MASTER THESIS NOV. 2021 INDUSTRIAL DESIGN, AALBORG UNIVERSITY MSc4-ID4 MARIA HAUGAARD ANDERSEN

TRINI

PRODUCT REPORT

TITLE PAGE

Title	**Trini**
Theme	**Master Thesis**
Project start	**01/02-2021**
Submission	**25/11-2021**
Project team	**MSc04 - ID4**
Main supervisor	**Nis Ovesen**
Co-supervisor	**Michael Skipper Andersen**
Report type	**Product report**
Pages	**31 (incl. technical drawings)**

Maria Haugaard Andersen

ABSTRACT

This report showcases Trini, a stepladder created to help the in-home daycare workers in their diaper changing routine to minimize work-related injuries. The report presents how Trini works and looks, and the overall most important aspects from the creation of it.

TABLE OF CONTENTS

PREPHASE

TECHNICAL DRAWINGS

INTRODUCTION

Trini is the product solution created on the 10th semester, Master Thesis on Industrial Design at Aalborg University. The stepladder Trini is created to assist the daycare workers in their daily routine of diaper changing the children, which on average requires the daycare workers to lift each child up to 8 times during a workday. Having to take care of 3-5 children 5 days a week results in a lot of diaper change where the daycare workers must lift the children up and down from the changing mat, resulting in work related injuries. Trini therefore gives the children the possibility to crawl/walk up and down from the changing mat themselves. This not only relieves the daycare workers from having to lift the children, but also strengthens the children's motor skills and general learning environment.

DIAPER CHANGE IN CONFINED SPACES

When the in-home daycare workers on a daily basis change the children's diapers, they are put into danger. The children varying from 6,5 months to 3,5 years can weigh between 6,5 and 19 kilos and are in total being lifted up to 70 times on an average workday with 5 children. This results in the daycare workers distorting their bodies and getting work related injuries, as they have to lift the children both up and down from the changing mat. None of the existing solutions on the market solve the problem of minimizing the lifts needed for diaper changing, as they either do not fit into the daycare workers private confined diaper changing spaces of 5-8 square meters or are too expensive. The daycare workers are therefore left with neck, shoulder, and back pain.


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TRINI

Trini is a foldable stepladder created to help the daycare workers in their day-to-day diaper changing routine, to avoid work-related injuries. The stepladder works by enabling the children with different abilities to get onto the changing mat, this includes even the smallest children who is just learning to crawl properly and the bigger children ready for kindergarten who can walk and run stably.

The daycare workers choose themselves if they wish to fold and store the solution between each diaper change, only before and after each workday or perhaps only before and after each work week, and therefore only having to fully lift the product twice a week. The user scenario therefore varies much depending on the users' preferences and living spaces. One type of user scenario is shown on page 8 and 9.

1

The stepladder is brought from the user's storage space

2

The user carries the stepladder to the changing table using the handles

3

As it is placed, the solution unfolds itself and the user locks the latch bolts underneath the third step

4

Trini is now ready for the children to then either crawl or walk up the steps, depending on their capabilities

5

When the child is on the changing mat, the daycare worker pushes the solution to the sides using the handles to grab onto. The diaper is then changed, and the user pushes the stepladder back in front of the changing mat.

6

The child now crawl/walk back down again, and the stepladder is ready for the next diaper change.

MINIMUM SPACE UPTAKE

The Trini stepladder's foldability ensures a solution that can easily be stored away in between use. This creates a solution that fits into as many daycare homes as possible as they now have the possibility to fold it away when their workday is over. The dimensions for a folded and unfolded solution can be seen on page 10 and 11, and in the technical drawings starting from page 21.

43 cm

99,2 cm

27 cm

MATERIALS & SHAPE

The Trini Stepladder is created from laser cut plywood which is then afterwards both roughly and finely sanded down to create soft curves safe for the children to interact with. The raw wood is then afterwards lacquered with a mat transparent lacquer to ensure an easy cleaning experience for the daycare workers.

The raw look of the wooden pieces creates a soft and safe, almost familiar looking expression, as the wood makes it look sturdy, soft, and lightweight in one go. The soft curves and rounded edges around the product create a modern and mature look, while still having references to a strong gorilla standing on both hands and feet combined with a baby elephant.

The shape of the overall stepladder is created from the functions added to the product. The handles are created from various of tests to ensure that they are both dimensioned and placed correctly to fit the smallest and largest children. The steps are shaped to ensure a safe crawling experience for the smallest children, this means adding more support in the sides as their feet turn outwards as they crawl and guiding them safely and centred down again as they follow the curve of the steps. At the back of each step is an added piece of wood to nudge the children to stay on the steps and not getting their toes towards the edge.

ENHANCED EXPERIENCE

To ensure that the child gets up onto the changing mat quickly, the users can choose to add decals onto the product. The decals could act as a motivation for the children to get from A to B by using storytelling, and hereby adding more to the children's learning environment.

The decals could be animal paw prints, of which they have to follow on their way up. It could also be numbers 1-4 on each step in different colors, the children could then from diaper change to diaper change, change if they count numbers or mention colors on their way up.

MARKET POTENTIAL & BUSINESS PLAN

There is no product just like Trini on the market. The existing products on the market are either focused on bigger institutions and are too big and too expensive, or are focused on parents and does not actually solve the problem.

Trini retails for only 1499,95 enabling both the municipalities and the private daycares to afford the solution, and by being able to fold, it fits better into the private homes when compared to the bigger institution products.

Key Partners

The **production** is **outsourced** through Key Partners facilities, such as cutting and sanding the wood, assemble and lacquering.

Key Activities

The Key Activities are ensuring good supply chain management, to ensure parts for repairing products, and to keep delivering new once.

The **Production** activities, such as designing, making and delivering products in good quality is the main activity, and the next one being further **Problem Solving**, to solve more problems for the Customer Segments.

Key Ressources

The Key Resources are **Physical** and **Human** resources.

It is important to have warehouse space for product stock, for service employees both taking calls, e-mails and driving out to the customers to offer help.

Cost Structure

The Cost Structure is mostly based on being Cost-driven, to aim on creating the leanest possible Cost Structure, however, the Value Propitiation also push towards us being Value-Driven, as the product gives a lot of value to the customers. **A balance should therefore be created between the Cost-Driven and Value-Driven.**

From the production and salaries, there is a lot of **Fixed Costs**. The income pr. Product will vary, depending on the bargains made from municipalities, and percentage from working as a daycare.

Value Propositions

Trini help the customers **reduce their daily risks of injuries**, by offering an **affordable foldable** stepladder solution for the children to climb up and down from the changing mat themselves, **created specifically to children from approx. 8 months of age.**

Customer Relationships

The Customer Relationship is based on **personal assistance with human interaction**. This ensures that all customers have the ability to talk to real customer representatives either by e-mail, through calls and when having to get service on the product.

Customer Segments

Niche market for the most important customer group: **Daycare workers, both private and municipal.**

Segmented: Everyone that either work with children, or need help in their daily activities at home or in an institution.

Channels

Awareness & evaluation: We wish to catch the daycare workers awareness when they shop for new products in stores like BabySam and stores alike, with an in store showcase. There should also be made an effort into contacting all municipalities to inform them on this new solution, and the benefits, and offering a good price. Lastly, a product flyer should be delivered in the daycare workers mailboxes, to spread the awareness directly to the users.

Purchase & delivery: Trini will be sold on our own website, through our sales forces when calling from looking at the flyers and through partner stores like BabySam. The organization is open for contract deals directly to the municipality or stores who already have contracts with multiple municipalities.

After sales: We will have a team of customer service, who take care of the customers from the website, and the customers making calls. When a product might need repairing, the organization sends out own repairing services home to the daycare workers.

Revenue Streams

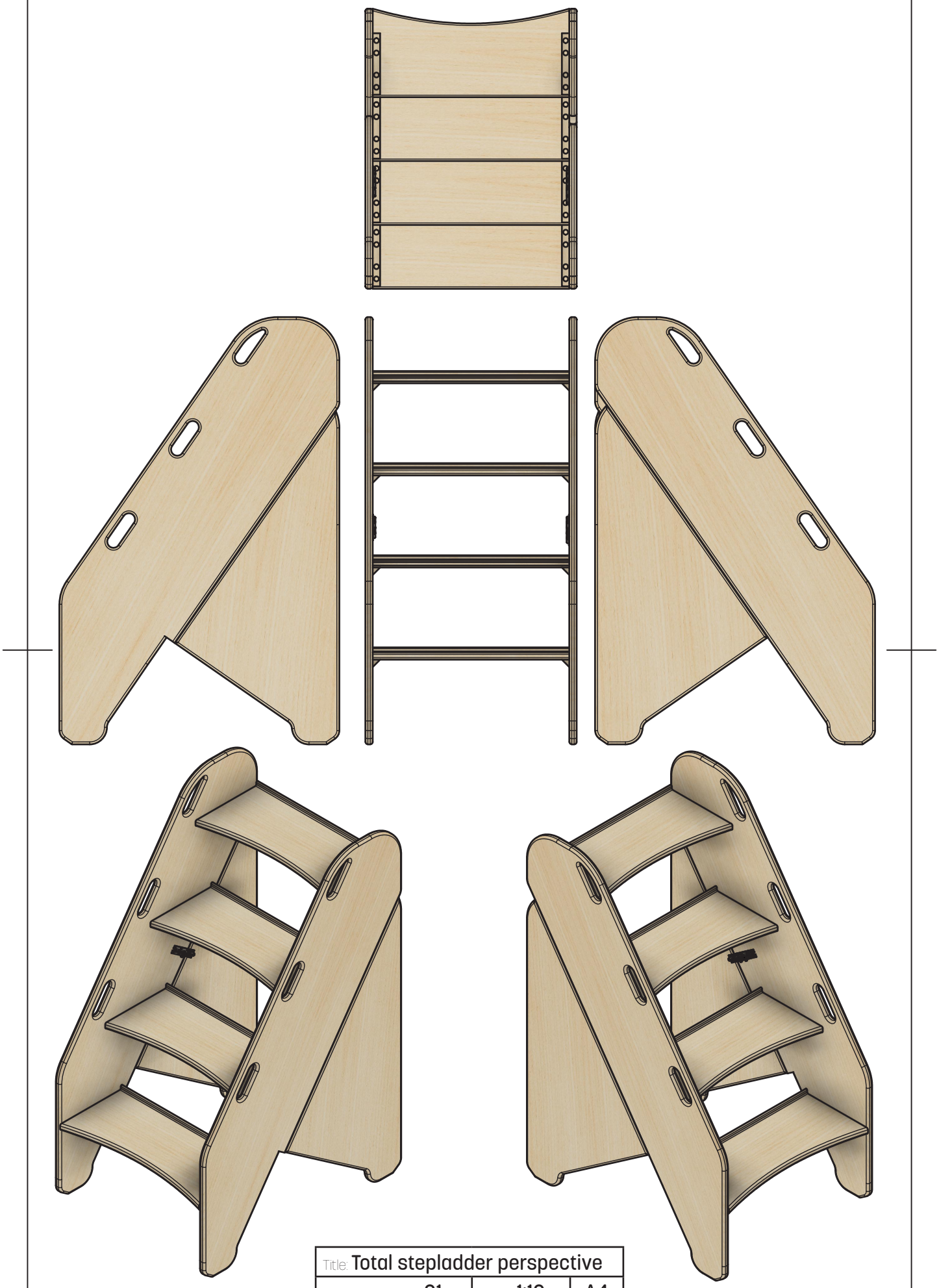
The Revenue Streams are **Asset Sale** – The Customers do with it what they want when they receive the product. We can repair it and the customer would only pay for the changed parts – unless it is a matter of warranty.

We expect a **medium to high revenue** from a **medium number of sales**, as the primary Customer Segment is in a niche market. The private daycare workers are able to get **percentage off**, the municipalities can get better **bargains** depending on how many they buy. Private parents and non-work related Customers **pay full price**.

SCALABILITY

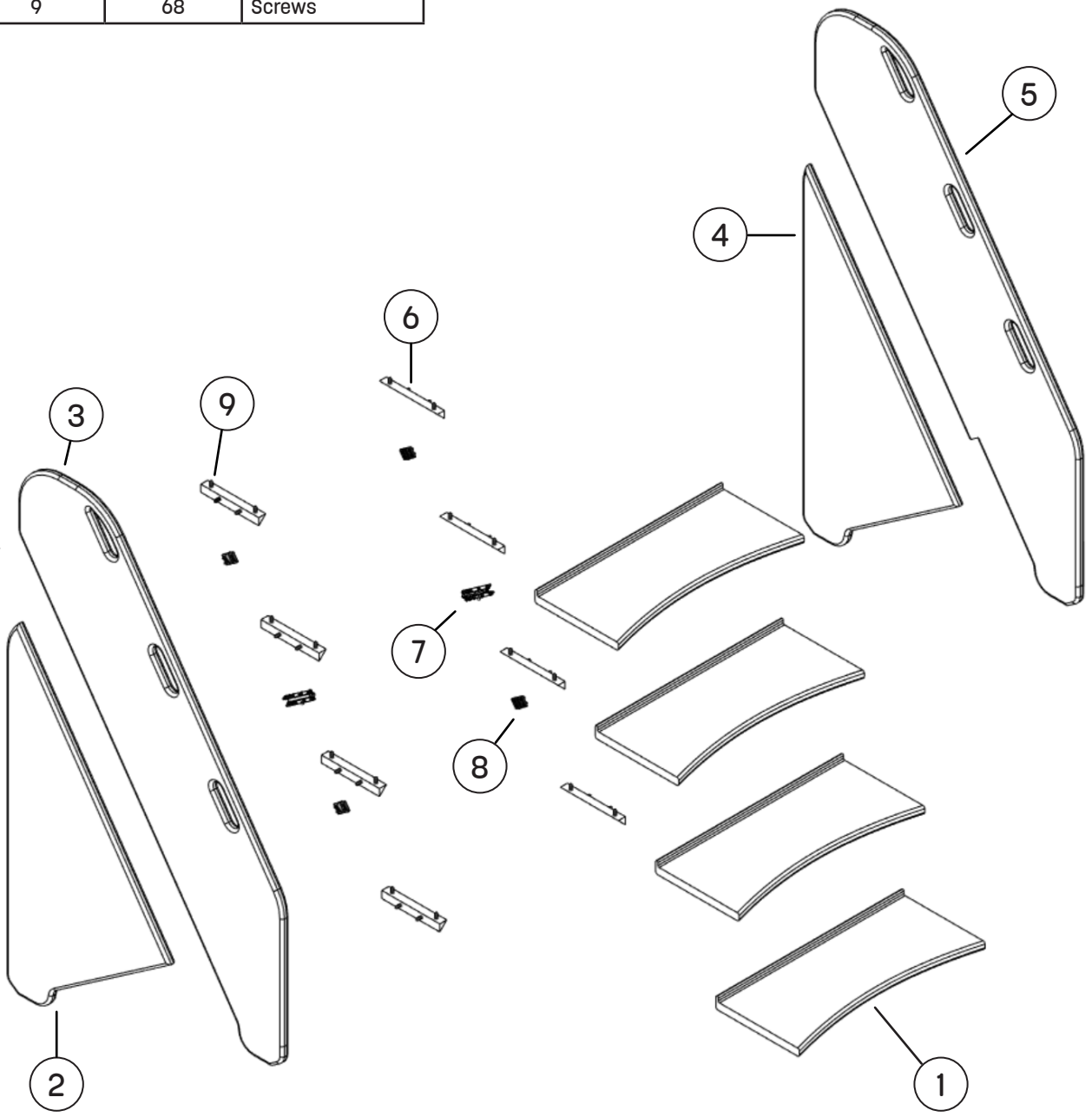
The wooden Trini solution will be the first release, then a plastic version will be created that also acts as a 2 in 1 solution being able to convert into a stool. This solution not only creates value by minimizing the daily lifts for the daycare workers, but also by creating more space in their already confined spaces, by eliminating a separate stool already used for when the children have to get their hands washed at a sink or for different countertop activities. This also means that the private daycares and the municipalities, who are the once buying the products for the municipal daycares, do not have to look for two separate products, but can stick to just buying one.

