kept alive were the screw type plain bearing construction, height adjustment by a groove in a horizontal plane, and the identical front and back ends of the ski. All three of these ideas can be seen in figure 25.

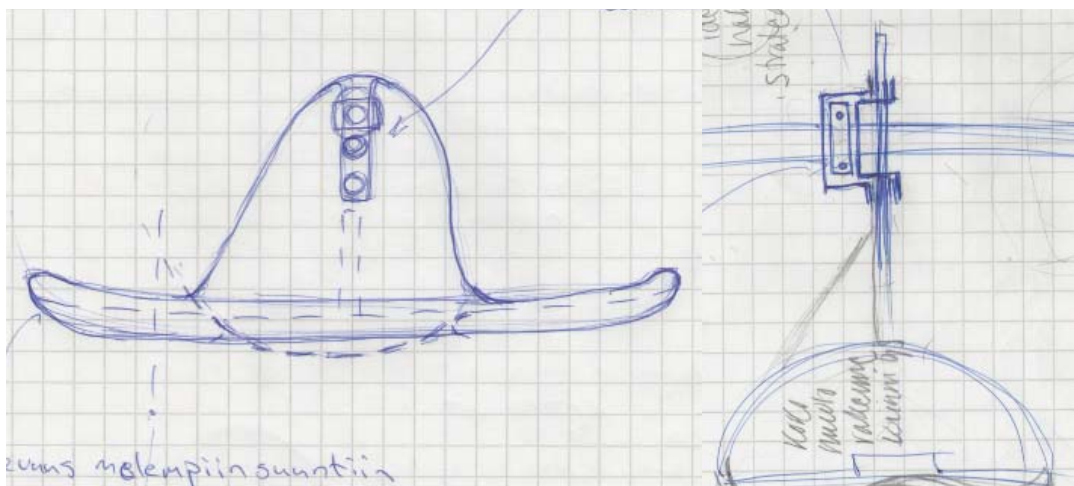


Figure 25: A sketch showing the main ideas that were selected to be used in the continued development of the concept (Heikkilä 2013)

At this point the development of the concept was divided into two main sections. The first section would concentrate on the connector design and aim to make it as universal as seemingly possible. The second part of the concept would then concentrated on the functionality of the ski itself.

5 THE CONNECTOR CONCEPT

Like it has been stated, connecting the skis directly to the wheel by straps or by other devices is not ideal. So one of first goals of the design was to find a different way of connecting the skis. An ideal solution would be to place the connector of some kind between the axle and the wheel bearing, because then the ski would always sit right next to the wheel. The problem with this ideal placement, as already stated earlier, is that most of the connections in modern prams are covered or the axle might even be used as a housing for a piston break. Because of these problems another place of connection needed to be found.

Because the prams on the market have very varying structures, quite a bit of background work had to be done to come up with a connection solution. Also because of the varying nature of pram chassis, it was decided that the product had to be designed to be only semi-universal.

5.1 Most common nominator

To have the connection of the skis to work on as many prams on the market as possible the goal was set to discover the most common nominator in the prams chassis. In the case of the turning wheeled prams the most common nominator turned out to be, according to the data collected, that there is either an axle or an support structure from round metal piping between the wheel pairs. If the wheels were turnable, the most common nominator turned out to be a bolt connector at the end of the axle. These conclusions were drawn by going around in baby pram dealers in the beginning of 2013 and by collecting data from the larger baby pram manufacturer websites. Selecting these nominators excludes most double-wheeled models out of the semi universality of the concept. This sacrifice

to the universality was done in order to keep the design of the add-on from getting too complicated. The double wheeled models represent only a nine percent cut of the models found during the study, see figure 26, so leaving them out of the target of the concept was seen as a worthy sacrifice

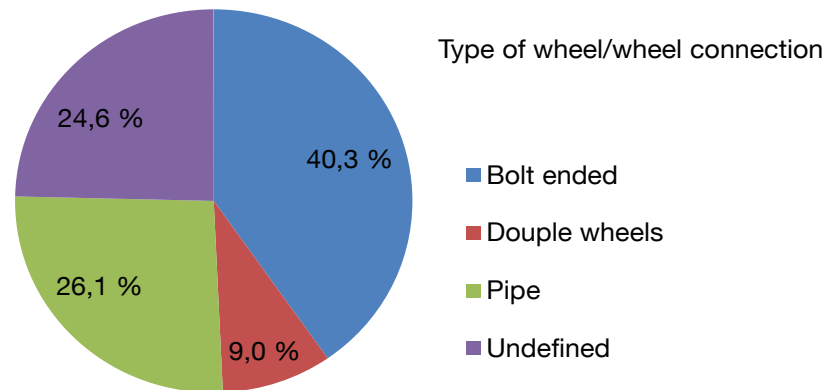


Figure 26: A pie diagram showing the percentages of different type of wheel connections found during the concept project (Heikkilä 2013)

Even though two main connection point types, bolt ended and pipe, can be seen from the data the size of the axles in the connections might vary quite much. Because of this the connector itself has to be designed to be adjustable.

5.2 The connection location

As stated in chapter 5.1 there two main nominators of wheel connections arose in the pram market. These two connection types, bolt ended and pipe, were thus selected as the main target that the connector concept would have to fit to.

Optimally the ski connector would be designed so that it allows the skis to orient themselves to the orientation of the ground. Because of this rotary movement, the centre of the skis rotation has to be designed to be on the midpoint of the wheels so there will be no possibility of the ski from locking with the wheel. Additionally to avoid the ski from locking to the wheel the concept was, at this point of the development, redesigned so that the wheel will not be coming through the ski, but it will sit next to it. This redesign will allow a larger selection of wheel sizes to be used with the ski.

5.3 The connection concept

The selected connection method, the plain bearing solution, went through many design rotations to work as well as possible with the selected connection locations. As mentioned before, the ideas from both of plain bearings used in the feasibility study were combined to come up with a completely new concept that would better fit the semi-universality goal of the concept design process. The results of these combined ideas can be seen in figure 27.