TECHNICAL DRAWINGS



Title: **Total stepladder perspective**		
Drawing number: **01**	Scale: **1:10**	**A4**
Date: 21-11-2021		

Bill of Materials		
PART NO.	QTY	PART NAME
1	4	Steps
2	1	Left buttom side
3	1	Left side handle
4	1	Right buttom side
5	1	Right side handle
6	8	Step connectors
7	2	Latch bolts
8	4	Hinges
9	68	Screws



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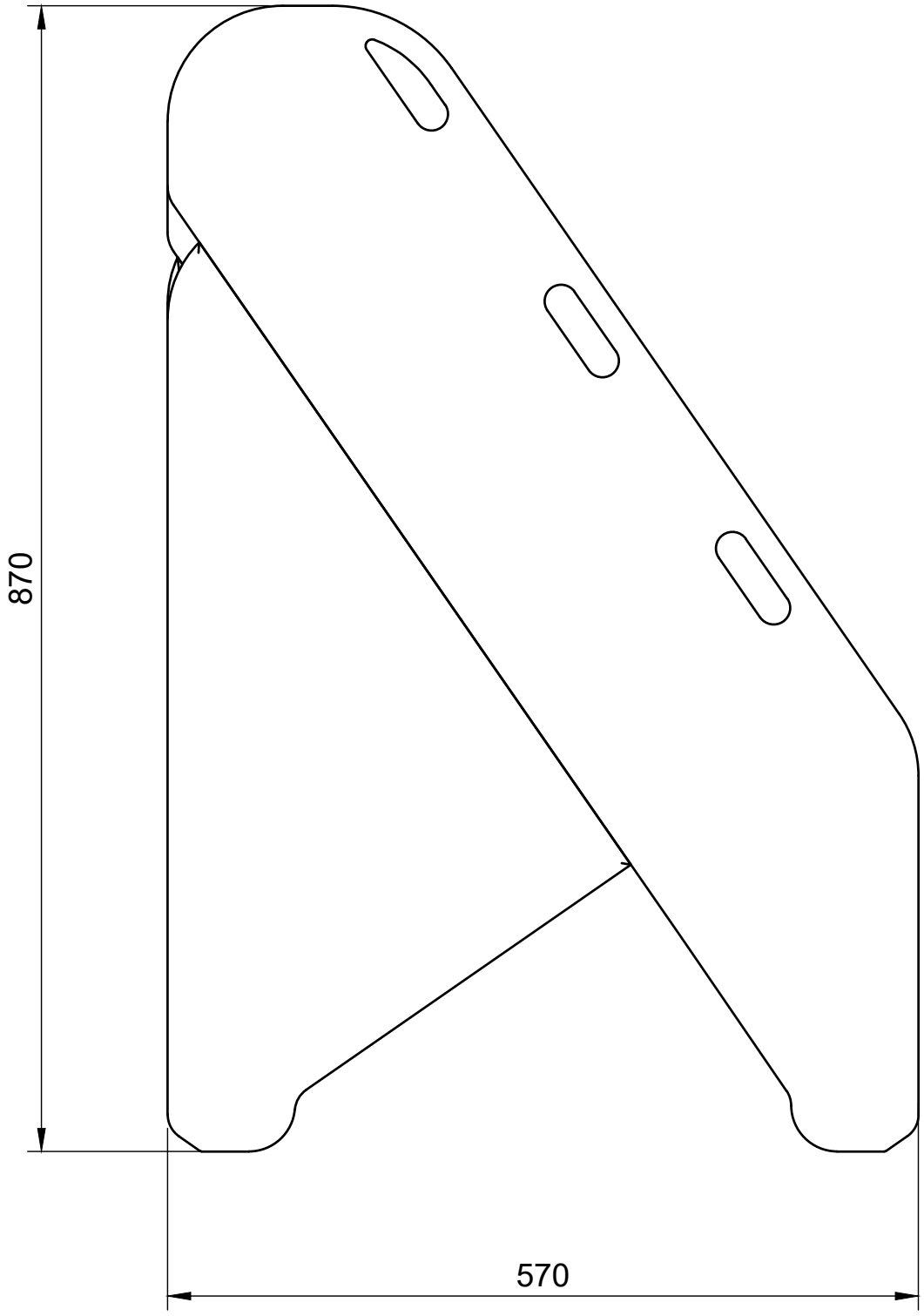

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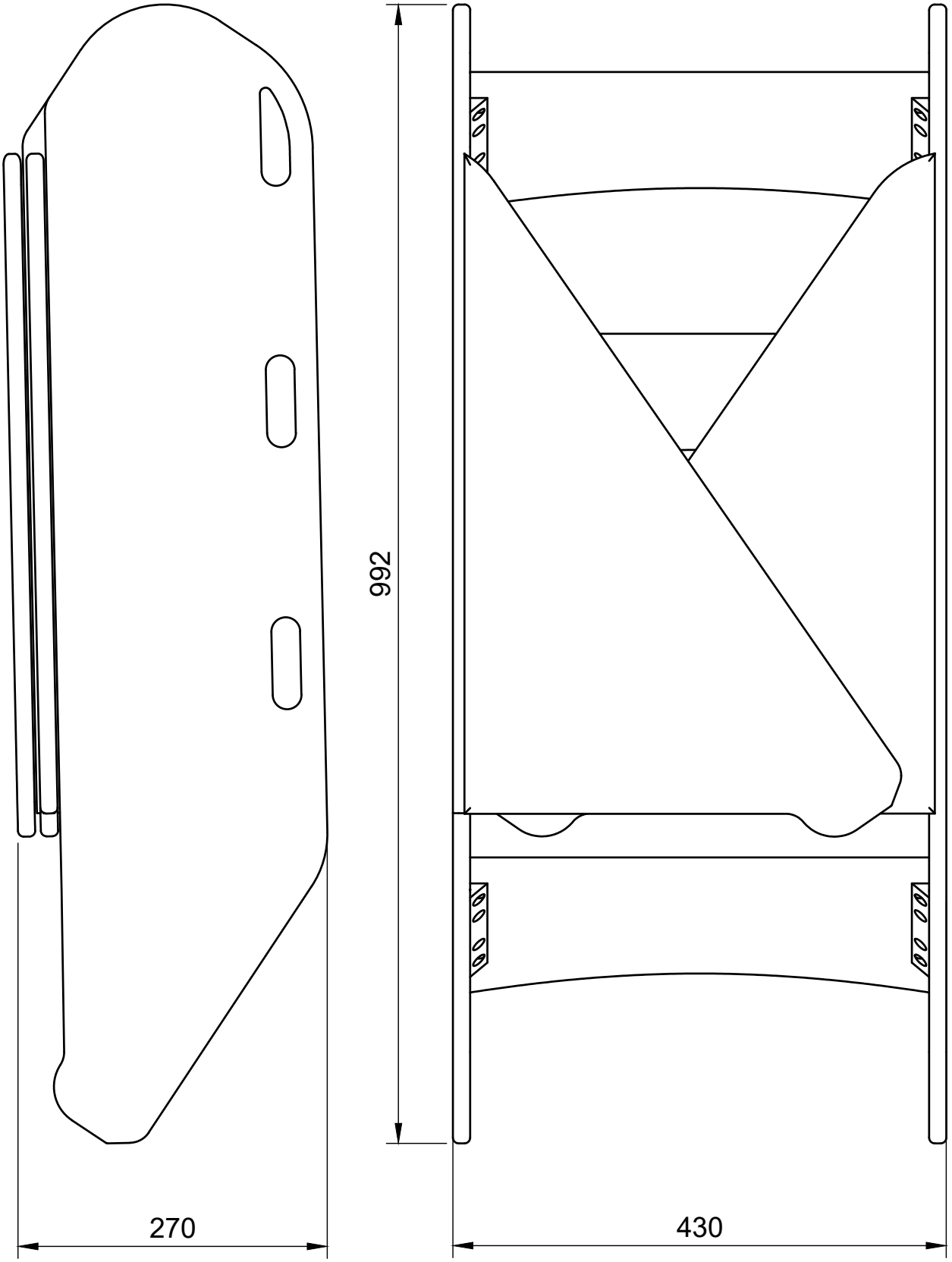
Date: 21-11-2021		



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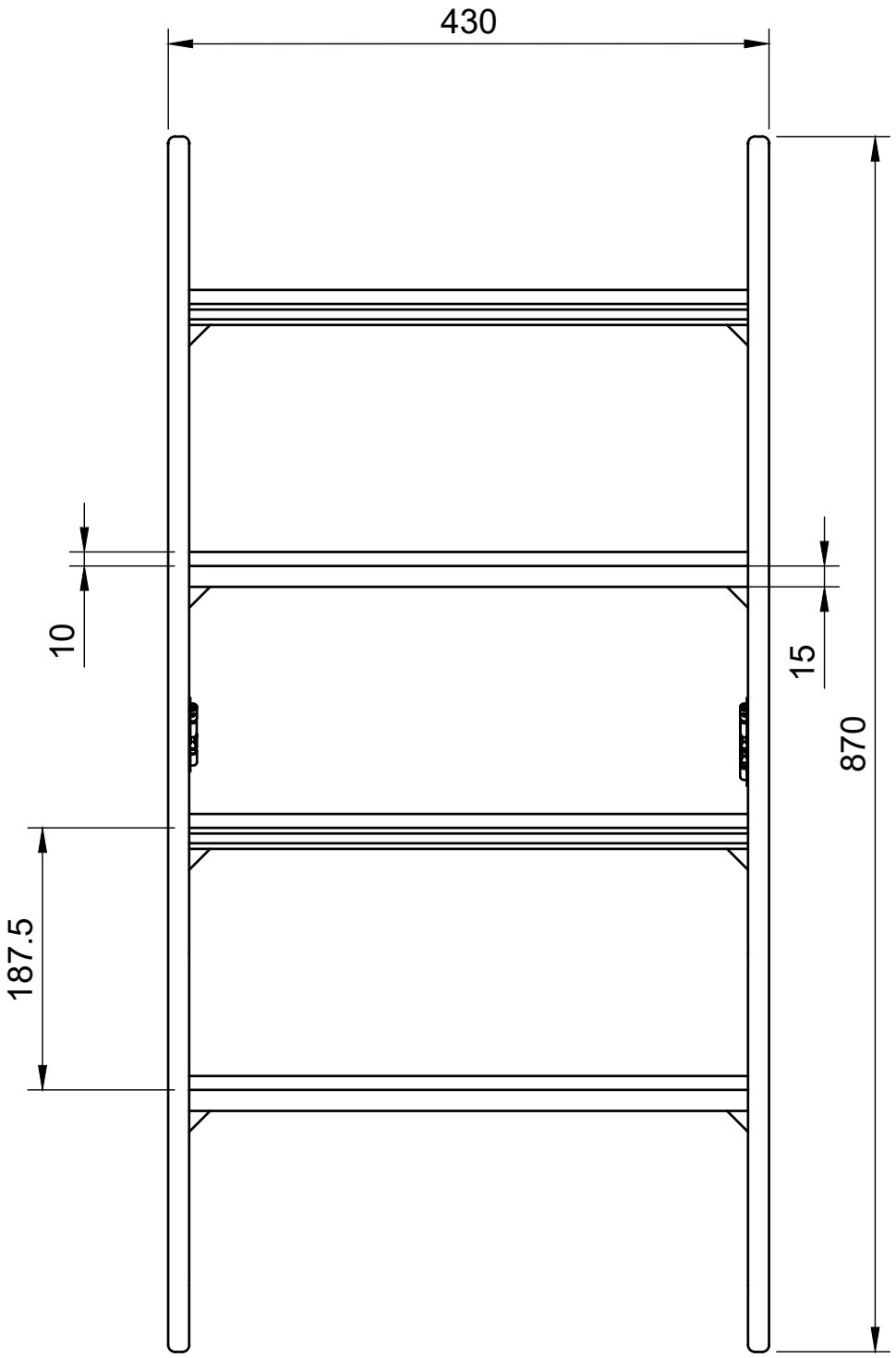

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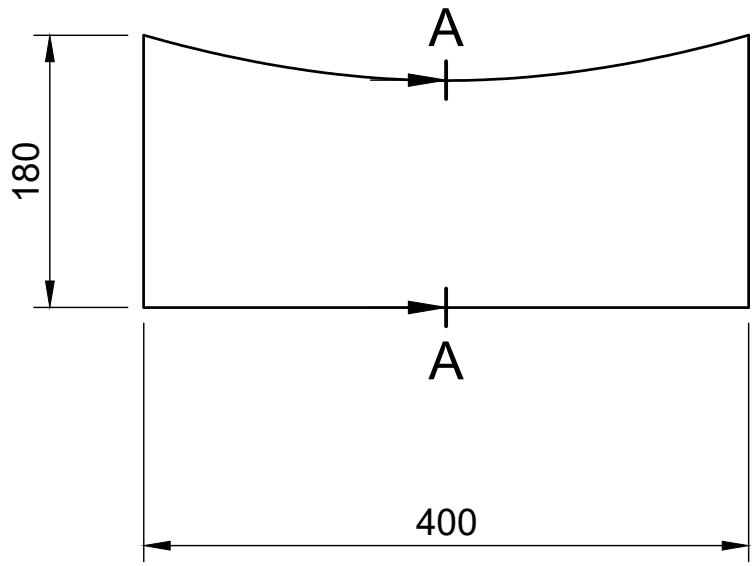
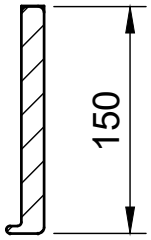
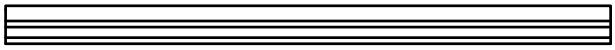
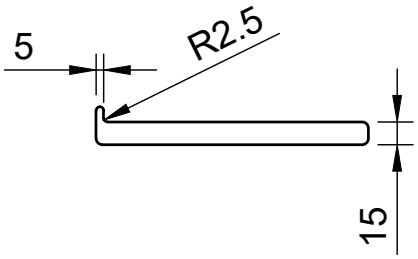
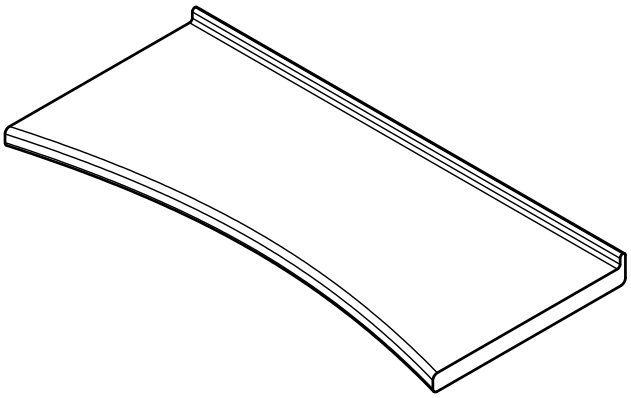


A-A (1:5)









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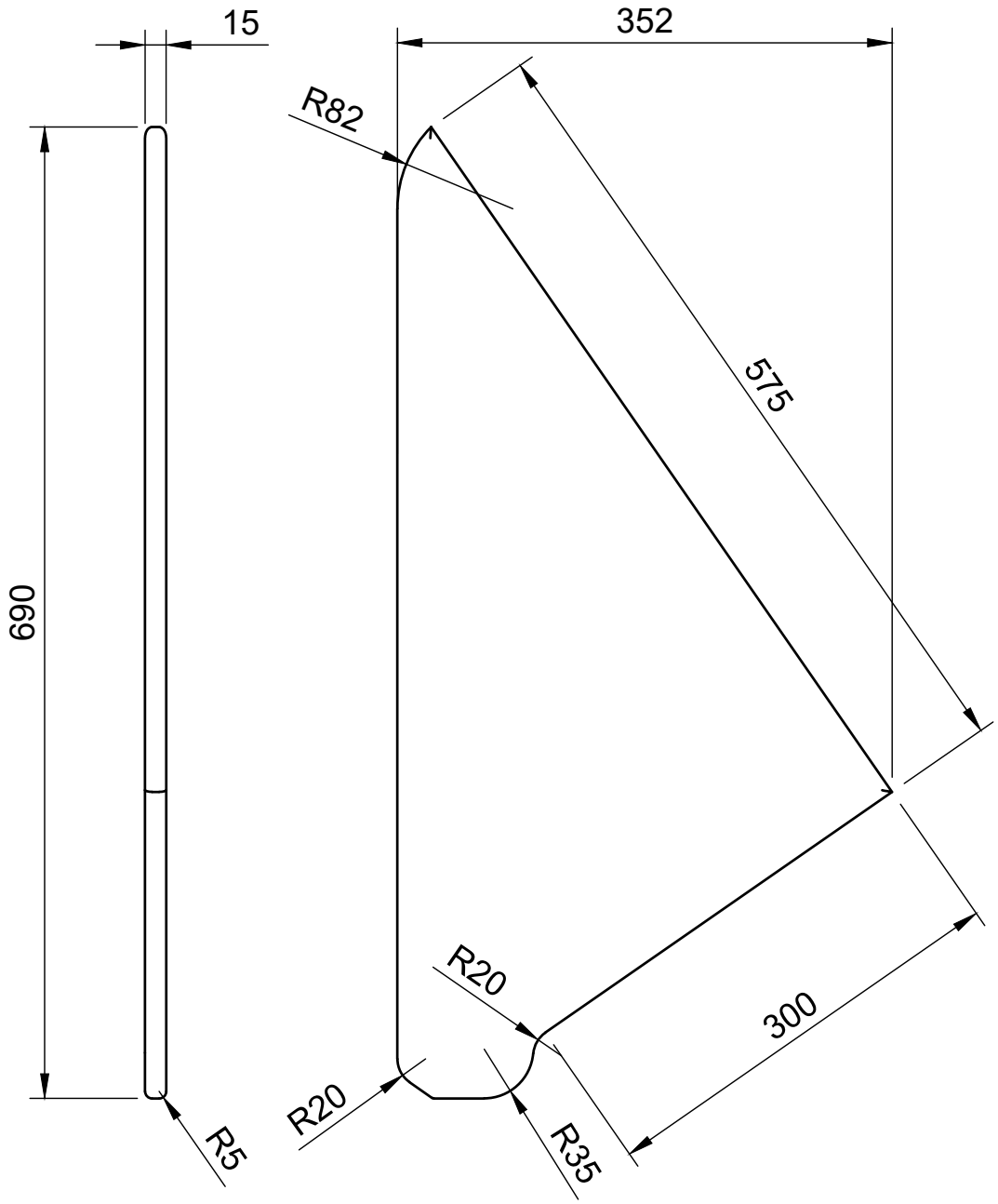