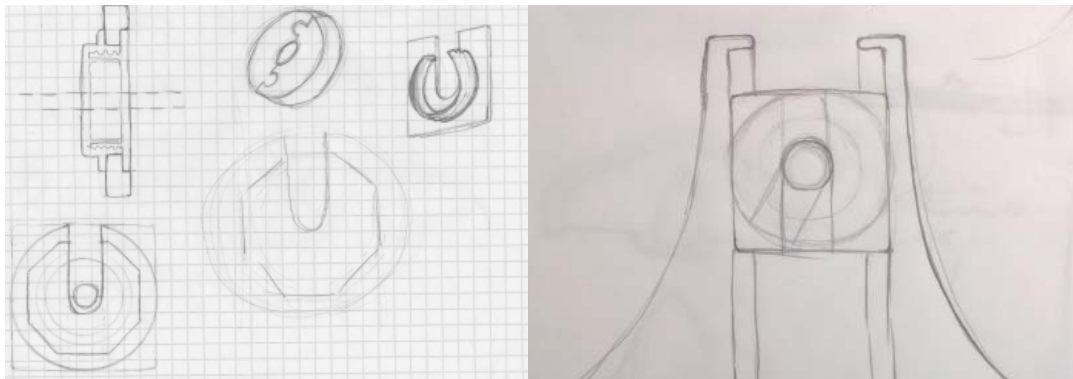


Figure 27: Sketches showing parts of the newly redesigned plain bearing connector (Heikkilä 2013)

The connection concept was designed so that it can be connected to various sized axles that exist by only swapping the innermost pieces of the plain bearing. The innermost piece therefore had to be designed so that it would be as cheap as possible to produce. In the beginning the innermost pieces of the bearing were connected to each others by a puzzle piece connection (see Figure 28). Later on this idea was scrapped from the concept to make sure that the pieces truly grab onto the axle that goes through them, and the puzzle connector was also seen as not durable enough for its intended use. Thus the puzzle connection was replaced by a nut and bolt connection. This same kind of screw connection is also used when attaching zinc rings to the propeller axles of boats. These axles revolve thousands of times per minute so this type of connection should therefore easily cope with the forces that are present in the intended pram usage.

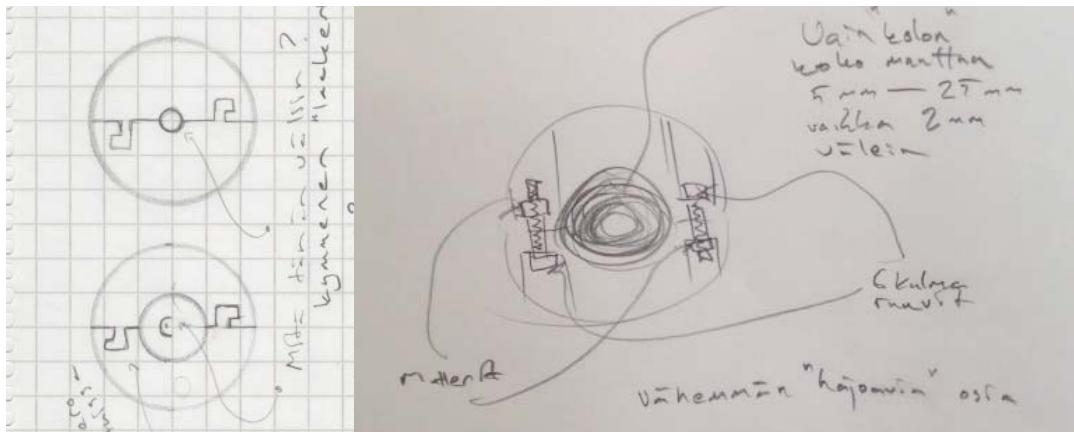


Figure 28: Sketches on the left showing the scrapped puzzle connection and the more durable nut and bolt connection option on the right (Heikkilä 2013)

The outside shell of the plain bearing connector was also redesigned multiple times to find the optimal shape. Some of these development versions can be seen in figure 29. Aspects that had to be considered in the shaping of the shell included the horizontal dimensions of the shell, the location of the shell in contrast to the groove that it will be fitted to, the contact area with which the shell will grab to the sides of the groove, and how the different connection targets will sit next to the connector.

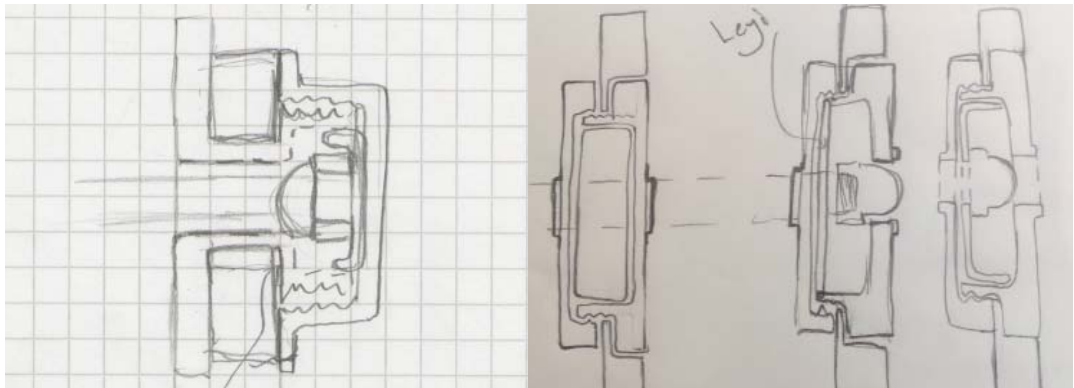


Figure 29: Cross section drawings showing different development versions of the connector shell (Heikkilä 2013)

6 SHAPE OF THE SKIS

When considering the shape of the bottom of the ski two main things effect the end result: the amount of needed lift, and the need for directional stability. Unfortunately, when shaping the base of the ski these forces are often conflicting. When adding grooves or guides to the base, or shaping the base to a more cutting shape the initial amount of contact surface is lost. And adversely when making the base to have the maximum area that touches the snow some directional stability is, in most cases, lost. In figure 30 can be seen some quite radically shaped early ideas for the shape of the ski bottom.

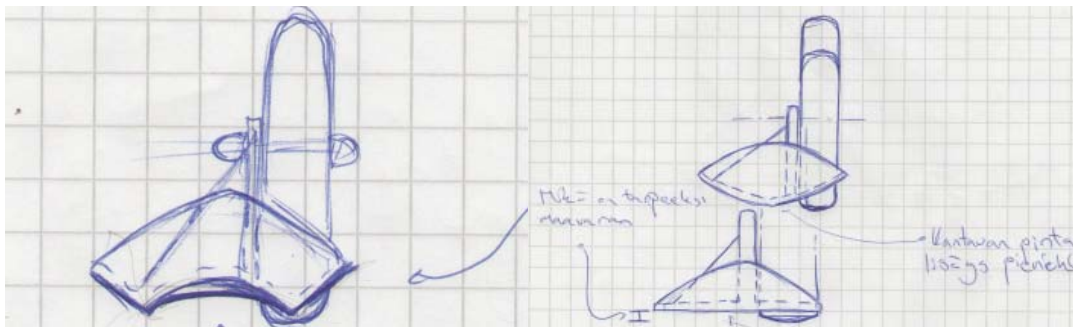


Figure 30: Some early sketches of the possible shape of the skis bottom shape (Heikkilä 2013)

6.1 Wheel location compared to the ski

In most of the early sketches for the concept design the wheel is drawn to go through the ski. This idea was used because it was seen that so the area that the prams take up would not be changed greatly and the stability of the prams would not get affected.

One of the strongest reasons this idea was scrapped from the concept is that the surface area lost by making a hole in the ski would most likely lessen the buoyancy of the ski too greatly. Some of the early ideas for the hole in the ski can be seen in figure 31. Furthermore the directional stability of the ski might become unpredictable because of the sides of the cut would break the glide of the ski.