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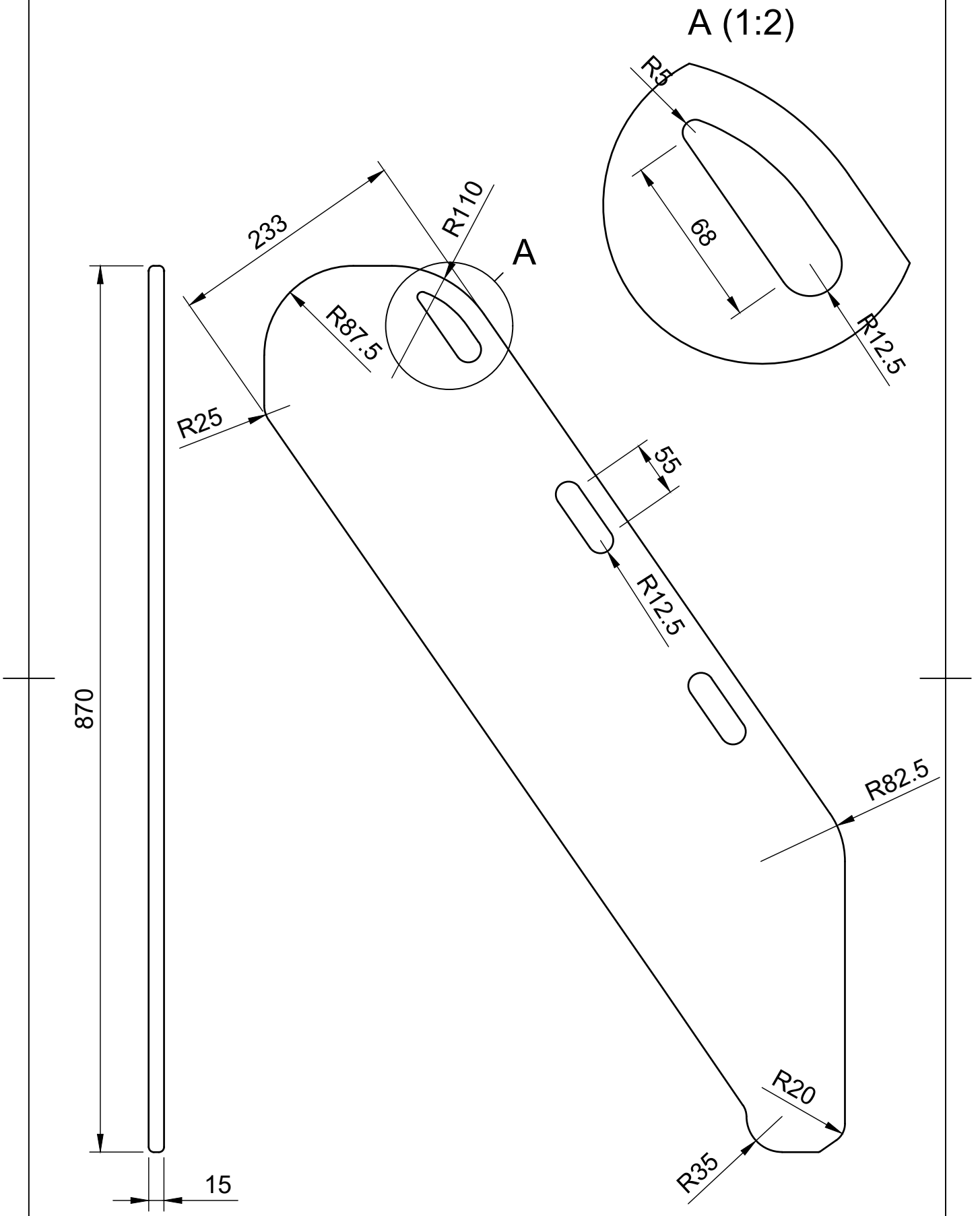

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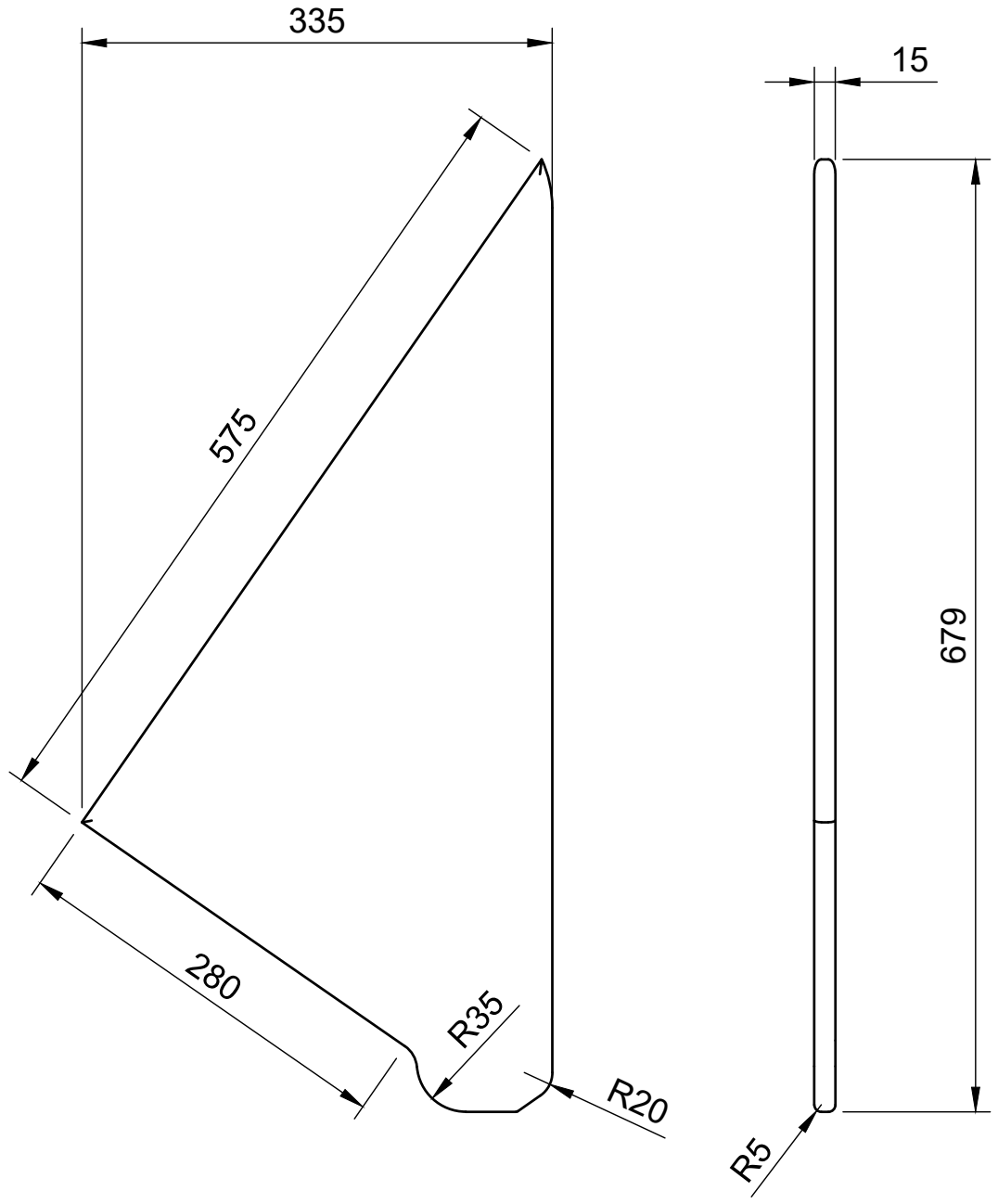

Title: **Part no. 4: Right buttom side**		
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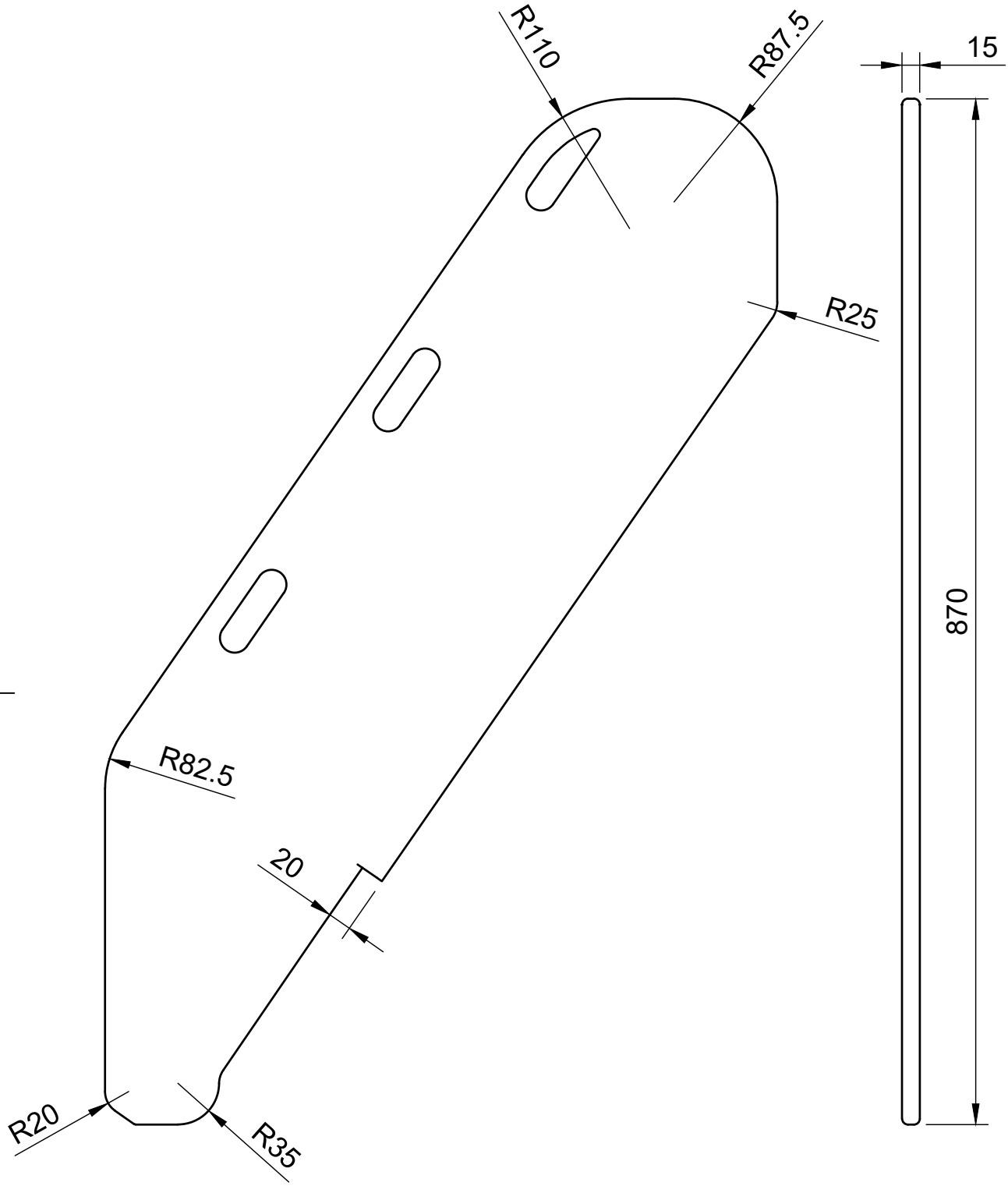

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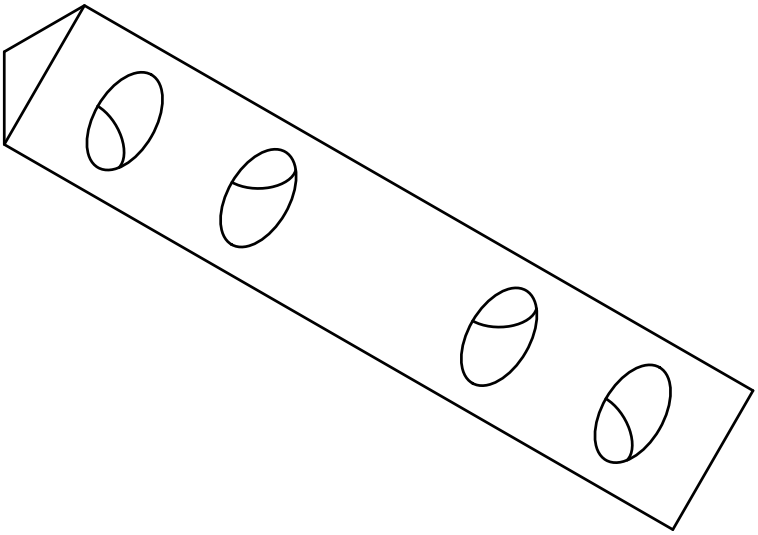

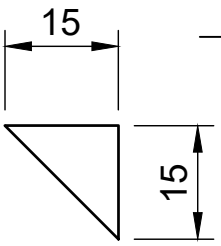

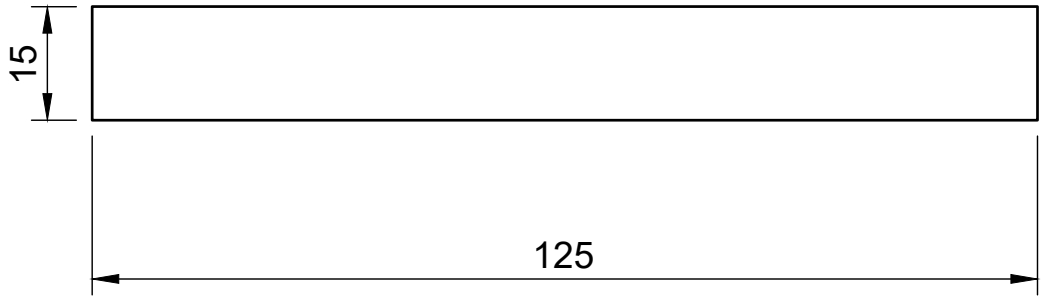

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Date: 23-11-2021		

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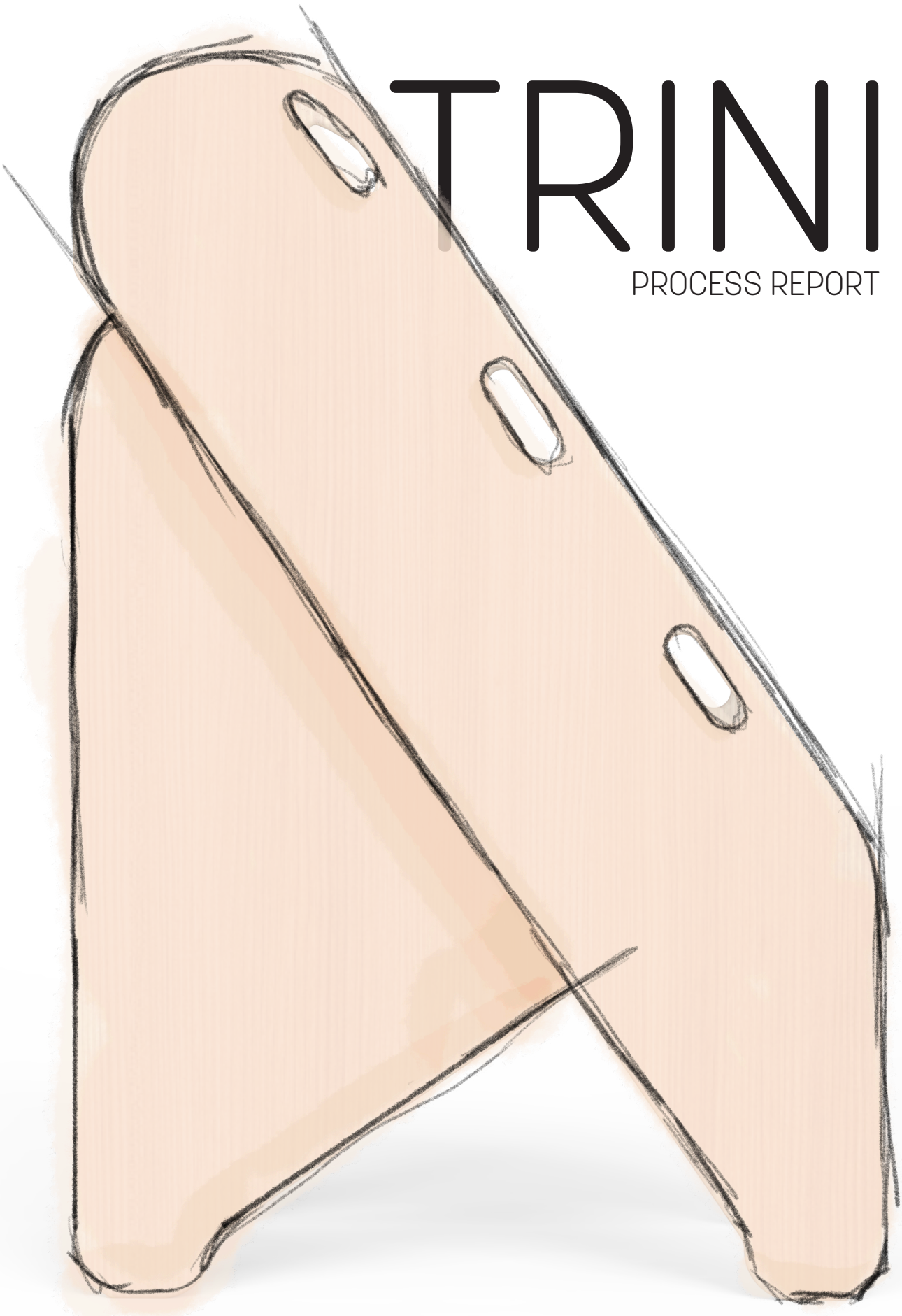
MASTER THESIS NOV. 2021 INDUSTRIAL DESIGN, AALBORG UNIVERSITY MSc4-ID4 MARIA HAUGAARD ANDERSEN

TRINI

PROCESS REPORT



TITLE PAGE

Title	**Trini**
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Project start	**01/02-2021**
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Project team	**MSc04 - ID4**
Main supervisor	**Nis Ovesen**
Co-supervisor	**Michael Skipper Andersen**
Report type	**Process report**
Pages	**87**

Maria Haugaard Andersen

ABSTRACT

This report shows the process of creating a helping device, Trini, for in-home daycare workers. The report shows how the team investigated the problem of work-related injuries for both municipal and private in-home daycare workers, with a specific look into how the day-care workers get injured when having to lift children of up to 3,5 years of age, both up and down from the changing mat when having to change their diapers.

The process then shows how the team uses the information investigated to create diverse concepts and use different methods throughout the creative process to also keep investigat-ing the problem and the users. The report finishes of with a design proposal including thoughts upon production and materials, and how a helping device for in-home daycare workers can be released onto a specific market.

ACKNOWLEDGEMENTS

This project was created by team MSc04-ID4 of the Industrial Design Master at Aalborg University 2021. The team separated at the end of April 2021 as a consequence of Marias sick leave. Most of the process was created together as a team before the separation, however, later in the design process at the end of the detailing phase, the process shows how the separation influenced the design decisions afterwards.

A generous thank you to the supervisors who contributed to guide the team through unexpected both personal and educational challenges throughout the whole process from starting the project together in February to Maria submitting alone in November 2021.

A generous thank you also goes to all the daycare workers who were very invested in helping the team to create a solution and inviting us into their own private homes meanwhile the whole country was in a lock down from Corona Virus, whether it being digitally or physical visits.

READING GUIDE

This project is reported through a process report and its appendix to show the design process leading to a finished product idea and then showcased in the product report and technical drawings folder. The process report is chronologically structured to match the process through out the project, starting with the discovery of the product, then the ideation and conceptualization, then product detailing and implementation and lastly a report ending epilogue.

To ensure privacy for the children who were used throughout the process to collect data and tests from, faces and names will remain private.
Through out the report, references towards literature, illustrations and the knowledge left in appendix will be referenced as followed: Appendix (Appendix X), literature: [Source, year] and illustrations as: [ill. X.x]. A literature list with all sources and illustrations is to be found in the back of each report.

To ensure an easier reading experience symbols will be used through out the process report to mark new insights and demands for the problem solving. The three symbols are as follows:

NEW INFO New information as a quick sum-up.

NEXT UP What the section resulted in the team planning for the next necessary step.

DEMAND A product requirement or wish created from the research.

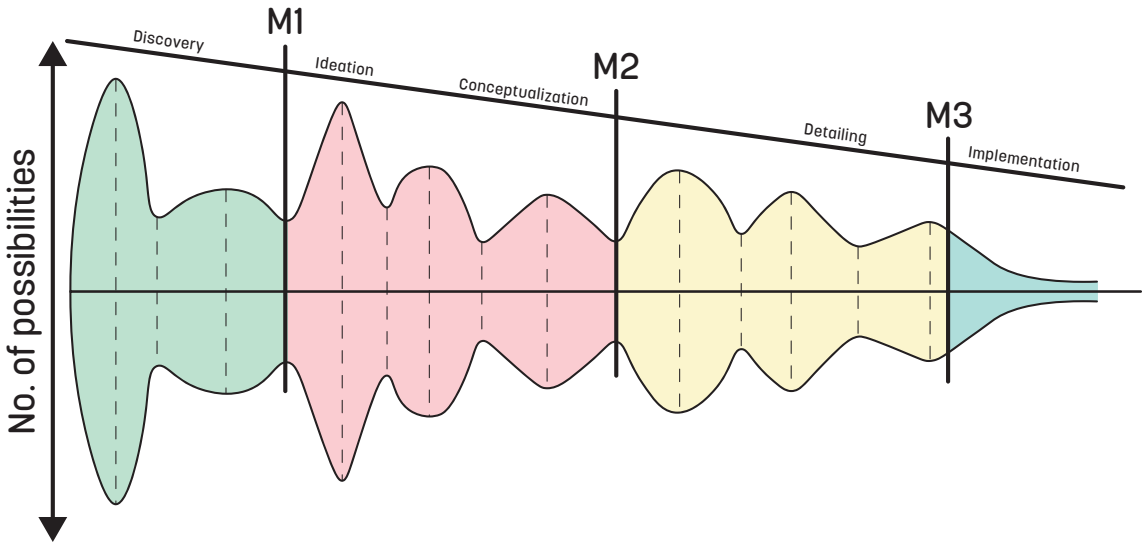
PROJECT OVERVIEW & MANAGEMENT

To give the readers for this report a glimpse of the overall process, a process model was created. This process model both shows how the team look at a design process, and how it was overall scheduled to ensure a final product concept.

The overall planning was made from the preset voluntary milestones, and the daily activities were planned by using the tool "www.monday.com". The team here created assignments for each week and day, to ensure that the requirements for each milestone could be reached.

When looking at the overall process model, the team looks at a design process using theory from four different models: 'Stepping Stones' by Marianne Stokholm [Stokholm, 2014], 'Dynamics of Divergence And Convergence' by Bela H. Banathy 1996, [Dubberly, 2004], 'IDEO' [Design Thinking For Educators, 2012] and lastly 'Overall, The Design Process Must Converge' by Nigel Cross 2000 [Dubberly 2004].

When combining the theory and the teams design process thinking, a model can be described by having overall steps, such as discovery to learn more about the problem before starting ideating. Yet keeping the ability to have an iterative process where it is possible to go back into investigating the problem throughout the process etc. The overall mindset is then that for each overall step and or milestone deadline, the team have a diverging and converging process to ensure new knowledge yet still ending with a clearer scope before next overall step. The most important factor is that the overall process must converge, to ensure that the scope becomes clearer towards a final product proposal before the exam. See ill. 0.1.



[Ill. 0.1]: Process Model

TABLE OF CONTENTS

DISCOVERY

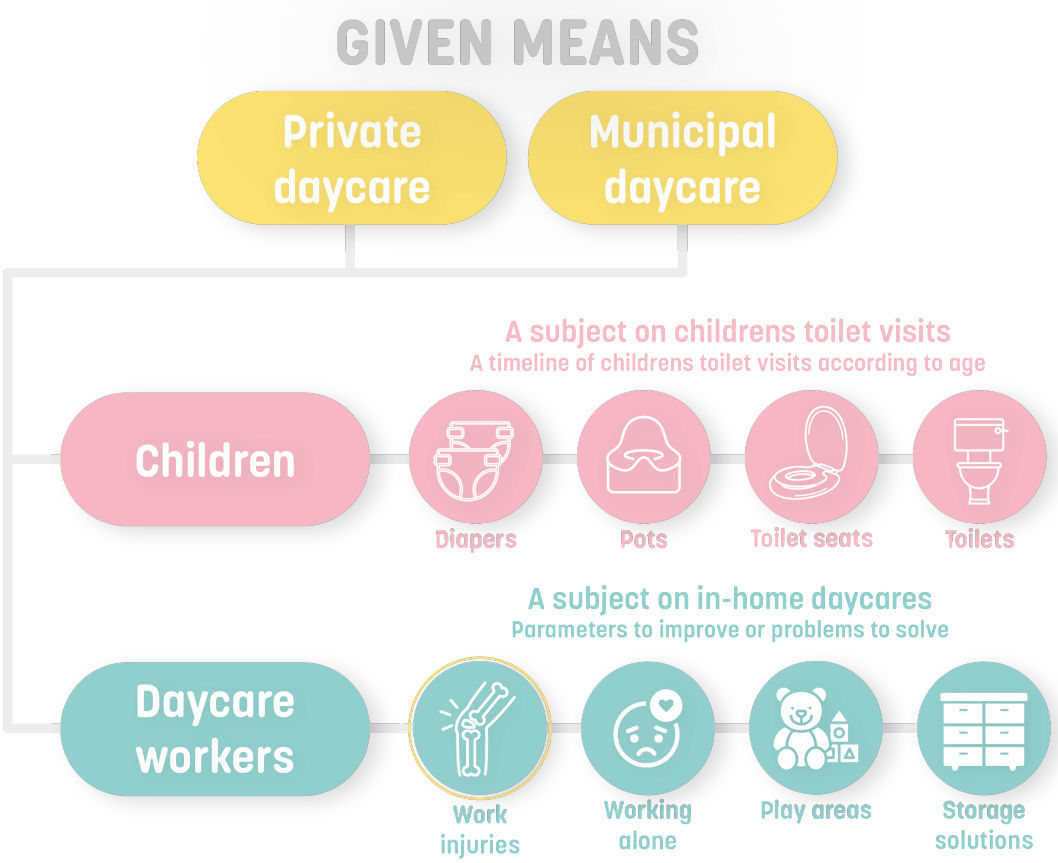
The first section of the process report introduces the chosen subject for the master thesis project and hereby the research needed to ensure a problem statement. The section “discovery” is thereby the underlying validation for a project, creating a problem statement for a further solution to then be created from.

PROBLEM DISCOVERY

Before starting the master thesis project, the team had to find a topic that would spark some interest for both of the team members to ensure motivation, while also having to solve a legitimate problem.

When deciding on which subject to choose, the team wanted to follow the theory by Saras D. Sarasvathy, on effectual reasoning and the bird-in-hand principle. Effectual reasoning is when you look into which means you already have to create a project, rather than starting with a given goal, and then having to figure out which means you have, and hereby which new means you might have to establish to then achieve the goal. [Sarasvathy, 2001] The bird-in-hand principle includes asking yourself "Who am I, what do I know and whom do I know" [Sarasvathy, 2008], where in this case, the team had closely related daycare workers on both sides. This meant a lot of children available for testing and observations and also daycare workers whom the team would still be able to get in contact with during a pandemic. The team then looked into problems concerning both available user groups (children and daycare workers), and ended up focusing on the daycare workers work related injuries.

See ill. 1.0 for a glimpse of the thought process behind choosing a master thesis focus area.



[Ill. 1.0]: The teams given means converted into thesis themes

IN-HOME DAYCARE WORKERS

To unfold the subject upon work injuries for daycare workers, the team had to start the discovery by looking into whom the daycare workers are and what their work consists of. This includes both the municipal daycares as well as the private daycares and slightly looking into which kind of requirements they might have, and whether they are any different. All information is gathered by desktop research including a timeline of childcare through time, see appendix 1.

PRIVATE VS. MUNICIPAL DAYCARE

The biggest difference between an in-home private and municipal daycare is the overall business aspect behind running a daycare. The private daycare must find the children themselves and pay for everything, as it is their own business. The municipal daycare however get children assigned by the municipality and products such as changing tables etc. are provided by the municipality.

The municipal daycare organizes the daily activities in close cooperation with a pedagogical curriculum provided by the municipality. Together the daycare worker and the municipality work on the curricula and to create and ensure a good learning environment for the children. The municipal daycares typically caretake 3-4 children and up to 5 in case a child from another municipal daycare is sick. This means that if another daycare worker gets sick, their children get placed by the municipality to other municipal daycares in their closest area. This means that the Municipal daycares support each other and sometimes work together and create playful meetings with the children. [Børne- og Undervisningsministeriet. 2021].

A private daycare is outside the municipality's administration and guidelines. The daycare worker is neither employed nor paid by the municipality but instead paid by the parents of the children in their private daycare. However, the municipality must approve and supervise the private daycare still. There can be no more than five children in a private daycare unless there are more people to look after the children. When getting childcare at a private daycare, it is possible to get financial subsidy by the municipality. A private daycare only have to work with learning environments and not the curricula like a municipal daycare do. Another thing about private daycares is that they work more alone than the municipal daycares do, meaning they don't have a group of nearby daycares to take the children in case of absence, this however mostly affects the parents of the children. [UVM. 2020] [Børne- og Undervisningsministeriet. 2021].

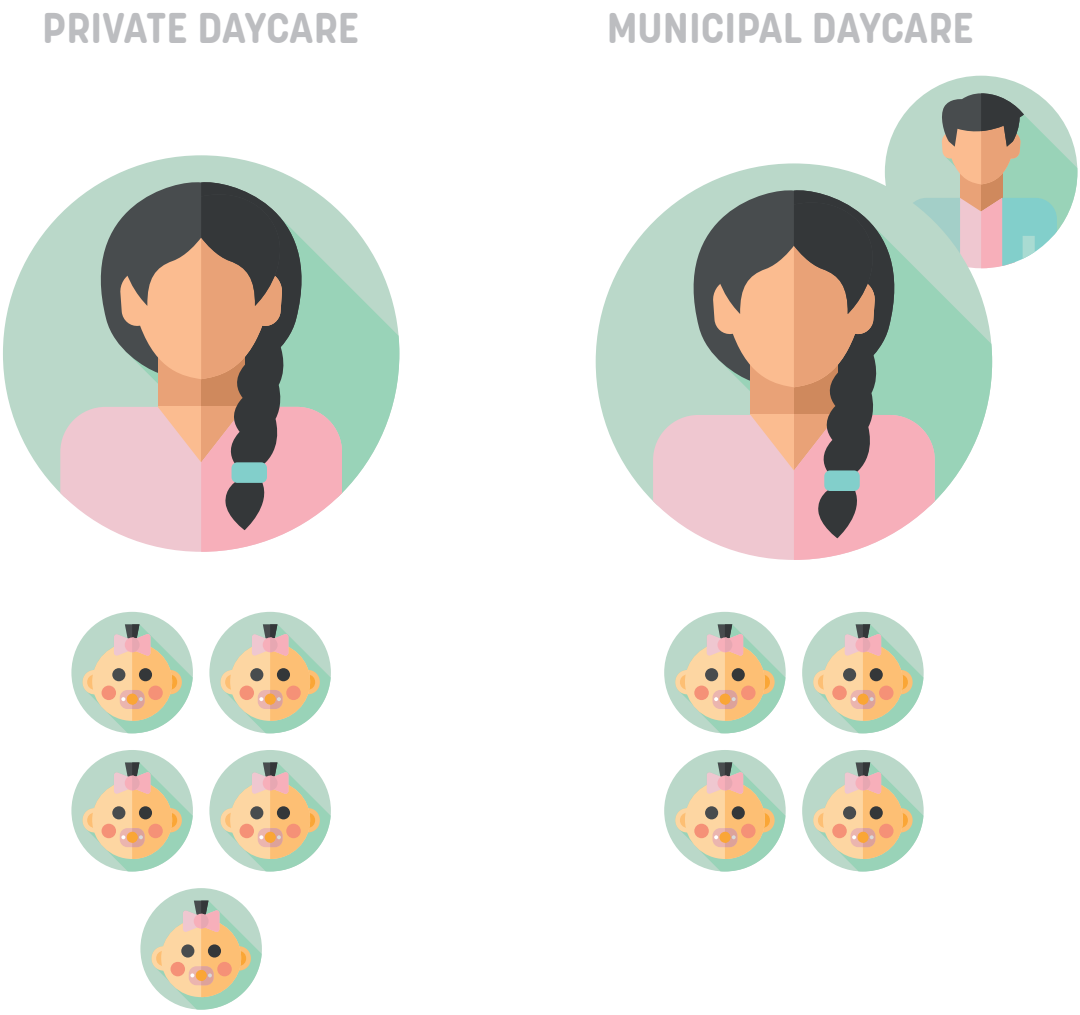
A municipal and private daycare is thereby not that different, they both take care of children in their own homes. The biggest difference is their view on a products pricepoint when having to get new supplies or furniture for the daycare. The private daycare have to find the money themselves, and the municipal daycare does not neccesarily have a say, as it is the municipality that takes the buying decision most times. In some cases, the municipal daycare worker get some money from the municipality to then themselves buy a product of which they together have agreed upon.

DAYCARE FACILITY

When running a daycare, they have to be approved by the municipality. The individual municipalities can have very different rules as to how a to-be-daycare's home can be accepted to become a daycare facility. Overall, the requirements are not very demanding, and the most important thing is the hygiene and size of the environment, and that it is an environment where the children can be safe and have space to play (Appendix 2 for some list from municipalities.).

CONCLUSION

A private and municipal in home daycare takes care of up to 5 children. The difference between the two types of daycares are slim, as it mostly comes down to economic decisions and requirements set by the municipalities. Overall there day to day job is the same.



[Ill. 1.1]

NEW INFO Work related injuries can appear for both municipal and private in-home daycares, as their day-to-day job of having to caretake children is the same.

NEXT UP Next up the team must investigate which challenges the in-home municipal and private daycares face on a daily basis to create risk of work related injuries.

DEMAND

- The solution should fit to both the municipality and the private daycares, as the municipality are the once making the buying decisions for the municipal daycares.

THE CHALLENGES

When starting the investigation of the problem: “work related injuries for daycare workers”, the team started with quick and diverse desktop research. This was intended to ensure insights into the daily tasks of an in-home daycare worker, and hereof their challenges. This meant that the team needed answers on which daily tasks could give physical side effects, and from this what these side effects be. This requires information on not only the daycare workers, but also the children, to know more about how much weight the daycare workers are lifting, depending on the children’s capabilities. And lastly, the team wanted insights into how big the challenges are when compared to other industries.

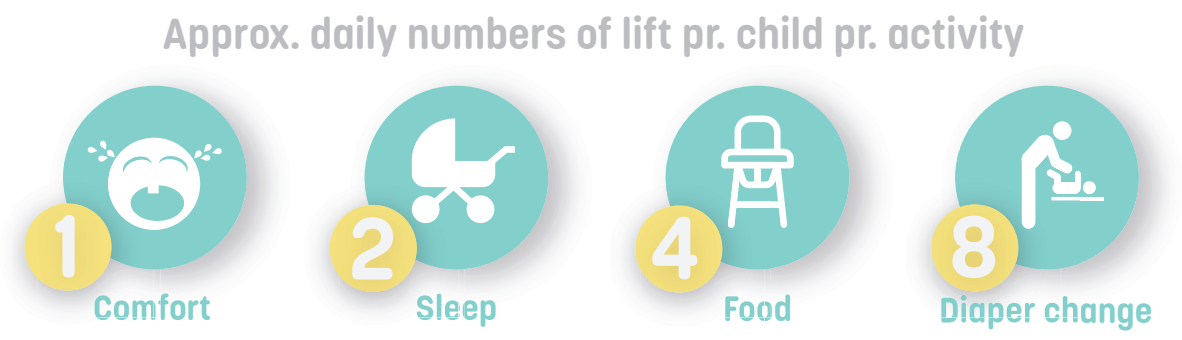
WHERE ARE THE CHALLENGES?
From looking into the research, the team found that the daycare workers lift and carry the children mostly when they have to comfort the child, get a child into their highchair, need a diaper change or when having to sleep in their prams see ill. 1.2 for approximately daily lift pr. child pr. activity. They however only have to lift the children up and down twice when the children have to nap or being comforted. Therefore, the two main reasons for lifting and carrying for a daycare worker, is for diaper changes and for feeding times, which still depending on the children, can vary much. Some days, the diaper changes are the most frequent as some children might have to get new diapers more often, combined with the possibility that some older children might be able to themselves crawl up into their highchair, depending on the chair. Not many daycares seem to have the possibility for the children themselves to crawl up onto the changing matte. [Slyngebarn.dk]

HOW BIG ARE THE CHILDREN?
Children in Denmark are ca. 9,7 months old when they start in daycare, however, it is possible to start in daycare from when the child is no more than 26 weeks old. This means that in some cases, children are placed in a daycare very early, and therefor require much more help. [Børne- Og Socialministeriet]

When looking at the charts and figures in appendix 3, showing the average height and weight of girls and boys in the age of 0-5, it shows that a child at only 26 weeks of age, might not even be able to sit without support. And therefore, the child has to be held and carried a lot more during the day. This would lead to the daycare worker to carry around a load of 6 to 10 kilos a lot throughout their workday. [sygebørn.dk, 2018]

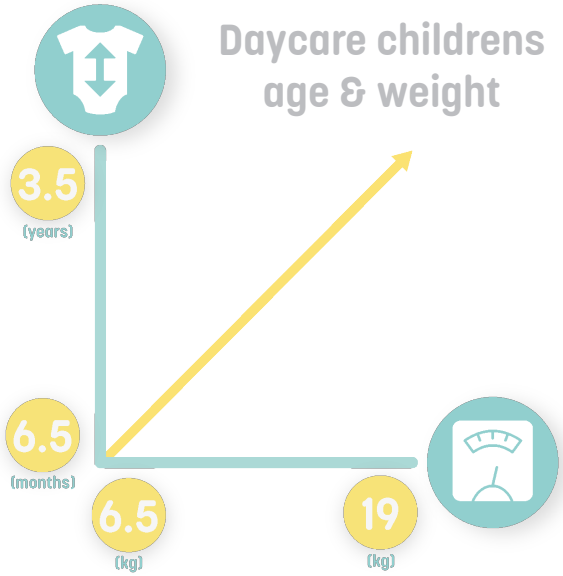
Most children are around 3 years of age before they stop in daycare, these children can however do a lot more themselves when compared to younger children. However, if the children in this age still use diapers, and the daycare workers do not have a ladder or anything alike for diaper change, this would mean that the daycare worker has to lift the child of up to 19 kilos 3-4 times a day and maybe more. [Babyklar.dk] ill. 1.3 illustrate the range of daycare childrens age and weight. See growth charts at appendix 4.