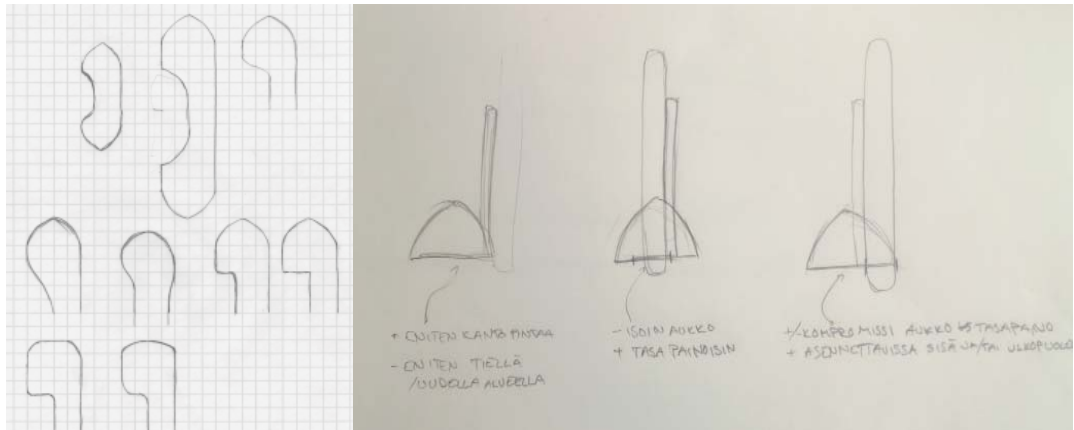


Figure 31: Sketches of the thought process behind the location of the ski in the concept design (Heikkilä 2013)

Later the ski was redesigned so that the wheel would run next to it, not through it. One of the most compelling reasons of doing this was to allow a the ski to be used with larger wheel sizes too making the concept more universal.

To have the ski work as universally as possible the connector plane was located off centre compared to the ski. This allows the end user to turn the ski around depending on how close to the wheel the connection point is.

6.2 The buoyancy or lift of the skis

When the ski touches the snow underneath two main forces, buoyancy and drag, affect how it will behave. Buoyancy is the force that keeps the ski from sinking to the material underneath and drag is the backward force that slows the skis down because of friction between the ski and the snow.

The buoyancy of any object can be calculated by using the Archimedes' principle. The principle mainly concern items wholly or partially submerged in a fluid. Even though snow only acts partially like a fluid since it has a crystallized structure the main points of the principle still apply. The main difference is that snow unlike water can be compressed. In short Archimedes' principle says that buoyancy = weight of displaced fluid.

The main point that should be derived from the principle is that the larger the ability of the ski to displace snow underneath itself the larger mass it can stop from sinking to the snow. Because there is no such thing as average snow, and the weight of the prams differ considerably, a true calculation of buoyancy is too complex for this thesis subject. Because of the almost impossible calculations for the buoyancy the concept design will aim to create a shape that forces the snow underneath the ski rather than ploughing the snow to the sides. This way the snow underneath will stay as packed as possible creating a more solid snow surface making the buoyancy a nonfactor. This packing snow idea is also the main idea when designing cross country skis for unbeaten snow. From the unbeaten snow skis could also be taken the idea that the ends of the skis should be high enough so that only a minimal amount of snow is allowed to flow above the skis.

6.3 Concerning directional stability

Not only do the skis have to be able to keep the pram wheels from sinking too deep into the snow but they will also have to be able to keep true on the course that the end user is pushing the prams to. If the bottom of the skis would be completely flat there could arise a danger that the prams start sliding sideways. By adding profile guides to the bottom of the skis the designer hopes to avoid such problems with the concept. The idea of profile guides is presented in Figure 31.

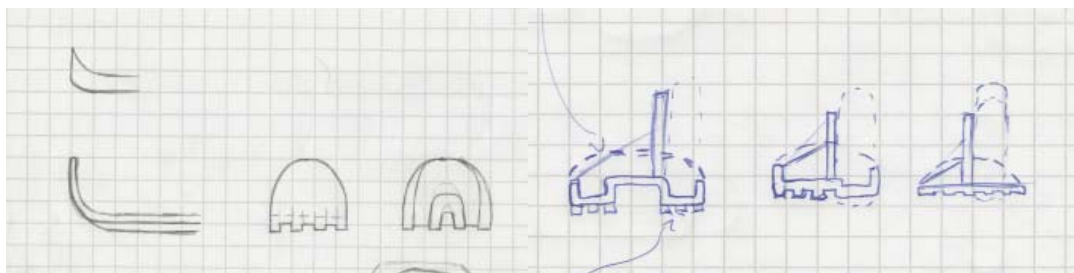


Figure 32: Early idea drawings for the profile guides (Heikkilä, 2013)

In order to select the most viable bottom profile for the skis a set of tests were conducted. The tests were done on a small snowy slope by moulding different kinds of bottom profiles and guides to the bottom of a pair

of mini skis. These test profiles were constructed by taping corrugated cardboard profiles with construction tape. The end results of these tests showed that having more than two guides did not increase the directional stability in quantities that would condone the added material usage and the added drag from the grown surface area.

6.4 Other types of skis in other uses

Because children are not the only ones that need to be transported in snowy conditions it was seen worthwhile to take some time to look at other ski uses to support the undergoing concept design process.

Other ski applications were searched from a various areas of transportation, including aviation, and personal transportation. The most promising findings will be gone through in the following chapters.

6.4.1 Snow landing skis for planes

The problematic fact that forces small planes to use skis in snowy conditions is quite close to the problem that this thesis aims to solve for pram usage. However, the connections in plane tires have a higher level of universality and the materials used differ greatly. Further more, the skis for planes can be manufactured by order whereas this thesis aims to create a semi-universal concept solution that could be mass manufactured.



Figure 33: A typical snow ski for small aeroplanes (Ultralight News, 2013)

The typical small aeroplane landing ski ,as seen in Figure 33, uses some of the same ideas, that were used in the beginning of the creation of this

thesis concept. Mainly the idea that the wheel goes partially through the ski. This shows that in some use cases the idea have worked.

6.4.2 Seaplane skis

Because of the lack of any proper side traction the bottoms of the seaplane skis have a varying number of longitudinal guides to add directional stability. The skis are also shaped more like boats or ploughs. Both of these design details can be seen in Figure 34.



Figure 34: A typical shape used in the undersides of seaplane skis (Break-water ski school, 2013)

The curved shape between the guides also adds to the directional stability of the skis. This detail was taken note of when shaping the final design concept.

6.4.3 Snow mobile skis

When designing the concept a considerable amount of time was taken to study the construction of snowmobile skis because of the snowmobile skis are roughly in the same size bracket where the final concept aimed at.

One idea that was taken, for a short time, from the snow mobile skis to the pram ski concept was the addition of a handle at the end of the ski that the end user could use if the prams would fall to some really hard places like ditches or other deeper crevices. Seeing how this addition would make the manufacturing of the concept much more complex the idea was

pretty soon scrapped. The snow mobile variation of this handle can be seen in figure 35.