WHAT ARE THE CONSEQUENSES?
When looking at how much weight a daycare worker thereby lift and carry, and how extensive the problem is compared to other industries. They do not lift as much, as for example a bricklayer. [Avisen.dk] However, a lot of other industries has a lot of assistive devices for moving objects, and even though the daycare workers only possibly lift heavy loads a few times daily,

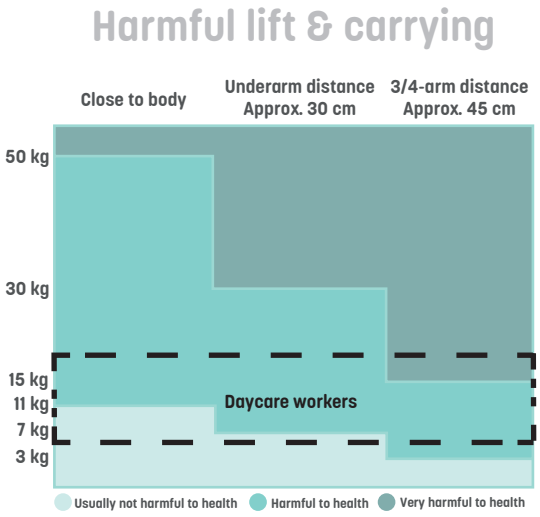


[Ill. 1.2]

it can still be very extensive for the body to lift small loads of weight approx. 70 times a day. A main difference is also that at a daycare, the children is not only lifted, but they are also often carried from one place to another, which means that instead of having 11 kilos and above as being harmful to their health depending on the placement of the arms, the weight is now when carrying only from 6 kilos and up, see ill. 1.4 When a person walks with a heavy load, the forces are shifted from side to side, creating distortions in the body, and apart from that, they also have the risk of tripping and falling from other children, toys etc. This results in them being the second biggest group in the FOA trade union to have work related injuries.



[Ill. 1.3]



[Ill. 1.4]

CONCLUSION

The biggest challenges for the daycare workers, are that they lift a child from 6,5 to 19 kilos, possibly up to 70 times daily, depending on the children's own capabilities. The lifting and carrying is done without any helping devices, resulting in them being at health risk daily. They therefore experience work related injuries from the distortions created in the body. The main problem for the daycare workers is concluded to be when the children have to be lifted and carried for a diaper change.

NEW INFO The daycare workers daily put their health at risk, by lifting children up to 19 kilos when having to change diapers.

NEXT UP Next up the team should ensure more information on the topic of injuries, both by doing desktop research and by reaching out to the daycare workers themselves.

DEMAND

- If future product should require interaction with children it should:
  Withstand up to 19 kilos and fit a minimum height of 105 cm.
- The product should ensure less harmful lifts and carrying before and after diaper change.

USER PANEL & OBSERVATIONS

A user panel was established, to ensure users to interact with throughout the process. The interaction between the team and the user panel, should be for investigating the problem and when having to get feedback on concepts and prototypes. The user panel consist of two daycare workers, one who has a municipal daycare and one who has a private daycare. Each daycare take care of three children in in different ages, whom all has been approved to help in the project. The team wanted to verify the problems found from desktop research, as well as learn more about the daily work of a daycare worker. The team then visited the user panel, and observed their working day, as well as getting answers on multiple questions by the use of a semi structured interview. The interview can be found in appendix 5.

Kirsten

65

Odense

Private daycare since 1996

Suffer from back pain

Hanne

54

Brovst

Municipal daycare since 1997

Do not suffer from any injuries

[Ill. 1.5]

The shadowing was done through out a whole working day to focus on all problems that could occur. From doing the observations and interviews, the team quickly found verification of the problem, that it is before and after diaper change, they lift or carry the most. The daycares carry and lift the children a lot during their day in general, and the team also saw how they often times carry the children through multiple obstacles before they are able to put the child down again. The daycares in action can be seen on ill. 1.6.

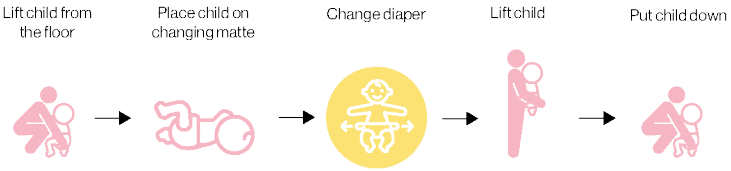
Neither of the daycare workers have any helping devices as such. Hanne have a steep ladder for the changing matte, however, only the oldest child was able to use the ladder for getting up onto the changing mat, but the child however was not able to use it for going back down again. See picture three on ill. 1.6. It is too difficult for the children to turn around when having to go back down, while being afraid of the heights, when looking down such a steep ladder. This just shows that there is a need for a product to help in the situation of getting the children up onto the changing mat, and back down again.

The interview and observations gave an overview of what they do during their work day, and also gave a possibility to see how the daycare workers use their body when interacting with the children. The daycare workers verified the discovered challenges while giving the team new insights into their difficulties, such as having to work from their own private homes, and how this results in them working in smaller confined places.

Multiple user scenarios are created, as seen on ill. 1.7, 1.8 and 1.9, on which steps the daycare workers go through with or without helping devices for diaper change. By creating these user scenarios on how the daycare worker change the children's diapers, with and without helping devices, it is clear to see in the illustrations, that the last one, where the child can both crawl up and down, is almost the doubled number of interactions. However, the daycare worker does not have to lift, yet bend once during the whole process. It is important to also emphasize that the number of interactions is of lower importance, when considering its performance to solve the daycare workers problems, and hereby prevent long-term injuries.

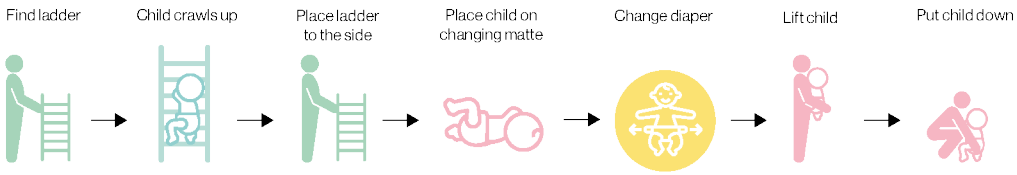
[Ill. 1.6]: User observations

The steps needed without helping devices:



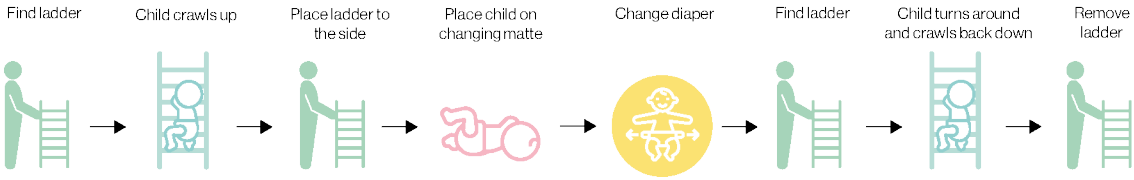
[Ill. 1.7]

The steps needed with a helping device to help the child up on the changing mat:



[Ill. 1.8]

The steps needed with a helping device where the child can crawl both up and down themselves:



[Ill. 1.9]

NEW INFO The problem is verified by the established user panel, alongside new insights on the daycare workers daily tasks and challenges, such as having to work in confined living spaces. The main problem investigated is that the number of interactions is likely to increase as the risk of injuries decreases.

NEXT UP Next step should be to take contact to more daycare workers and further verify the problem, specifically looking into injuries and their workspaces.

PROBLEM VERIFICATION

To ensure more knowledge on the daycare workers challenges, the team reached out to more daycare workers for further verification. The team took use of a quantitative method of creating a survey, to emphasize the challenges through statistics created from a larger data collection. The survey was introduced to the daycare workers via various of Facebook groups relevant for daycare, including municipal and private daycares. The survey had answers from 67 daycare workers and can be seen in appendix 6. Page 14 and 15 presents the most important insights from the survey, including some of the pictures recieved of the daycare workers changing station.

NEW INFO

The problem is now verified on a larger scale with multiple daycare workers suffering from work related injuries. The product should overall be targeted towards women's aesthetics, work efficiency and confined living spaces.

NEXT UP

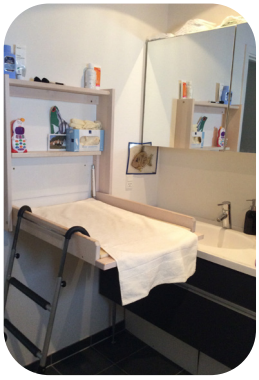
Next up the team should look further into which products already exist on the market and by this look into how these would be able to improve the daycare workers work environment and their price points.

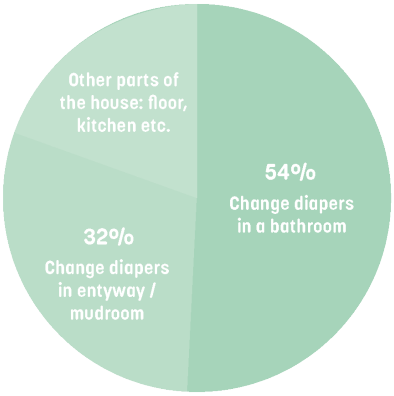
DEMAND

- The product should fit into different types of confined spaces
- The product should be designed to women's aesthetics
- The product should be easy to clean
- The product must be safe for the children to interact with
- The product should avoid shoulder and lower back pain

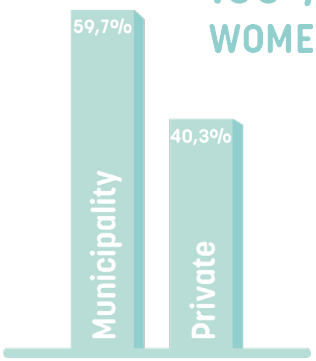




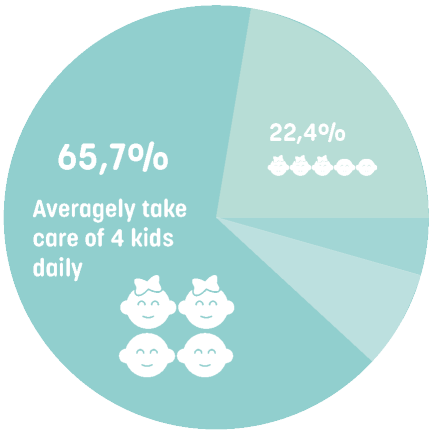


100%
WOMEN



Have worked in the industry for
11-20 years

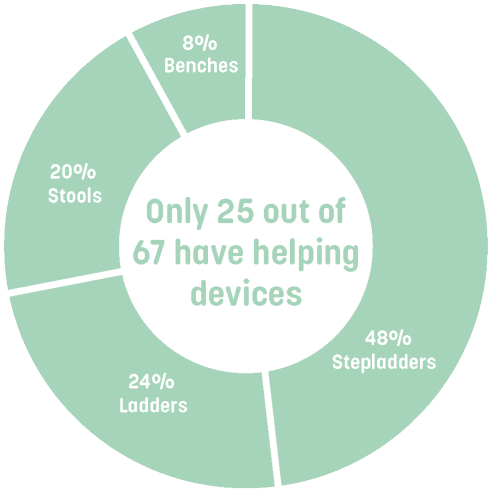


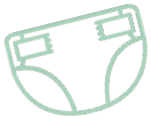
They mostly suffer from shoulder, neck and back pain

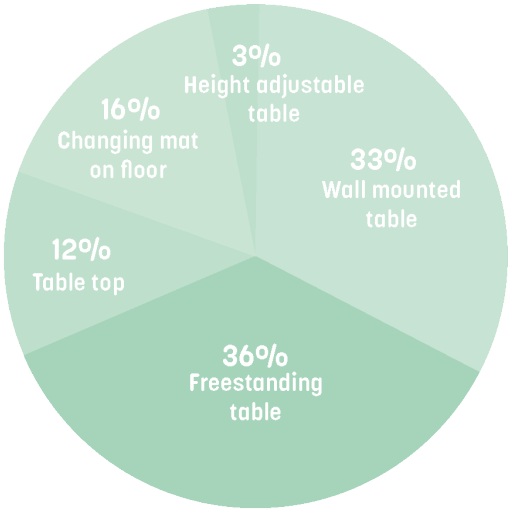
They lift a child up to
70
times daily

They carry a child up to
25-30
meters daily

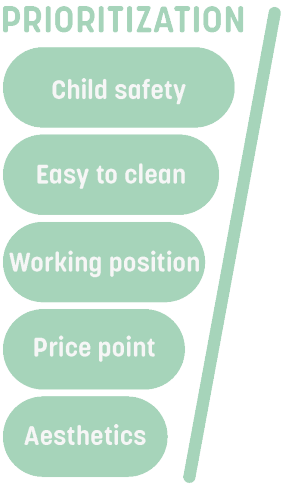
36,7%
Get massage treatments for the injuries







PRIORITIZATION



[Ill. 1.10]

MARKET POTENTIAL

To further understand the problem of work injuries during diaper change, the team investigated the market of existing solutions and helping devices. The study was created from desktop research, looking at different online stores and by looking into what the users already have. The goal was to find product categories and a potential hole in the market to help determine the project direction. See more detailed product overview in appendix 7.

WALL-MOUNTED CHANGING TABLE

For smaller spaces with left over wall space, a wall-mounted changing table is an ideal changing solution, see ill. 1.11. It has built in storage shelves and the tabletop can be closed against the wall when not in use. The wall-mounted changing table is therefore a rather flexible solution suited for different types of rooms, whether its in the bathroom, hallway or other. The wall-mounted changing table can be bought at a price point of 1000-2000 DKK. Products with more functions such as a height adjustable changing table, see ill. 1.12, is also available for the daycare workers, however, these types of products are more focused towards institutions as their price point range from 17.000 to 28.000 DKK and require a larger installation. By having a height adjustable feature, the table is more suited to improve the daycare workers work environment, however, lifting and bending will still have to occur in some degree.

[Ill. 1.11]

[Ill. 1.12]

FREESTANDING CHANGING TABLE

The most known changing table is a simple freestanding changing table, some can fold as seen in ill. 1.13, and some have wheels for easy room arranging, see ill x. The freestanding changing table is often a more economic solution with a price range from 399-799 DKK. It is also possible to get height adjustable changing tables (ill. 1.14), which again are more suited for institutions with a price point of 14.000-18.000 DKK.

[Ill. 1.13]

[Ill. 1.14]

CHANGING CUSHION

For the smaller homes where a changing table is too large, the users just have a changing cushion/ mattress (ill. 1.15) placed on a tabletop or the floor. Some of the users specifically mentioned that they change the diapers on the floor, so that they would eliminate having to lift the children, however, they just create distortions in other parts of the body, e.g., the knees by doing this, and at the municipal daycares this would not be accepted. A changing cushion is mostly found at a price range of 179-799 DKK.