Figure 35: A typical snowmobile front ski with a handle for pulling the snowmobile out of tricky spots (Moto Seinäjoki, 2013)

The main problem with the adding of the handle to the ski would have been that if the handle would have been in front of the tip of the ski it would have made the ski tremendously larger, and if the handle would have been inside, or on top of the ski the tool needed to create the ski would have become harder to manufacture (See chapter 8.2). Some early ideas for adding the handle to the ski concept can be seen in Figure 36.



Figure 36: Some idea sketches of the possibility of adding a handle to the pram ski concept (Heikkilä 2013)

7 SELECTED PARTS FOR THE PRODUCT

In the end the selected parts, from the ski development, and from the connection design development phases of the concept process were put together to form one cohesive product concept. At this point the development of the concept was also moved mainly from pen and paper to a computerized solution to finalize the scale of the product.

7.1 Results of ski shape

The final shape of the ski was intentionally kept as simple as possible to allow low manufacturing costs for the concept. If the concept would ever be taken in to manufacturing is another question.

Two additional support planes were added to the horizontal supports. These should make the construction of the connector plane more sturdy to prevent the supports from twisting apart from the skis. On both sides of the vertical supports, guides were also added to force the connector to follow the right track and stop it from spinning while tightening the connector. All of the additions mentioned above can be seen in Figure 37. The whole ski part of the concept was designed so that it can be manufactured from one part, and hopefully with a so-called natural mould.

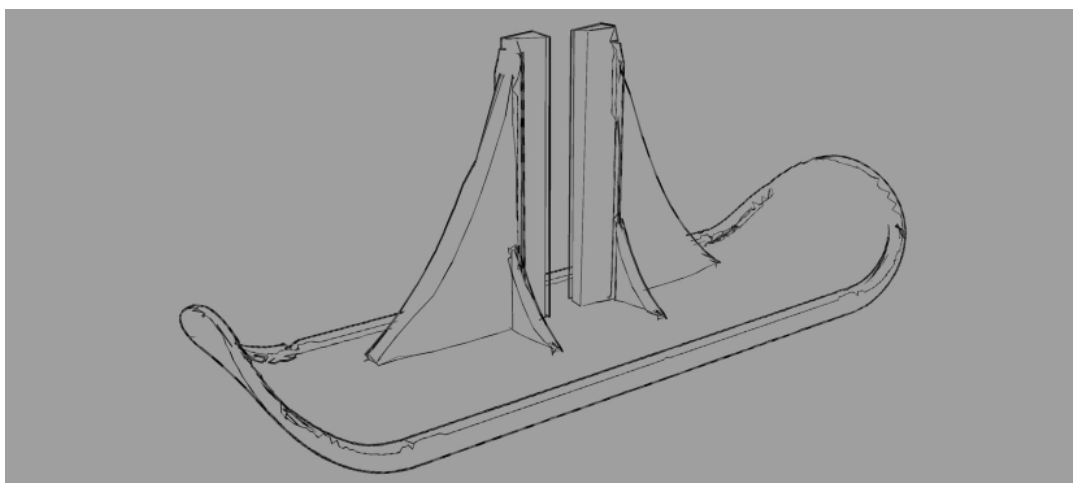


Figure 37: Sketch rendering of the final ski concept showing the added supports and guides on the main support planes (Heikkilä, 2013)

The final dimensions of the ski ended up as 400 mm of length and 120 mm of width. The bottom of the ski is shaped convexly, the shape is shown in Figure 38, to include the idea of packing snow under the ski for support and directional stability (see chapter 6.2).

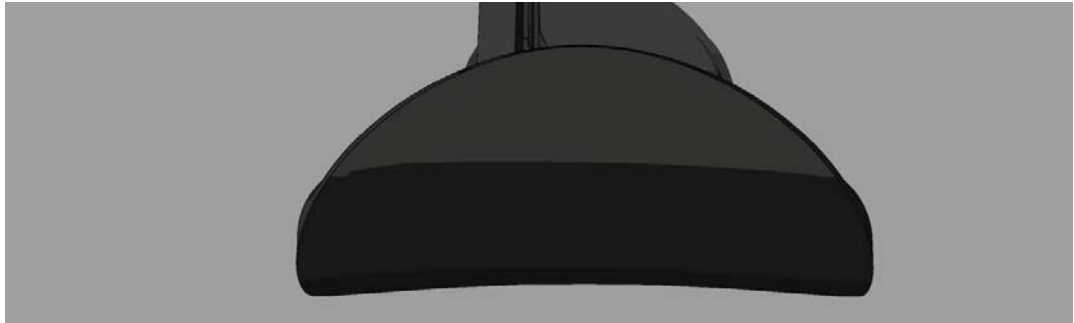


Figure 38: A rendered image of the ski part alone showing the small convexity of the ski bottom (Heikkilä, 2013)

7.2 Results of connection designs

The final concept version of the plain bearing connector has four main pieces, the two outer shell parts that screw together, and the two different bearing inserts that are used depending on the connection point of the skis to the prams used.

The two pieces of the connector shells, shown in Figure 39, did not go through as dramatic redesigning in this later stage of the concept design, as the plastic bearing inserts, but still the outer shell had 11 cylindrical turning aids added to the outside surface to help the tightening of the bearing.

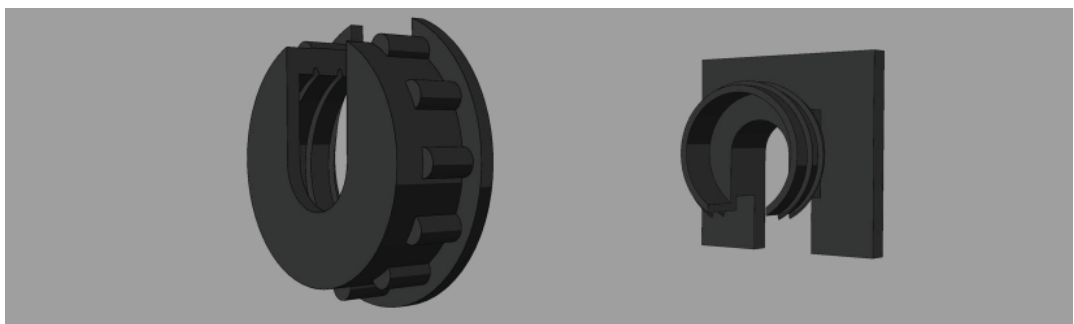


Figure 39: The two final concept pieces of the shell of the plain bearing connector (Heikkilä 2013)

During the final stages of the concept design process the sizing problem of the plain bearing connections inserts was solved by cutting the insert into layers, seen in Figure 40, that connect to each others via studs that stop them from revolving around. This idea allows the connection to be used with axles ranging from 5mm to 16 mm in 1 mm increments.

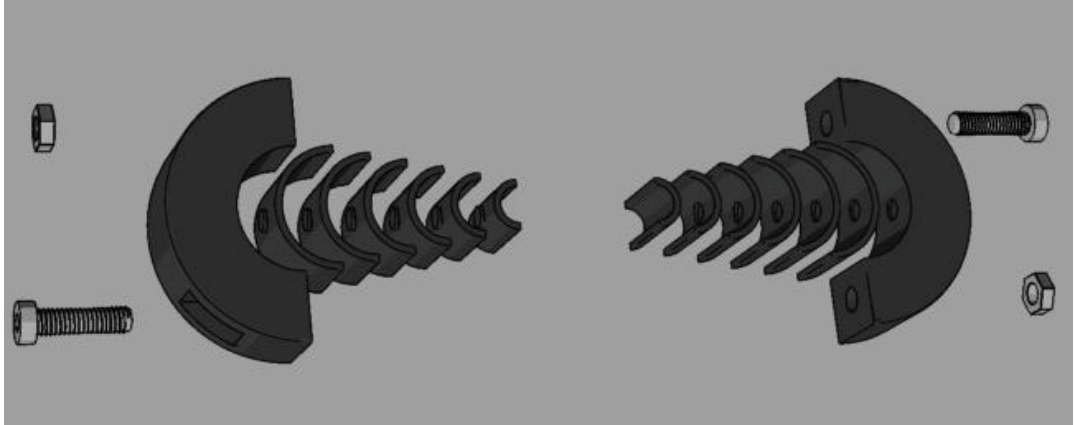


Figure 40: Exploded view of the layered plain bearing connector showing the stud connections between the pieces (Heikkilä, 2013)

The fourth and final main piece of the connector is only used, instead of the plastic inserts, when the connector is used to connect the skis to bolt ended axles. This piece, seen in Figure 41, had the least re working done after the initial conception. This version of the plain bearing insert would be manufactured from a metal to make it strong enough to cope with the added torsion caused by the different weight point of the prams.

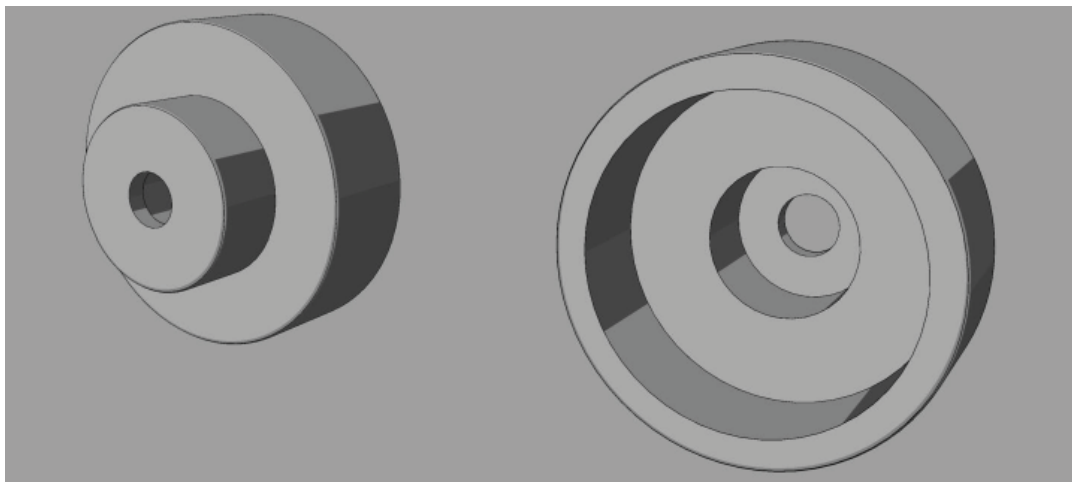


Figure 41: Two sides of the metallic version on the plain bearing insert (Heikkilä, 2013)

8 COMBINING THE SKI AND THE CONNECTION

8.1 Making it look pretty

While the nature and execution of the problems in this concept are mainly technical the need for the concept to look pretty in the eyes of the end users should not be taken lightly. Especially when it comes to add-ons they easily become an eyesore if the looks of the product are not fully thought out.

The ends of the ski were drawn to be round to suit the design style of modern prams. The ends also rise quite abruptly so that the skis would not make the area that the prams need even larger than necessary. The curves on the horizontal support structures were added so that the shape would look similar to the shape of the curve of the ski itself.

If the skis would go into production they would most likely be coloured black so that they would not stand out from most of the pram wheels.

8.2 Possible manufacturing method and the consequences to the design

Depending on how the concept would be manufactured some changes might be necessary to be made to the concept. Some of the possible methods, and their consequences to the concept, will be looked at in the following paragraphs.

8.2.1 Injection moulding

Injection moulding would probably be the main candidate of manufacturing this type of concept, because the more of the same product is produced the cheaper per unit the concept would become to produce. The cost of starting the production is however quite big, because of high costs of tooling the moulds (Injection moulding 2009). For this reason to start manufacturing this concept the manufacturer would probably need a ready order base to get financing for the concept.

To produce the concept with injection moulding technique the model would have to be fitted with drafts angles that would allow the produced parts to free themselves from the moulds. See figure 42 for the basic idea of the draft angle.

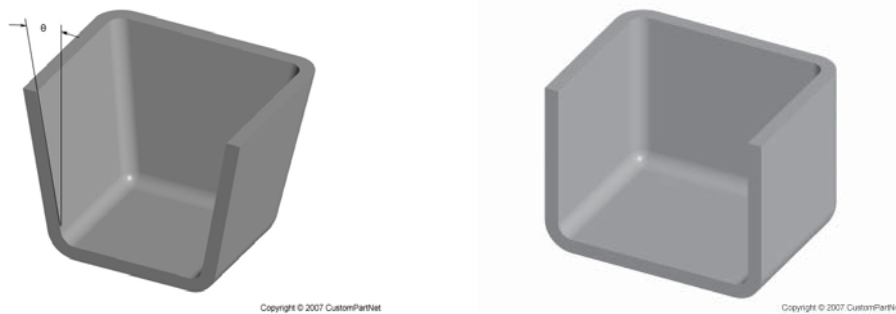


Figure 42: One part with and without the draft angles applied to it (Custompart.net)

If the concept would be manufactured by injection moulding the final material would most likely be polypropylene for it has many properties that are needed in the concept including lightweight, heat resistance, high chemical resistance, scratch resistance, toughness, and stiffness, and low cost (Injection moulding 2009).

8.2.2 Rotation moulding

Unlike with injection moulding rotation moulding moulds are relatively cheap to manufacture making the instant needed investment into the production smaller. However rotation moulding is at its best when making hollow pieces (Crawford & Kearns 2003), so manufacturing this concept with rotation moulding might not even be possible, or then the concept would have to be drawn again to incorporate some hollow areas. In the case of this concept these hollow areas would most likely be placed inside the vertical support planes, for they are the thickest areas of the concept. And as the concept model stands right now some thicknesses in the supports exceed the ideal range of 6.4 mm (Beall 1998).