[Ill. 1.15]

HELPING DEVICES

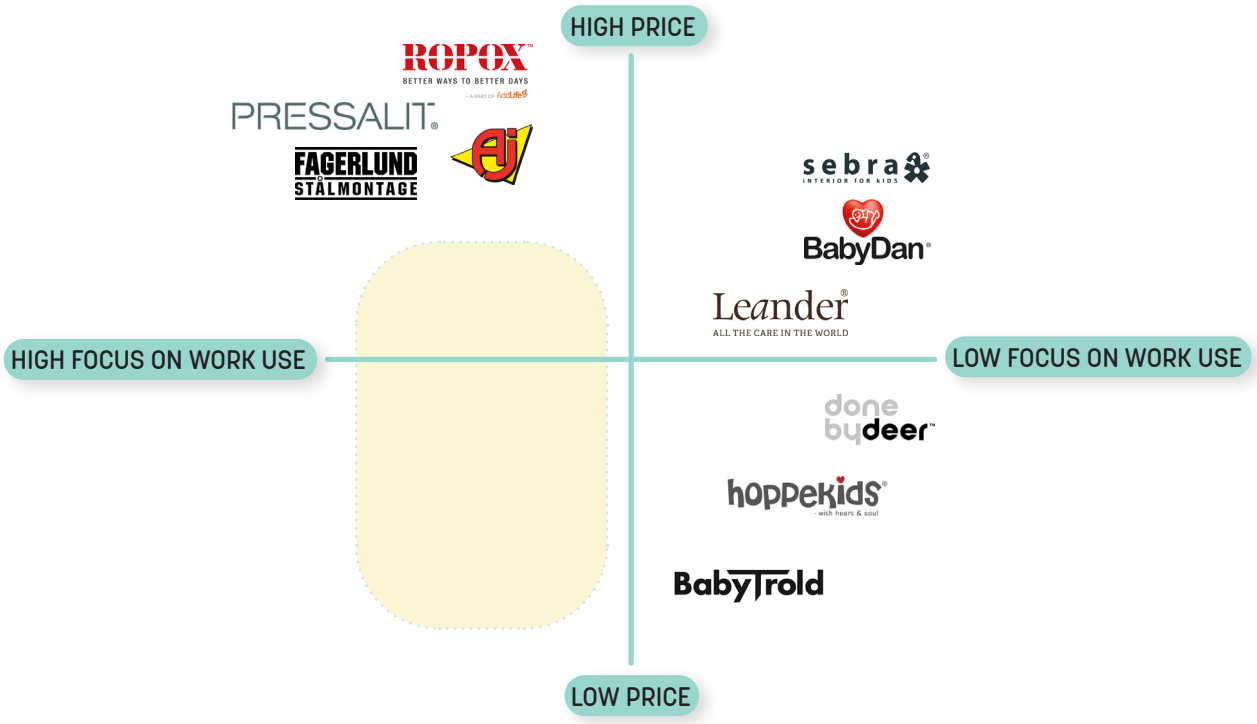
When looking into helping devices specifically, to add onto or alongside another changing solution, three types of products were found. First of two-stepped stools (ill 1.16), where the daycare worker still must lift the child up and down but does not have to bend as far down. A second option would be to use ladders where only the larger children can climb up. Third option is a larger type of stair/ stepladder which takes up a lot of room (ill 1.17.). The three types of products are available at a price point of 129-4000 DKK.

[Ill. 1.16]

[Ill. 1.17]

FOCUS POSITION MAPPING

When looking into different brands the products designed for a changing station, it is obvious that the focus is mostly either on institutions or parents. As seen in the positioning map at ill. 1.18 a large hole is found in the market. There is a need for products that suit the at home daycares with the same context as parents but with the same desire for good work environment as the institution workers. The two biggest factors are the price and the focus on work environment. See appendix 8 for company research notes.



[Ill. 1.18]: Position mapping, focus on work vs price

CONCLUSION

To lower the risk of injuries from lifting the children, two scenarios was detected. The daycare workers either have the option to invest in cheaper changing tables and then ad a helping device, being either a stool, ladder or stepladder. The other option is to invest in big and expensive height adjustable products more suited for institutions. None of the solutions however fully solve the problem or is even designed to realistically fit to the in-home daycares. When having to develop a solution for the in-home daycares, a lower price point combined with the higher focus on the work environment is key.

NEW INFO

There is a large gap in the market for products suited for in-home daycares where the price point is relatively low while still focusing on the functions needed for a daycare worker.

STAKEHOLDERS

To ensure a clear understanding of whom the team should design a product to, a stakeholder overview has been unfolded. The stakeholders are the people who might have needs or requirements necessary to consider for the product to become an overall success. This could be in regards to the buying process, the context of which the product should be placed in and the general use of it.

DAYCARE WORKER (PRIMARY)

The primary stakeholder is the daycare worker. They are the once who the product should be created for, to ensure that its functions are specifically tailored to them and their needs. This means that the product should fit into their home size-wise, but also possibly their style. If the daycare worker is a private self-owning daycare, they themselves are the once who take the decisions on which products they need, and alongside this how much they are willing to pay for it. This means, that the product should not only fit to the daycare worker in size, functions, and aesthetic but also pricewise. The team are in close contact with Hanne and Kirsten and a lot of daycare workers on various of Facebook groups. When asking them about the price point of their existing solutions, the team found that most of them pay between 100-2000 DKK.

MUNICIPALITY (SECONDARY)

The secondary stakeholder is the municipality. In Denmark, there are 98 municipalities. This includes that for the municipal daycares, the municipality decides which products they get or how much money the daycare themselves should have to buy for. The team took contact to Lene that represent Jammerbugt municipality and is the one who decides which solutions Hanne is able to get for her daycare (Appendix 9). An interview with Lene gave insight into the importance of the price of the product, and making sure that the product matches the requirements the municipality has in regards of safety and health regulations, such as a preferable CE-marking. They are willing to pay as much for the products as they think they are worth. So, if they see a solution that is a bit pricey, and they think that it could make a great product for the daycare, then they can choose this solution and not be restricted to the price. Lene also mentioned that they mostly buy products from Nikostine, Babysam or Lekolar. In some cases the products are also bought at e.g. IKEA and might not be CE-marked, meaning that the municipality mostly focus on the functions of the use and the pricepoint.

DAYCARE CHILDREN (TERTIARY)

The tertiary stakeholders are the children. Even though the children do not have a say which products a daycare worker should buy, or how the daycare worker use the product, they themselves are still going to interact with the product. Whether they lie on a mattress or climb up onto the product, the children must be considered. The products materials and shapes should be fitted to engage with a child, regarding their physical size and weight but also of safety and health reasons. There might also be some requirements to ensure the entertainment of the children, this requirement could both have good effects for the daycare worker and the children. The team have the possibility to test on the 6 children from Kirsten and Hanne combined, they range from 10 months to 3 years of age and have very different capabilities.

DEMAND

- The product should be created to fit all three stakeholders
- Estimated max price point at around 3000 Dkk

INITIAL DESIGN BRIEF

PROJECT CHALLENGE
In-home daycare workers who run their own private daycare or a daycare through the municipality at home, are daily put into danger. They caretake children from the age of 6,5 months up to 3,5 years giving a lifting weight for the daycare workers between 6,5 kilos and all the way up to 19 kilos. When looking into the possibility for the daycare worker to lift a child up to 70 times daily with loads between 6,5 to 19 kilos, the daycare workers are daily put into danger with too heavy lifting and distortions created in the body from carrying them around. The problem mostly occurs when a child has to get their diapers changed, as the daycare worker have to lift the child both up and down from the changing mat.

STAKEHOLDERS
The product should be designed to fit into all the three stakeholders' requirements: Daycare workers, the municipality and the children. This indicates being aware of the context of which the product should fit into, being aware of whom has to interact with the children and making sure that the functions combined with the price point is both interesting for the private daycares as well as the municipalities. Overall, the design should fit into a woman's taste, while still being able to fit into different types of homes, however, the aesthetic itself is not a big prioritization for the daycare workers. They are more aware of the price point, the working position the product requires of them, how easy it is to clean but most importantly, how safe it would be for the children to interact with.

BUSINESS POTENTIAL
The market of products including changing tables and helping devices for the diaper changing situation, does not fulfill the needs of an in-home daycare. The products either suit families with low focus on working positions or bigger institutions that have a larger budget for the products. The helping devices that some of the daycare workers can afford, still does not solve the problem of having to lift the child up and down from the changing matte. If they use a stool as a helping device, the child still has to be lifted from the stool op onto the changing matte and down again. If they use a ladder, only the larger children almost ready for kindergarten can climb up onto the changing mat, and they also still have to be lifted back down again by the daycare worker.

EARLY REQUIREMENTS
If future product should require interaction with children it should: Withstand up to 19 kilos and fit a minimum height of 105 cm.

The product should ensure less harmful lifts and carrying before and after diaper change.

The product should fit into different types of confined spaces.

The product should be designed to women's aesthetics.

The product should be easy to clean

The product must be safe for the children to interact with.

The product should avoid shoulder and lower back pain.

The product should be created to fit all three stakeholders.

Estimated max price point at around 3000 DKK.

PROBLEM STATEMENT

"How to create a helping device that prevents multiple lifts for the in-home daycare worker, when daily having to change diapers on the children in confined living spaces."

IDEATION

The second section of the process report 'Ideation' reveals the beginning of early product idea development, created from the former research and initial design brief created in the previous section. By doing ideation on the chosen subject of working injuries at in-home daycares, the team gets the possibility to further investigate and understand the problem, and by this diverge the possibilities, to then easier converge into a more specific project framing. The section will thereby include product ideations and methods for understanding the user better, such as shadowing, interviews and surveys.

IDEATION #1

To start the next phase of ideation, a quick idea development exercise was initiated for the team to empty their heads of ideas coming from the previously done research and investigations. The team grouped the raw sketches, which can be found in appendix 10, by a clustering exercise. [Tollestrup, 2004] By clustering the ideas and putting them in different categories that had something in common, the team recognized a pattern and ended up with three groups: integrated stairs/ladder, height adjustable changing table and folding stair/ladder. In each of the three groups the team together then combined the sketches and afterwards evaluated them by mentioning pros and cons for each concept.

INTEGRATED LADDER ill. 2.1.
This concept idea is based on designing a wall-mounted changing table and integrating a ladder that comes down to the child. The idea is to hide the ladder away under the changing table resulting in few interactions when having to use it.

Pros: The user get two products in one. No need to find a ladder somewhere else, it is already there.
Cons: Only usable for wall mounted solutions with free space underneath. Only the large children can use the ladder and they might not be able to crawl down themselves.

HEIGHT ADJUSTABLE TABLE ill. 2.2.
This concept idea is based on the changing table coming down to the child and lifting the child up to a height that fits a good working position for the daycare worker.

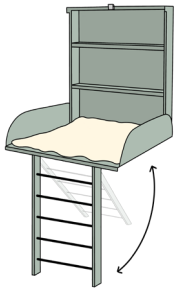
Pros: Just like the first concept it does not require an extra helping solution, such as a ladder.
Cons: Only usable for wall mounted solutions with free space underneath. Need electricity (wiring). Heavier solution. More expensive.

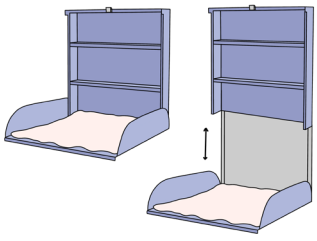
FOLDING STEPLADDER ill. 2.3.
The final concept idea is based on the child themselves getting onto the changing mat, without them being lifted by either a solution or a daycare worker. The concept is a foldable stepladder for easy storage, which the daycare worker then has to bring in front of the changing table before and after diaper change.

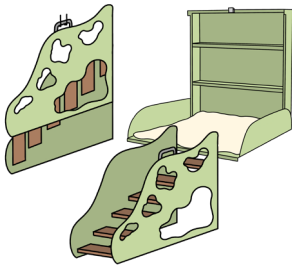
Pros: Do not take up as much space when folded. Is good for the children's motorically skills. Fits to a lot of different types of changing tables.
Cons: Has to be moved back/forth before, during and after use. Take up a lot of space when unfolded.

CONCLUSION
The outcome of this task shows that a more broadly basis of inspiration is needed to investigate the solution space. Two out of three of the concept ideas only fit to one type of changing table. After doing the task the team realized that they needed to dig deeper into what the problem at the changing table is: Lifting the child up and down or distortions when putting the child at the changing mat. This could help the team to find out if they should have a solution space with or without the changing table.

The quick sketching got the team to think about possible solution spaces on a very early stage. By using a method of clustering and creating three new concepts as a team the ideas were easier to evaluate on, as patterns and comparisons were found.


[Ill. 2.1]: Integraded ladder


[Ill. 2.2]: Height adjustable table


[Ill. 2.3]: Folding stepladder

NEXT UP Next step is for the team to dig deeper into where the injuries happen during diaper change.

CORE PROBLEMATICS

To look deeper into the core problematics of the work-related injuries happening during diaper change, the team reached out to the daycare workers through various of Facebook groups. The main objective of the data collection was to identify which movements that create the worst injuries, whether it is when the daycare worker lifts the child op onto the changing mat, or if it is when they place the child on the changing mat, meaning making sure that they lie down properly. Instead of creating surveys, the team merely asked a question directly in the groups, see appendix 11, to get directly answers and insights into the problem. The Facebook question was combined with user observations afterwards, on Kirsten from the user panel, where the team videorecorded her from different angles when getting children from the floor and onto the changing mat.

FACEBOOK-POST

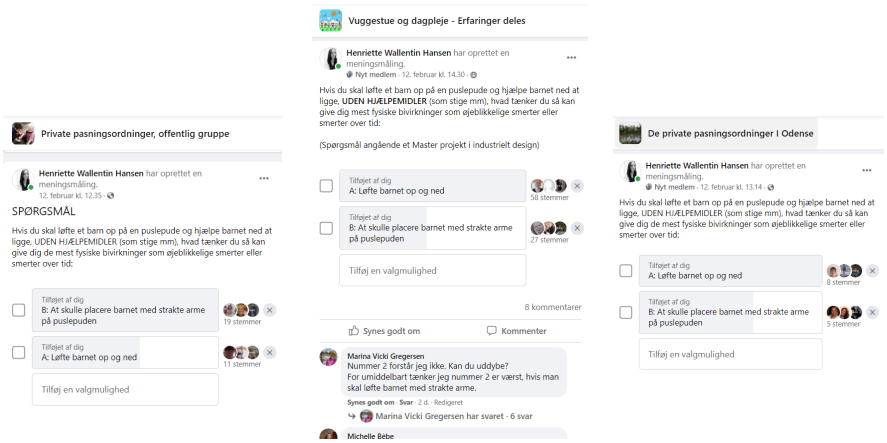
A Facebook-post was created in 3 Facebook groups ensuring answers from both municipal and private daycares. The question asked was quite directly: "If you lift a child up onto the changing mat and help them to lie down, without any types of helping devices like ladders, what would you say would have the worst physical harm either in the second or over time: A: Lifting the child up and down? B: Placing the child with straight arms onto the changing mat?" When gathering the information from all 3 groups **77 had answered A** and **51 had answered B**. The team had hoped that the difference between the two choices would be larger. This led the team to visit the user panel and ask them the same questions and observe them from multiple angles, see ill. 2.5. When asking Kirsten, she said as followed: "If I should choose between lifting and placing a child, **the lifting is definitely worst for me**". Where Hanne instead said as followed: "I think the lifting is worst for the back while the placement is worst for the shoulders and neck. In the end, **it's probably just as bad**".

VIDEO OBSERVATIONS

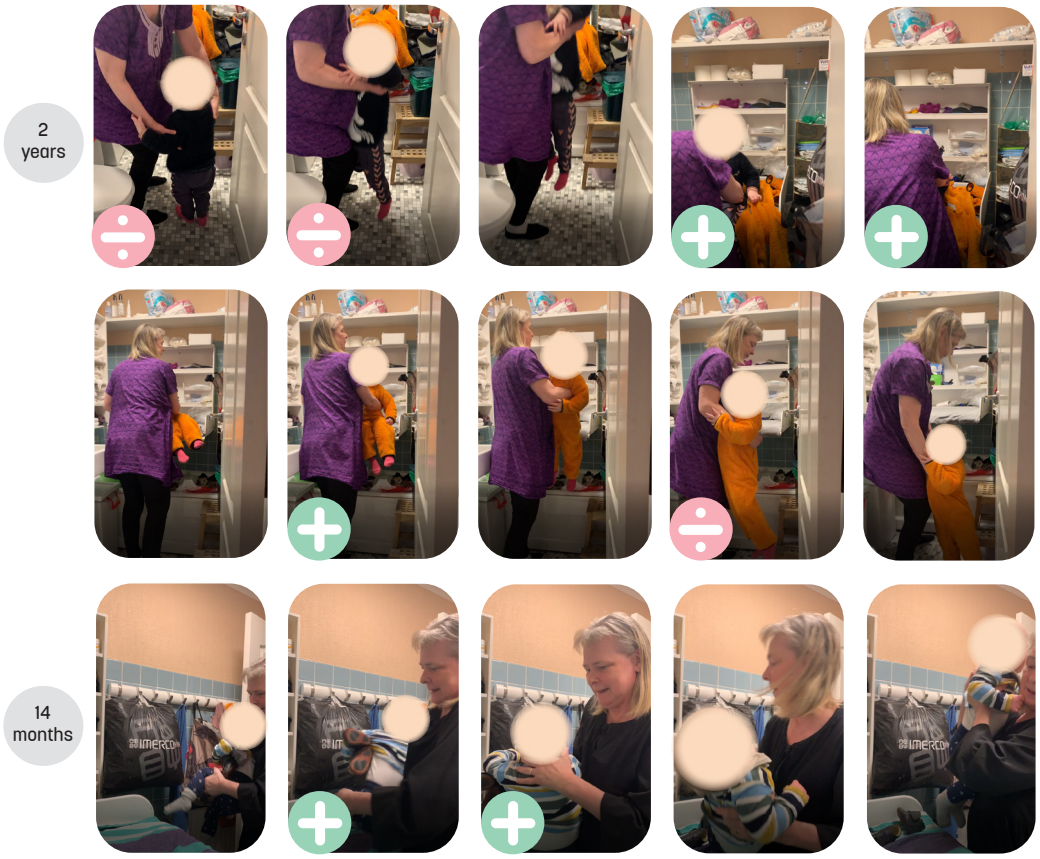
The observations of Kirsten lifting the children, was done on one child at de age of 2 and two children at the age of 14 months. When looking into the videos recorded of Kirsten lifting the 2-year-old child, see ill. 2.5, the child walks from the kitchen and all the way to the changing table where Kirsten then lift the child both up onto the changing mat and back down again. It is noticeable that Kirsten must twist and distort her whole body to lift the child up onto the mat. When she then has to ensure the child is lying down onto the mat, the child is close to her body by ensuring that the child sits down first, and then she pushes the child into the right position.
When looking at the video recordings of the two smaller children of 14 months, see ill. 2.5, Kirsten must carry them both from the highchair in the kitchen and directly onto the changing mat. She is here doing the same thing with the children, where she places them on their bottom first and then lay them down with her arm under their backs. When placing the children onto the changing mat, nothing indicates towards bad posture when comparing it to lifting and carrying the child.