If the concept how ever could be manufactured by rotation moulding it would again need to have draft angles (see chapter 8.2.1) added to it. With

rotation moulding the draft angles do not need to be as large as with injection moulding, but to not to have to use release agents it is recommended to design them into the products.

8.2.3 3D printing

By manufacturing the concept by 3D Printing no additional changes would have to be made for the concept. And every time that a change would come to the designers mind it could be taken into action already in the next model printed. However the costs of manufacturing any number of products by 3D printing is still quite high.

At the moment 3D printing should mainly be seen as a way to try out the usability and functioning of the concept. For this reason the locking mechanism of this concept was indeed printed (see chapter 8.3).

8.3 testing of the prototypes

The mock-up prototype for the ski concept was hand made from cardboard by bending the cardboard to shape and then hot glued together. This was done to test the fitting of the concept underneath different prams. The ski prototype unfortunately was not done in a way that a real on snow test of the skis added lift could have been done. However the ski did fit under the prams that were available to be tested with. Even if the test pram had a foot break, thanks to the curvature of the vertical support plane the break was still usable. The fitting of the mockup can be seen in Figure 43.



Figure 43: Picture showing the connector connected to Hauck prams (Heikkilä 2013)

As can be seen from figures 43, and 44 the ski does fit under the test prams. The pram in Figure 43 has double wheels in front, and a round metal support in between the back wheels. Because of this the skis can only be attached to the back of the pram. The space between the skis is quite small when the skis are connected in between the wheels but a small walking test showed that the user still has adequate leg room to walk with even with the ski attached.



Figure 44: Two photographs from different directions showing the mock-up prototype ski and the 3d printed connection connected to a bolt type connection on a turning pram wheel (Heikkilä 2013)

A prototype version of the locking mechanism was manufactured for testing purposes of the final concept version. This prototype can be seen in use in Figures 43, and 44. The mechanism prototype was 3D printed using a Objet Eden 260V printer. The prototypes fitting was tested to several prams, including prams by Hauck, and Hartan.

The 3D printed prototype was relatively easy to connect to the test prams. However if future models would be made the screw tracks that connect the shell pieces together should be made larger for easier screwing and the outermost insert smaller so that it would fit more easily inside the shell.

9 CONCLUSIONS AND FINAL RESULTS

After seeing that the prototypes were functional, to the extent of their limitations, it can be said that the conception process was a success. For the concept to move forward, to the detailed design phase (Chitale & Gupta 2007), from this level, a true working prototype would have to be manufactured and tested in mid winter conditions. The prototype versions of the concept made during this thesis project (see Figure 45) can not unfortunately be used for this purpose..



Figure 45: A photograph showing the final connection concept 3d prints and the mock-up prototype of the ski (Heikkilä 2013)

The detailed design phase for the concept would also have tests for mechanical strengths so that it would be safe to start manufacturing, advertising, and selling the concept. The drawings of the final concept that would be tested in this phase are attached as appendixes of this thesis. Even as the drawings are called final at his point of the conception an allowance of redesigning of parts should still be allowed for the detailed design phase (Chitale & Gupta 2007).

The connection concept will most likely be idea protected in the national board of patents and registration so that the creator of this thesis might come back to the idea for future development and productization. Most likely with an associate who has more knowledge of the production and sales of this kinds of products.

In the mind of the designer of this concept the aim of this thesis project was met: to create a concept that would help the use of prams during snowy conditions so that the end user does not have to remove the skis when the snow underneath runs out. The final concept in idea is quite close to the idea of the Axso pram ski, as both the concept ski and the Axso pram ski rely on the idea that having two skis per pram is quite enough in suburban areas. But it could be said that the idea in this concept has been taken some steps further at least when it comes to the usability of the idea.

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LIST OF FIGURES

Figure 1: Answers to the first question show that the end users have problems with their prams during snowy seasons.

Figure 2: The end users would be interested in a product that is more versatile than the ones on the market at the moment.

Figure 3: The end users have not found the existing ski concepts in large numbers.

Figure 4: Patent picture by Key and Key showing the idea for a stroller ski that rotates around the wheel. Source Key and Key, 2002 Conversion sled for stroller wheels. USA.Pat. 6824148 [Online] Available from: <http://www.freepatentsonline.com/68241480large.jpg> [Accessed 01 March 2013]

Figure 5: The Swedish made Axso pram ski with and without the pram wheel inserted into the ski.[Online] Axsolution. 2013 Company homepage Available from: <http://axso.se/en/axso-strollerskis.html> & <http://axso.se/en/axso-strollerskis.html> [Accessed 02 January 2013]

Figure 6: The huge HTSuksee pram skis showing the adorable pink colour and the connection requiring several straps per ski. [Online] HTSuksee. 2013. Company homepage. Available from: <http://www.htsuksee.fi/data/uploads/vaunut.png> and http://www.htsuksee.fi/data/uploads/101_0110.jpg [Accessed 15 February 2013]

Figure 7: The Canadian Premiere Ski showing the wide variety of wheel sizes, and types the skis that can be attached to them. [Online] Premiere ski. 2013. Company homepage. Available from: http://www.premierski.ca/images/thum/P1070891_thum.jpg and http://www.premierski.ca/images/thum/P1070886_thum.jpg [Accessed 15.02.2013]

Figure 8: This quite usual front wheel fender type prevents the use of Premiere Skis. [Online] Premiere ski. 2013. Company homepage. Available from: <http://www.premierski.ca/images/attention.jpg> [Accessed 05.03.2013]

Figure 9: Safe start stroller ski in use in various sized wheels. [Online] Babeaze. 2013. Company homepage. Available from: http://babeaze.com.au/images/products/out--about/st_47862.jpg and <http://babeaze.com.au/images/products/snow-products/skis.jpg> [Accessed 15.02.2013]

Figure 10: While designed for pushchairs the Wheelblades aims at resolving the same problem; small front wheel get stuck in snow [Online] Wheelblades GmbH. 2013. Company homepage. Available from: http://www.wheelblades.ch/wheelblades-wAssets/img/Anwenderfotos/weblication/wThumbnails/1_wheelblades-7cfaee18eb612f189de3c9db54486a26.jpg [Accessed 15.02.2013]

Figure 11: The Seed PLI prams showing the two strap per ski to wheel connection. [Online] Seed Europe GmbH. 2013. Internet magazine. Available from: <http://designapplause.com/wp-content/xG58hlz9/2010/08/seed-ski1-150x150.png> [Accessed 15.02.2013]

Figure 12: Traditional kick sled for one passenger plus one pusher. Available from: <http://www.akaslompolosportshop.fi/static/media/images/0d/300x300/0d48ab32fb575e87e2d3f324a3b41106.jpg> [Accessed 21.02.2013]

Figure 13: Sled for smaller children or babies. Available from: <http://www.orthexgroup.fi/C4/imgnew/960x706/23890.jpg> [Accessed 21.02.2013]

Figure 14: Toboggan in use. Available from: <http://www.hikingtravelhit.fi/kuvat/lapsipulkka.jpg> [Accessed 21.02.2013]

Figure 15: A modern baby carrier that can be carried on the back or in front of the user. Available from: <http://www.pursepage.com/wp-content/uploads/2007/09/gucci-designer-baby-carrier.jpg> [Accessed 21.02.2013]

Figure 16: The baby wrap i use. Available from: <http://www.carrymeaway.com/images/Eggplant-Organic-Moby-Wrap-Baby-Sling-Igo.jpg> [Accessed 21.02.2013]

Figure 17: The original sketch that was the starting point of this thesis project. Showing a one piece ski connected next to the wheel.

Figure 18: A simplified cross section of a quick release system, locked on left, and open on right.

Figure 19: An early sketch showing ideas of how to connect the ski to the wheel by the use spools or ball connectors in various configurations.

Figure 20: A sketch showing a promising idea of adding the wheels again to the base of the ski add-on.

Figure 21: A sketch showing a four and three spool connection of the ski to the wheel via two or one adjustable support canes.

Figure 22: A 2d sketch showing the possible variable wheel sizes and the construction of the second spool solution.

Figure 23: Early sketches of a possibility of using a plain bearing around the axle of the pram to position the connection.

Figure 24: Two sketches of the ski concept with a support cane as the connection method.

Figure 25: A sketch showing the main ideas that were selected to be used in the continued development of the concept.

Figure 26: A pie diagram showing the percentages of different type of wheel connections found during the concept project.

Figure 27: Sketches showing parts of the newly redesigned plain bearing connector.

Figure 28: Sketches on the left showing the scrapped puzzle connection and the more durable nut and bolt connection option on the right.

Figure 29: Cross section drawings showing different development versions of the connector shell.

Figure 30: Some early sketches of the possible shape of the skis bottom shape.

Figure 31: Sketches of the thought process behind the location of the ski in the concept design.

Figure 32: Early idea drawings for the profile guides.

Figure 33: A typical snow ski for small aeroplanes. Available from: <http://www.ultralightnews.ca/aircraft-skis/> [Accessed 19.03.2013]

Figure 34: A typical shape used in the undersides of seaplane skis. Available from: http://www.breakwaterski.com/seaplane_waterlift.htm [Accessed 19.03.2013]

Figure 35: A typical snowmobile front ski with a handle for pulling the snowmobile out of tricky spots. Available from: <http://www.moto-seinajoki.fi/gripper-suksi-musta-hinta1kpl-p-398825.html> [Accessed 19.03.2013]

Figure 36: Some idea sketches of the possibility of adding a handle to the pram ski concept.

Figure 37: Sketch rendering of the final ski concept showing the added supports and guides on the main support planes.

Figure 38: A rendered image of the ski part alone showing the small convexity of the ski bottom.

Figure 39: The two final concept pieces of the shell of the plain bearing connector.

Figure 40: Exploded view of the layered plain bearing connector showing the stud connections between the pieces.

Figure 41: Two sides of the metallic version on the plain bearing insert.

Figure 42: One part with and without the draft angles applied to it. Available from: <http://www.custompartnet.com/wu/InjectionMolding#tooling>. [Accessed 08.04.2013]

Figure 43: Picture showing the connector connected to Hauck prams.

Figure 44: Two photographs from different directions showing the mock-up prototype ski and the 3D printed connection connected to a bolt type connection on a turning pram wheel.

Figure 45: A photograph showing the final connection concept 3d prints and the mock-up prototype of the ski.

APPENDICES

Appendix 1: Screen captures of the original questionnaire pages.

Appendix 2: Table of the original answers given to the questionnaire.

Appendix 3: Measure drawing of the final ski concept

Appendix 4: Measure drawings of the final plastic insert concept

Appendix 5: Measure drawings of the final metal insert concept

Appendix 6: Measure drawings of the final connector cover concept

Appendix 7: Measure drawings of the final connector base concept

Kysely rattaiden talvikäytöstä

Vastaamalla seuraavaan kyselyyn autat Kymenlaakson ammattikorkeakoulussa muotoilua opiskelevaa yhden lapsen isää tekemään oppinäytetyötään.

Vastaamiseen menee vain noin 5 minuuttia.

Vastauksia otetaan vastaan tammikuun loppuun asti.

Kiitos!

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Kysely rattaiden talvikäytöstä

Tausta tietoja

Montako lasta perheeseenne kuuluu?

- 1
 2
 3
 4 tai enemmän

Miten tällä hetkellä kuljettatte lastanne/lapsianne talvisin?

- Rattaissa
 Pulkassa / muussa vastaavassa
 Kantoliinassa / muussa vastaavassa
 Auton turvaistuimessa
 Muu:

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Kysely rattaiden talvikäytöstä

*Pakollinen

*1. Onko teillä ollut rattaiden talvikäytössä ongelmia? **

Esim. suuren lumimäärän takia.

- kyllä
 Ei

1b. Jos on millaisia?

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Kysely rattaiden talvikäytöstä

2. Oletteko aktiivisesti etsinyt ratkaisua rattaiden talvikäytön ongelmiin?

- Kyllä
 En

2b. Millaisiin ratkaisuihin olette törmännyt?

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Kysely rattaiden talvikäytöstä

3. Oletteko mahdollisesti törmännyt rattaiden renkaisiin kiinnitettäviin jalas ratkaisuihin?

- Kyllä
 En

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Kysely rattaiden talvikäytöstä

4. Mitä olisitte valmis maksamaan talviapuvälineestä rattaisiin?

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Kysely rattaiden talvikäytöstä

5. Olisitko kiinnostunut/kiinnostuneempi rattaiden jalas ratkaisusta jos jalkset voisi jättää paikoilleen kun lumi rattaiden alla loppuu?

esim. siirtyessäsi sisätiloihin; kauppaan, bussiin jne.

- Kyllä
 En

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Kysely rattaiden talvikäytöstä

6. Lisäisikö tuotteen kotimaisuus mielenkiintonne tuotetta kohtaan?

- Kyllä
 Ei

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Kysely rattaiden talvikäytöstä

Kiitos ajastanne jonka käytitte vastaamiseen.

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Älä koskaan lähetä salasanaa Google-lomakkeiden kautta.