CONCLUSION

From asking the daycare workers on Facebook about whether the lifting or the placement of the child is the worst and from doing observations on the user panel, the team concludes that the lifting of the child is the worst. This is concluded by looking at the lifting of a 2–3-year-old when compared to a smaller child under the age of 2, the lifting only gets progressively worse as the child gets bigger. And when comparing the placement of the children when looking at smaller vs older children, the overall movement is the same. The video observations also showed that the movements seemed more controlled when having to place the child onto the changing mat, as the child is placed on their bottom close to the daycare workers body and then pushed down into the right position. By using multiple methods to investigate the same objective, the team had different viewpoints onto the problem and thereby more information to conclude from. When asking the users questions that might confuse them, as they might seem a bit similar, the team must stay very attentive when looking through the answers. When asking a user about an activity or a movement, of which they at the time of the questions is not doing, the user does not necessarily know what they want or need [Sanders 2006]. The observations and screenshots of the daycare workers doing the movements therefore gave a better look into the problem with far more detail.



[Ill. 2.4]: Facebook posts



[Ill. 2.5]: Observations at Kirstens daycare

NEW INFO

The team concludes that the core problem is lifting the children, especially the older the children are.

NEXT UP

From knowing a bit more about the problem the team now wants to further ideate to create more questions on the subject. The focus should be to create ideas from looking into how other industries lift objects, humans etc.

DEMAND

- The product should work as a helping device to replace the daycare workers lifting of the child, both up and down from the changing mat.

IDEATION #2

By looking into how other industries lift objects and beings, the team wished to get inspired to create new ideas that were more diverse than what came out of the first ideation round. After creating new sketches, the team then clustered them and gave them points in a point value chart to help the team get a better sense of which parameters are the most important when taking the users into account, this should then help give a sense of direction for a further conceptualization.

EXPLORING OTHER INDUSTRIS
The team brainstormed upon different jobs and lifting opportunities and created a feature board with products. The team found 9 types of lifting categories to inspire the team to get more diverse solution spaces. See appendix 12.

SKETCHING & CLUSTERING
From looking at the board of different lifting solutions the team was inspired to create new ideas on something different than what is already found at the daycare institutions. 21 sketches were created, giving solutions that bring the child automatically up to the changing mt, transporting the child by almost flying, pump-up solutions, braces etc, see appendix 13. The sketches were clustered to evaluate the sketches and find similar patterns, by doing this, the team realized that the sketches could fit into the four categories as seen in ill. 2.6.

POINT VALUE CHART (APPENDIX 14)
Instead of just only looking for patterns and categories, the team decided to take all 21 sketches into a point value chart with 9 pre-set parameters from the previously found requirements, to ensure that the concept direction is something that fits all the stakeholders needs, see page 26. The sketches were scored from 0-5 at each parameter, with 5 being the best. Each parameter score was then afterwards multiplied with the value of the parameters. From this, 4 sketches with the highest score of more than 160 point was taken into further evaluation and could be put into the three following categories.

1) MULTIFUNCTIONAL WALL STAIRS
The multifunctional wall stairs show a type of solution where one chooses where to place the steps to climb up towards the changing table. The steps should be placed by a strong suction cup, to enable that the position can be changed depending on what needs or wishes the children want from them. They create a playful environment but has some big safety issues. It does not require a lot of space in the room; however it does still require a specific changing table such as a wall mounted one, or a wall next to it with extra space, or even a counter to crawl up against.

2) STEPLADDER
The stepladder solution show staircases with some sort of support for the children to hold onto when climbing/crawling up the stairs. The stairs can be used for all types of changing solutions, such as a wall mounted changing table or just using a changing mat on a countertop. The product ensures that the daycare worker does not have to lift the children, the children do the work for them, and at the same time, the children learn more about moving their body and enhance their own skills.

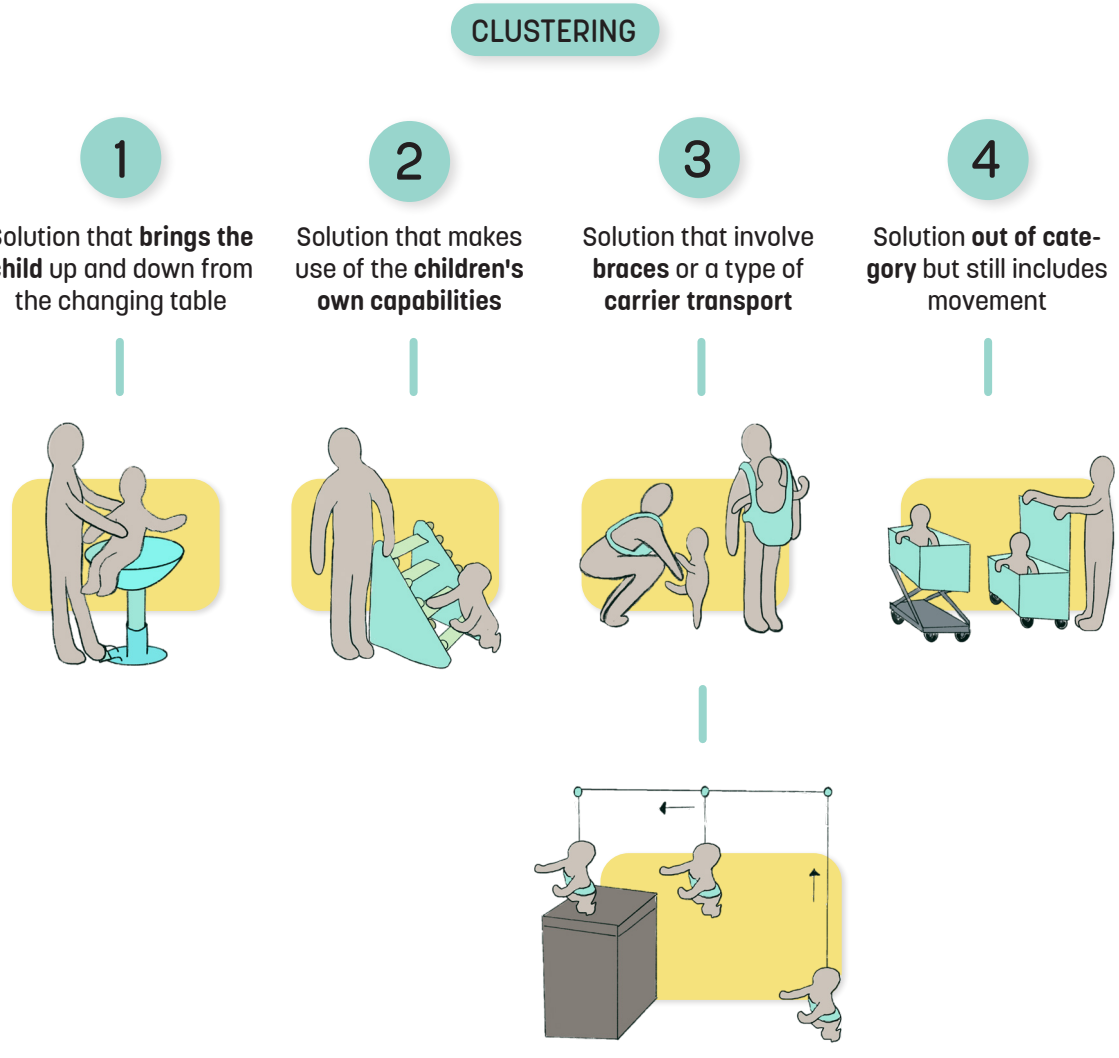
3) BABY CARRIER
A baby carrier type of solution much like a regular baby carrier, was designed for the children to easily get into, much like a kangaroo pouch. It however still means that the daycare worker must bend down to get the child, and still means that they have to lift the child. It only ensures a more stable carry process, with more added mobility for the daycare worker.

COMPARISON
Even though they all have overall good points/ high scores, as seen in the chart on appendix 14, two of the directions are questionable to continue further work with when looking at how they score in the two most important parameters, 8 + 9, on the safety of the children and on solving the challenges of the daycare worker. The multifunctional wall stairs only score 1 point on the children's safety, because of the suction cup having to withstand up to 19 kilos, as well as being able to remove and replace. If the concept idea had to be safer, the steps should be permanently attached to the wall, meaning that it would have far less points in parameter 7, 5, 4 and 6, of which it had 5 points, giving the reason as to why the score is so high. The baby carrier solution does not solve the daycare workers actual problem, when looking at only 1 point at parameter 9. It would therefore not make sense to go further

with this direction either. This leaves the team with one direction “stepladders”, if however, the focus is on minimizing the space uptake in the room when not in use.

CONCLUSION

After creating a new ideation round from looking at different industries on how to lift heavy objects, 21 sketches were created. All sketches were valued with a high score on how well they performed on 9 chosen parameters created from the stakeholders’ requirements. From looking at the three concept directions that scored the highest points, one final concept direction was chosen: A, preferably foldable, stepladder of which the children themselves can crawl up onto the changing matte from, and back down again.
By getting inspiration from other industries, I helped the team to make more diverse sketches. By clustering these newly created sketches, the team had the possibility to find patterns and evaluate them. This made it clearer for the team that a point value chart could be a good method to use afterwards, to ensure a better look into how the ideas solves the problems and how they matched with the stakeholders’ requirements. The point value chart also makes sure that the team does not take any subjective decisions but take decisions that make more sense for the users.

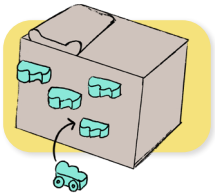


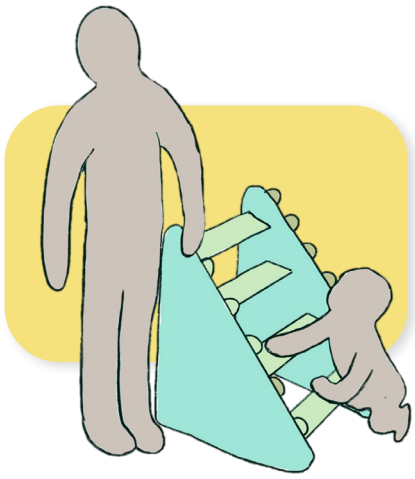
[Ill. 2.6]

POINT VALUE CHART

1. Easy interaction for the children
2. Easy interaction for the daycare workers
3. Good cleaning properties
4. Number of features / price (No. of features often result in higher prices)
5. Space uptake needed
6. Easy to remove after workday
7. Ability to fit into different types of homes
8. Children safety guarantee
9. Solve the daycares challenges (Pain, inconvenience etc.)

3 CONCEPTS





[Ill. 2.7]

NEW INFO

The team found a set direction on stepladders for the further conceptualization. Stepladders would solve the daycare workers problems by making sure that the children themselves do the hard work by crawling up and down from the changing mat themselves, rather than having the daycare workers lifting them. This also results in a better learning environment for the children.

NEXT UP

After choosing a product/concept direction to lead into, it was now relevant to investigate which features that are the most important for a stepladder solution, enabling the children to themselves crawl up onto the changing matte.

DEMAND

- Children must be able to themselves crawl up onto the changing matte

CONCEPTUALIZATION

Through the ideation phase, the team found a set direction for the product solution to solve the daycare workers problem of lifting the child up and down from the diaper changing mat. The conceptualization phase will now further investigate this direction and get further towards a final concept idea ready for detailing.

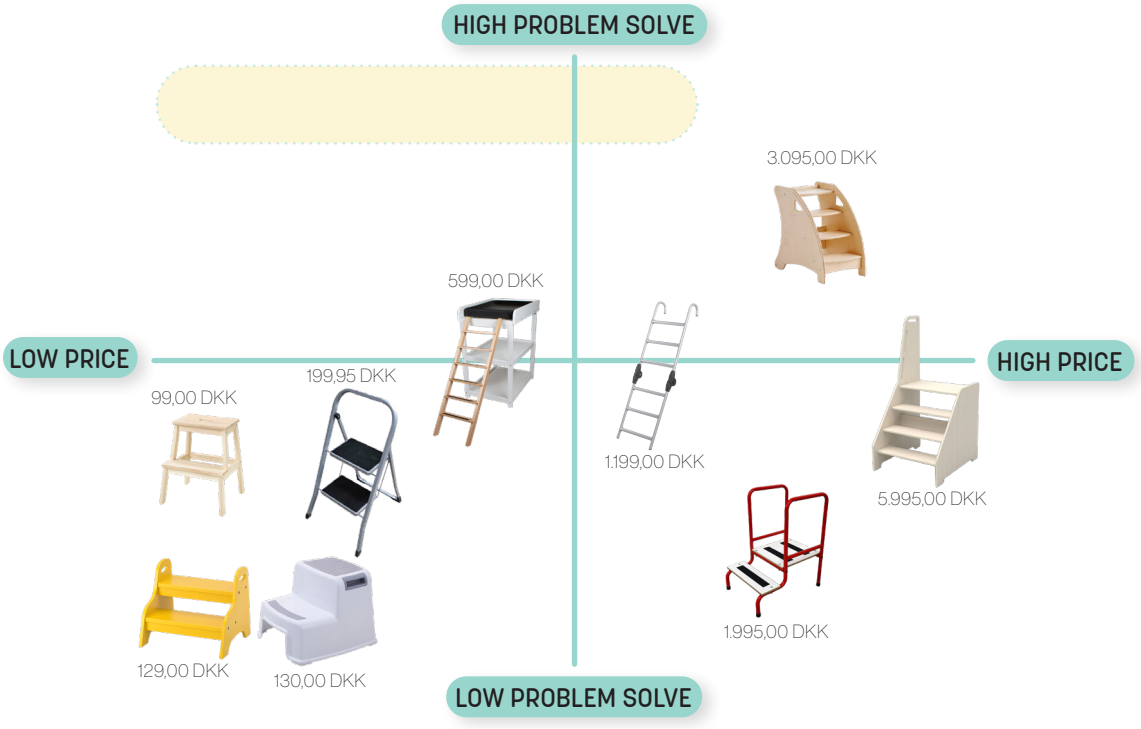
MARKET RESEARCH

From choosing stepladders as a further direction, the team had to look further into the market of existing solutions. Just as in the previous market research, found on page 16/17, the teams focus is on the correlation between the products price point and its ability to solve the problem, of ensuring the daycare does not have to lift the child. The objective of this market research is to find a more specific market potential area for a following solution to still be outstanding. The information for the market research was gathered by desktop research as well as looking at different stores. The team also looked at the pictures reviewed from the daycares from the first survey and studied which products they already use.

As seen in ill. 3.1. the team created a mapping comparing products on price vs how well they solve the problem, of the daycare worker having to lift the child. Afterwards the team unfolded some more details on each product as seen on ill. 3.2 to 3.6. Most of the daycares choose a simple and cheap solution that has the possibility to be used for different purposes. However, when looking at the mapping in ill. 3.1. none of the existing solutions solve the problem. The daycare workers must to some extend lift the child. The team therefore found a gap in the market for cheaper solutions that has the ability for the children themselves to crawl all the way up onto the changing mat and back down again, without any lifting from the daycare workers. The products were evaluated on the price, as it was found important for the users that the solution is in a price range they can afford. The products found has a price range from 130 DKK up to 4.795 DKK. From looking at the mapping, it is also noticeable that the price changes rapidly according to the type of function in the product. The team also chose to incorporate "safety" and "storage ability" as a part of solving the problem, as a lot of the daycare workers would not have the ability to store all types of products in their private homes. When looking at the mapping only a few of the solutions are easy to store before and after use without taking up any unnecessary space, also, if it has good storage abilities, it is more expensive.

CONCLUSION

When looking at the existing solutions on the marked and what the daycare workers already have in their homes, it is obvious that there is a need for a new solution to ensure that the daycare workers daily challenges are improved with a product that ensures safety for the children, can fit into their confined living spaces and help get the children from A to B without any lifting.



[Ill. 3.1]: Position mapping, price vs problem solving

WOODEN LADDER - PRICE: 599 DKK

[Ill. 3.2]

PROS
- Anti-slip on the steps
- Includes flat bracket that fits under the changing cushion

CONS
- Sticks out into the room
- Not easy to set aside, because of brackets
- Scary for the children to crawl down from

IKEA BEKVÄM STOOL - PRICE: 99 DKK

[Ill. 3.3]

PROS
- Hole in the upper step make the stool easy to move.
- Easy to wipe of with a cloth
- Wide steps

CONS
- Only two steps
- Only 50cm heigh Children are not able to reach the changing mat without any lifting

ODDER COLLAPSIBLE LADDER - PRICE: 1200 DKK

[Ill. 3.4]

PROS
- Foldable to half size
- Easy to store and hang up
- Handles support the cushion as antislip

CONS
- Cold metal
- Round steps are unpractical/unsafe
- Scary for the children to crawl down from

CONSTRUCTION STAIR - PRICE: 375 DKK

[Ill. 3.5]

PROS
- Foldable
- Handle in the top for easy transport
- Antislip on feet and steps
- Railing support

CONS
- Only 2 steps
- Only 30cmx20cm Children are not able to reach the changing mat without any lifting
- Fingers may get pinched
- Cold railing support
- Handle in the top interfere the children

KLATTRA STIARS - PRICE: 3.095 DKK

[Ill. 3.6]

PROS
- Smaller children have better crawling opportunities
- Material on both sides makes it look safe

CONS
- Takes up a lot of space in the room both before and during use
- Looks very heavy

NEW INFO

Through market research, a gap in the market was found, for cheaper alternatives that solve the daycare workers challenges while ensuring good safety for the children.

NEXT UP

The team must do further research as to how the age gap of the children in a daycare would have effect on how they would be able to crawl up onto a stepladder, as the age gap results in big capability differences.