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1. Onko teillä ollut rattaiden talvikäytössä ongelmia?	1b. Jos on millaisia?	2. Oletteko aktiivisesti etsinyt ratkaisua rattaiden talvikäytön ongelmiin?	2b. Millaisiin ratkaisuihin olette törmännyt?	3. Oletteko mahdollisesti törmännyt rattaiden renkaisiin kiinnitetäviin jalas ratkaisuihin?	3b. Oletteko mahdollisesti kokeillutkäytännön ko. tuotteita/jotain sen kaltaista?	3c. Mitä mieltä olitte jalaksien toimivuudesta?	4. Mitä olisitte valmiis maksamaan talviväpöilyineistä rattaisiin?	5. Oisitteko kiinnostunut/kiinnostuneempi rattaiden jalas ratkaisuihin jos jalat voisi jättää paikalleen kun lumi rattaiden alla loppuu?	6. Lisäisikö tuotteen kotimaisuus mielenkiintoa tuotetta kohtaan?	Montako lasta perheeseenne kuuluu?	Miten tällä hetkellä kuljettatte lastanne/lapsenne talvisin?
Kyllä	Kovina lumisadepäivinä haasteita asettavat auralautojen jättämät kinnokset esim suojaiteiden varsilta. Lumessa pystyy puskemaan muuten voimalla, mutta noista ei pääse.	En		Kyllä	En		40	Kyllä	Kyllä		1 Rattaissa
Ei				En			50 eur	Kyllä	Kyllä		3 Auton
Ei				En			En mitään.	En	Ei		1 Rattaissa, Auton
Ei				En			50-80e	Kyllä	Kyllä		1 Rattaissa, Auton
Ei				En				Kyllä	Kyllä		1 Rattaissa, Auton
Ei				Kyllä	Kyllä	Pyöräkärri Chariot Cougarissa on jalakset. Käytetty hiihtäessä, jolloin toimivat hyvin vedettäessä. Työntäminen ei onnistuisi, sillä kiinnityksen jouston vuoksi etupää laskeutuisi maahan (pysähdyttäessä). Eivät myöskään toimita linja-autoa käytettäessä.					1 Rattaissa
Ei				Kyllä	Kyllä		50e. Tarve peikille jalaksille kaupunkioissa jäisi kovin vähäiseksi ja liikkuminen julkisilla ja sisätiloissa vaikeutuisi. Lisäosan pitäisi olla ERITTÄIN helposti vaihdettavissa pyörään (jopa helpommin kuin Chariotissa).	Kyllä	Kyllä		1 Rattaissa
Kyllä	Teiden avaraamattomuus teettää haasteita, samoin matkarattaiden käyttö mahdollonta talvella suurem lumimäärän vuoksi	En	Sukset vaunujen alla olisivat näppärät	Kyllä	En		30 euroa	Kyllä	Kyllä		Rattaissa, Pulkassa / muussa vastaavassa, Auton turvatuimessa
Ei				Kyllä	En			En	Ei		1 Pulkassa / muussa
Kyllä	välillä on liikaa lunta ja ei liiku rattaat kunnolla	En	sitoo rattaisiin kiinnitää mukavaa vetcapua	En				40	Kyllä	Kyllä	/ muussa vastaavassa, 1 Kantolinassa /
Kyllä	Renkaat ei kulje kun on lunta avaraamatta	En		En			30 euroa	Kyllä	Kyllä		Pulkassa / muussa vastaavassa
Ei				En			20 euroa	Kyllä	Kyllä		3 Rattaissa, Pulkassa
Ei				Kyllä	En		isopyöräiset rattaat	Kyllä	Ei		2 Rattaissa, Pulkassa
Ei				En			10	Kyllä	Ei		1 Rattaissa, Pulkassa
Ei				En			30	Kyllä	Kyllä		1 Rattaissa, Pulkassa
Kyllä	Lumi tarttuu etupyöriin (lokasuojien väliin) ja lumittaa ne.	En		Kyllä	En		35 eur	Kyllä	Kyllä		1 Rattaissa
Kyllä	Etupyörä vapaanaollessa menee omia teittään, lukittuna ei ongelmaa.	Kyllä	etupyörän lukitseminen	Kyllä	En						Rattaissa, Pulkassa / muussa vastaavassa, Auton turvatuimessa
Kyllä	auraamaton tie ja ns. irtolumi - raskas työntää, ei kunnolla pitoa. Pari kertaa tämän talven aikana kohdannut ongelmaan, ei siis jokapäiväistä vaihtoa.	En		En				en koe tarvitsevani niin paljon että hankkisin.	Kyllä	Kyllä	Rattaissa, Pulkassa / muussa vastaavassa, Auton turvatuimessa
Kyllä	Auraamattomat tiet tai kinnokset joiden yli ei rattailla pääse	En	Jalaksiin jotka voi kiinnittää pyörään alle	Kyllä	En		20-50€	Kyllä	Kyllä		3 Rattaissa
Ei				En			noim 50euroa	Kyllä	Kyllä		1 Rattaissa, Pulkassa
Kyllä	liian pienet renkaat, eivät jaksaa mennä lumikinnosten läpi ei ole aurattu	En		En			50 e	Kyllä	Kyllä		Rattaissa, Pulkassa / muussa vastaavassa
Kyllä	välillä huonosti auratut tiet hidastavat matkaa tai estävät kulun kokonaan	En		En			30e	Kyllä	Kyllä		1 Rattaissa, Auton
Kyllä	Aurausvalit kulkuväylillä (esim. suojaiteiden reunat)	En		En				100	Kyllä	Kyllä	Rattaissa, Pulkassa / muussa vastaavassa, Auton turvatuimessa
Kyllä	renkaat tuppaa jumittumaan hanteen	En		En				0	Kyllä	Kyllä	1 Rattaissa
Kyllä		En		En				50	Kyllä	Kyllä	1 Rattaissa
Ei	Jalkakäytävien huono huolto. Ei ole aurattu kaikkialta ollenkaan, tai esim. vain hyvin kapealta alueelta. Lisäksi suolaamisen takia lumi on usein muhjuu, jossa rattailla on raskas työntää.	Kyllä	Olen vähentänyt rattaiden käyttöä, lisännyt lapsen kuljettamista kantorepussa. Olisi tosin hyvä laittaa myös teiden kunnossapito-osastolle palautetta, niin voisi jalkakäytävien tilanne muuttua joskus tulevaisuudessa.	En	En		max. 50 euroa (ostaisin varmaan itse käytettynä)	Kyllä	Kyllä		Kantolinassa / muussa vastaavassa
Ei				Kyllä	En		50e	Kyllä	Kyllä		2 Rattaissa
Kyllä	rattaiden työntäminen lumessa käy voimalle, etenkin tänä talvena kun lunta on usein tullut "ryöppyinä" eikä kaupungin avarauskalusto pysy perässä. avaraamattomilla teillä meno on ärsyttävää.	En	edelliseen: mies on niitä katsellut :)	Kyllä	En	vaikuttaa hankalalta eestaa venkslaamisella nämä rykyratkaisut	50e	Kyllä	Kyllä		Rattaissa, Pulkassa / muussa vastaavassa, Auton turvatuimessa
Kyllä	lunta ei aurata kunnolla jalkakäytävillä, isoja kinnoksia jätetään kulkuväylien eteen	Kyllä	pidän oman lapion rattaissa jolla ravaan tietä jos tulee este joka on voitettavissa	En	En		no ehkäpä ne jalakset	Kyllä	Kyllä		Rattaissa, 2 tuplarattaissa
Ei				Kyllä	En		?	En	Kyllä		1 Rattaissa, Pulkassa