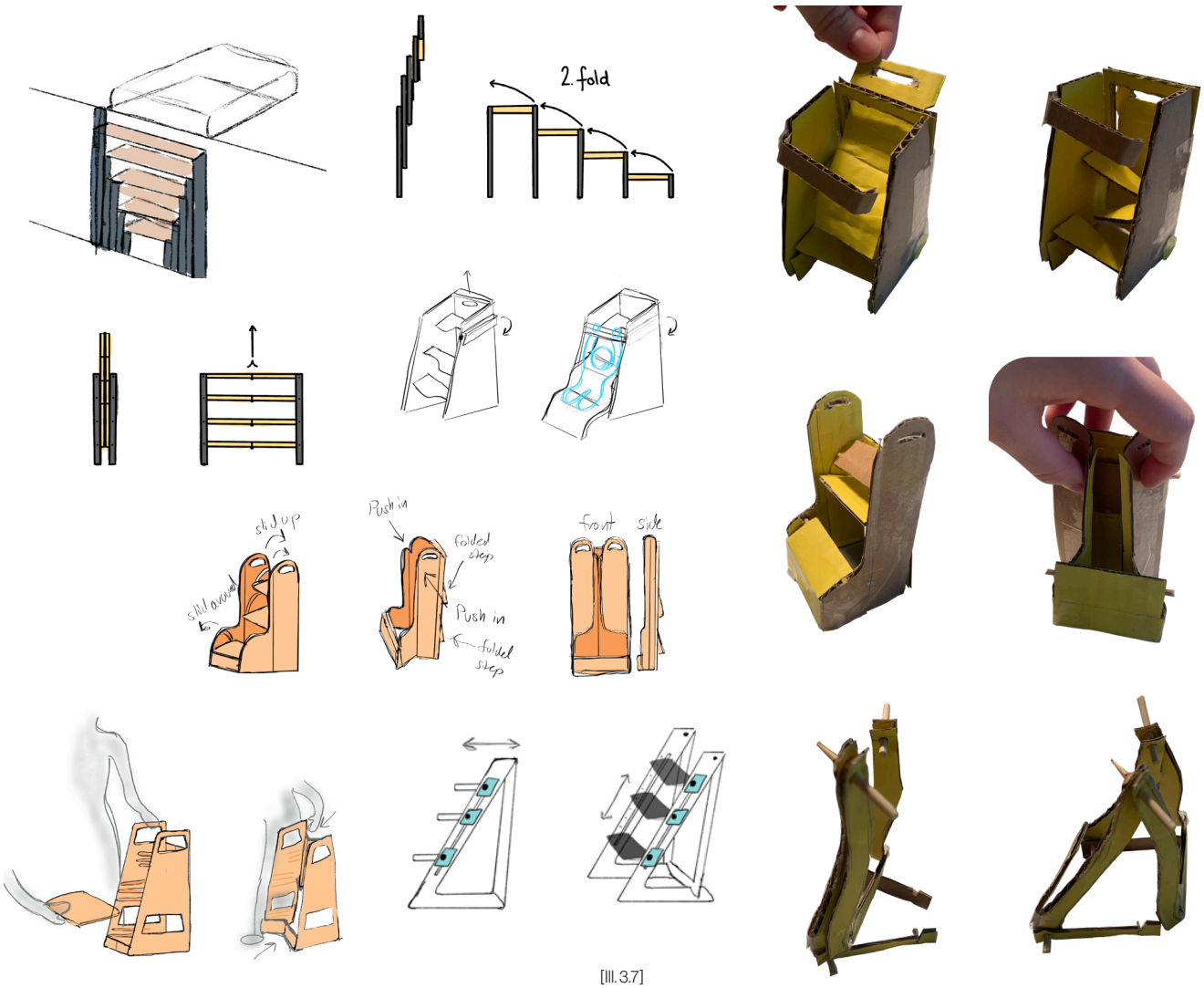
DEMAND

- Should fit into confined living spaces during and after use.
- Should fit to different types of changing table solutions.
- Should ensure that the solution fits multiple age gaps.
- Should be stable and safe for the children to use, including when they both crawl and walk up.

IDEATION #3

From looking into existing solutions and realizing what they lack of, the team wanted to create another ideation found to spark more ideas and thoughts upon the challenge. To ensure inspiration for the sketching, the method used for this ideation round was a principle of "what if", where the team have several what if questions to sketch from. After creating the sketches, the team evaluated the good and bad things from each concept to ensure more insights into the sketches and the challenges, mockups of some of the sketches were in this case necessary. See appendix 15. for full exercise materials. From the evaluation of concepts, the team wanted to ensure maximum understanding, and thereby afterwards created a new survey for the users found on the multiple Facebook groups, see appendix 16.

From the "What if" questions, a lot of different stepladder ideas appeared. The evaluation on the concept ideas resulted in the team realizing following: **1:** Height adjustable steps might not include more ages and could just be unnecessary. If the steps are created for the smaller children, then the bigger children will be able to use it as well. **2:** When adding attachments to a solution, such as brackets for the solution to hold onto a changing mat, it might not be possible for everyone to fit the solution into their homes, as the brackets would not suit every kind of changing table. **3:** The product should not have to be multifunctional regarding the children's entertainment, as the solution should be distraction free to enable the children to get from A-B as easy as possible for the daycare workers. It would however be preferable if the solution could be multifunctional in terms of other purposes for the daycare worker e.g., for when the child has to was hands at the sink, change clothes before going outside etc.



[Ill. 3.7]

SURVEY (92 responses)
From the ideation the team had the following questions to ask the users, see appendix 16:
-Do you recon it would be a good or bad idea to include railing on a stepladder of which the child itself has to climb up onto the changing mat?
-How many steps do you recon would be necessary for the children to get from the floor and up onto the changing mat?
-Where do you already store your stools and ladders? And are they at that same position most of the day?
-Where would you prefer to store a foldable stepladder?

SUPPORT RAILING
The survey answers show that 67% think that a railing on the steps would be a disadvantage, with the most common elaboration being that it would take up too much space between the daycare worker and the child, as they wish to get as close to the child as possible, in case they would need a hand on their way up. A lot of the users also commented that the children might not use the railings, as they use the steps to push themselves up if needed. This could indicate, that having a closed step for safety reasons could have negative effects regarding their possibilities to crawl up. The biggest advantage to use a railing would be to support the children to not fall out from the sides.

STEPS
When looking at other stools, ladder, and stepladders they seem to have between 2 to 8 steps. The survey shows that the most answered would be 3-5 steps. However, this question would need testing on different mock-ups to get a final answer on.

STORAGE OF PRODUCTS
The survey showed that the users store their products in 6 different ways: 1. Pushed under the changing table. 2. Placed in another room. 3. It stays, where it should be used. 4. Folded and stand up against something. 5. Folded and placed behind a door and last 6. Hanging it up. When asking the users of where they prefer to store a helping device to a changing solution. 4 topics were highlighted: Beside the changing table (53%), in a closet (16%), behind a door (12%) or hanging it up (19%).

CONCLUSION
The ideation round sparked a lot of thoughts and questions regarding the functions of the product. The challenging “What if” questions gave the team some interesting directions, such as a solution that could act as a multifunctional product. However, from creating the idea the team realized that the solution should be a helping device for the daycare worker, and not a piece of furniture for the children’s pleasure, who is placed as a tertiary stakeholder. The task also gave the team insights into different questions that needed to be answers before adding a lot of different functions. A huge percentage from the survey think it is a disadvantage to have a rail support. Most answers think that 4 steps are necessary where 3 and 5 steps come next. Lastly, the team got informed of 6 places of which the user already stores products, however, for this type of product the user would prefer to store it close to the changing table to easily having it ready for use.

NEW INFO

It is important to remember that the stepladder is a tool for the daycare worker, and thereby something that should get the child from A-B without too many distractions. If the product should have railings, they should not interfere in between the daycare worker and the child. The product should preferably be stored as close to the changing table as possible.

NEXT UP

The ideation and survey resulted in a lot of information, however, some of it has to be tested in context for better understanding.

DEMAND

- The solution should be foldable
- The solution can be multifunctional for the daycare workers advantage

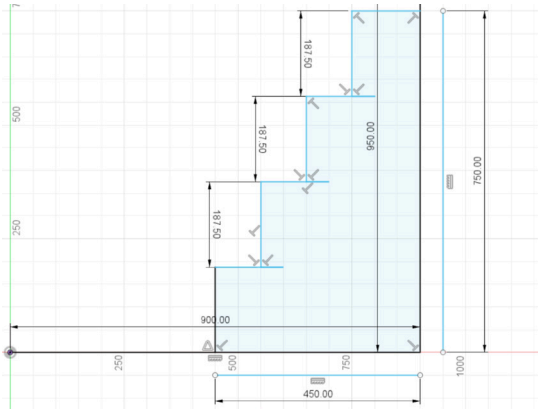
STEP DEVELOPMENT

Instead of looking further into which kind of stepladder-concept the team should create, the team started investigating the necessary part functions of the stepladder as these overall could create a solution. The team therefore started investigating the dimensions of the steps which should lead to dimensional answers fitting the smaller children as well. The research was created by looking at the sizes of existing solutions and statistics of the children's sizes and capabilities depending on their ages, see appendix 17. The team also wanted to look further into, depending on the steps dimensions, how deep the stepladder overall would be, and thereby how much space uptake it would need. The team mostly used methods of 3D sketching to visualize the steps in a 1:1 ratio when looking at the maximum space uptake.

From the survey created in ideation #3 the team found it necessary to test several steps of 3, 4 and 5 to fit a height of 85-95 cm from the average height of changing tables and countertops. [Online Dreams, 2018] When looking at the average size of the children's feet from the ages six months and up to 2,2-3 years, there is a span from 9,9 to 14,7 cm. [Measures of man]. This means that the steps would have to be at a minimum 14,7 cm deep. When also looking at the existing solutions we see a step depth of 13-25 cm, and from research done, the team found a number of 20,32 cm when looking into playground stepladders. [U.S. Consumer product safety commission, 2008]. On the existing products used, the step distance is between 13-25cm.
Regarding the length of each step and the dimensions of the children, the team found that their hips have a span from 15,9 to 19cm. Their average dimension from shoulder to shoulder is between 20,8-24,3cm [Measures of man] and when looking at the existing solutions, the step length is between 24,40-38cm. Lastly, when again looking at stepladders on a playground, the length should be 30,48-53,34 cm. [U.S. Consumer product safety commission, 2008]. The team chose to try and work with 30 cm. as a starting point.

3D 1:1 SKETCHING (Overall depth & height)

The team then investigated the maximum space uptake for a product to fit into multiple types of confined living spaces. The team talked to the user panel, Hanne and Kirsten about how much space they would be able to fit a product into, this resulted in a maximum depth uptake of preferably 90 cm. When looking at a maximum height compared to other products and counter surfaces, the team set a maximum height of 95 cm. From having some overall step requirements, the 3D 1:1 sketching could begin. The team primarily focused on the depth and height of the total stepladder, to figure out how many steps the stepladder should have, and the distance between these. The team created multiple solutions. The team chose the best solution to be with 4 steps with 18,75 cm, depth of 15 cm and length of 30 cm, resulting in making the top of the stepladder work as a step itself up onto the changing surface. See ill. 3.8 and appendix 18.



[Ill. 3.8]: 1:1 sketching

CONCLUSION

From looking into the measurements of different products and the surrounding context of which the solution should be in, the team found a span for the dimensions in regards of the step depth, step length, step distance and thereby also the stepladders total depth and height. The team concluded that the stepladder should have 4 steps with the step distance of 18,75 cm, a depth of 15 cm and a length of 30 cm, resulting in the stepladder being 45 cm deep and 75 cm high.

NEW INFO — Total overall dimensions of the stepladder from a sideview, should be roufly 45 cm deep and 75 cm high.

NEXT UP — The dimensions set should be tested by the children to ensure a validated answer.

DEMAND
- Need to fit into a maximum area of 90 cm deep and 95 cm high.
- The step dimension should be:
  step distance = 18,75 cm, depth= 15 cm and length= 30 cm.

VERIFYING STEPS DIMENSION

From having some overall set dimensions for the stepladder, the children were tested on a mockup created by the set dimensions from previous section, and with the possibility for both the smallest and bigger children to crawl/walk up and down from. The mockup itself was created by various of soft materials at Kirsten's daycare and tested by three children, two at 14 months who can only crawl and one at 2 years of age who can walk and run. The objective of the testing is to verify the dimensions and reassure that the smallest children can use it as well.

When looking into how the children at different ages climb and walk up and down the steps on the mockup, the team found the following: The oldest child at the age of 2 takes one step at a time and gathers both feet at each step before continuing. She also supports herself, using her right hand on the sides of the mockup. When she had to walk down, she turns around to easier see where she steps, while still holding the side for support.

When looking at the first of the smallest children, not able to yet walk, crawls up onto the mockup, the team observed that she uses her knees and feet a lot, and takes one step at a time without pausing as the bigger child. She therefore mostly has one knee and one foot on the steps and then continues. When she almost reaches the top, she looks for support, and when she crawls down again, she takes on foot at a time and occasionally looks back to see where she should step, but otherwise uses her feet to guide her down. The last child at also 14 months, not able to walk, crawls similarly to the other child at same age, however, when he crawls down, he uses his hand more to support himself.

CONCLUSION

From observing the children both crawling and walking up and down the steps, the team were able to conclude that the step dimensions work great, both for getting up and down. The team also found that support in maybe just one of the sides, could be a big help for the bigger children, for them to hold onto. The smaller children do not really seem that interested in support, however, it might lead them to focus on crawling upwards and keep them safe, as they in some ways are guided through a path. Regarding the mockup itself, as it was created of soft materials including a sofa with rounded edges, it looks more welcoming and safer for the children to crawl up and down from. If it was made from wood or alike, the children might have been more afraid of trying it. However, the soft materials also meant that the children sometimes seemed a bit insecure, as the cushions moved underneath them.

[Ill. 3.9]: Step mockup

NEW INFO — The chosen dimensions can be used for both small and bigger children.

NEXT UP — The team must observe more children crawling and walking up and down from different types of steps, to ensure more insights into their capabilities before finalizing the measurements for the steps.

DEMAND

- The product should look aesthetically welcoming and safe for a child to use

STEP SHADOWING

As a follow up to the previous two sections, the team now wanted to observe more children crawling and walking up and down from different types of steps. This was done to get more insights into which dimensions seem to be more fitting to the children's capabilities, and to observe even further how the children act when crawling/walking the steps, where they put their fingers etc. A visit to both Kirsten and Hanne from the user panel made it possible to test on 6 children combined with an age span from 10 months to 3 years. The observation was done by taking videos and pictures to analyze afterwards.

THE MUNICIPAL DAYCARE AT HANNE
At Hanne's daycare, the team were able to observe the children try out two types of stools and one ladder. The youngest child is 10 months and had just started to crawl, mostly still on her belly. The middle child is 1 year and 3 months and can walk but still unstable. The oldest child is 3, almost ready for kindergarten and can both walk and run controlled. See ill. 3.10.

PLASTIC VS. WOOD STOOL
All three children tried climbing on the plastic stool, however, only the oldest tried to climb the wooden stool. Even though he had full control of walking both up and down the steps, it was noticeable that he was more hesitant with the wooden stool. Hanne mentioned that it might be because of the harsh materials and sharper edges, the further testing was therefore only done on the plastic stool, as the two smaller children had never tried climbing steps before. The smallest child, only capable of crawling on her belly, was able to crawl up onto the plastic chair, and it was noticeable how quickly she became better at it for each time she tried. This entails that even the smallest children, whom the steps feel the biggest for, can become more comfortable with a product/solution in a matter of maybe weeks, and hereon feel more comfortable using the steps. She was very stiff in her legs in the beginning, when she first tried, but learnt more about how to move her legs afterwards. The first step on the white stool, was not a big problem for her to get up onto when she had tried it multiple times, but from here, it was a big challenge, the step on this stool is around 20 cm high, but the big gap in between the steps still feels scary, as they can get their feet into this hole. The fillets/curves on the upper step also means that the children must get further up onto the next step before they feel like they are fully up there.

STEPLADDER
The two oldest children tried using the stepladder, only the oldest child can fully climb up, however, if he were to climb down himself, he is very scared because of the steep angle. And Hanne also points out that having to hold the child on their way down is more physical for her than just lifting them down. The second oldest child did not like climbing the ladder, this meant that Hanne had to lift him between each step, and make sure to hold him tightly all the way up, as there is no step for him to lean onto, in case he falls or let go. Hannes body has to be rather stiff for holding the ladder in towards the table, while making sure that she holds the child all the way up.

THE PRIVATE DAYCARE AT KIRSTEN
The visit to Kirsten's daycare had more focus of generally trying objects with steps, rather than just existing solutions. The children observed was two at 14 months only capable of crawling and one at 2 who's able to walk and run.

OUTDOOR SLIDE
When one of the younger children tried climbing up the steps to the slide, he uses both hands to hold onto the back of the steps and pull himself up until he can stand on the first step, but he would not get further up than this as the steps seemed too difficult for him. When the oldest child tried the steps, she easily takes one foot at a time while holding the side supports.

PLAYGROUND TOWER
When the children tried climbing up onto the playground tower, it was noticeable that the smallest children take a lot of time to climb up, as they take breaks on each of the big steps and play with the sand. The bigger child climbs up quicker and does not get as distracted, she however looks more for support on the sides to hold onto.

SOFA
The smallest children tried climbing up and down from the sofa with a step depth of 20 cm. The step depth made it difficult for them to reach the next step on their way up, and it also seemed to make them slide more on their belly when trying to crawl back down again. The team then

rearranged the sofa to a depth of 15 cm, and this seemed to make them crawl faster and more confident.

OUTDOOR CLIMBING TRIANGLE

The team wanted to test the children on something a bit more challenging as well, such as a climbing wall. The larges child was able to do it alright, but it still seemed difficult. The smallest children however really wanted to try but did not know how to.

CONCLUSION

After testing different steps on children and evaluating the different solutions the dimensions where redefined. The distance between the steps, e.g., the height of which the child should step/crawl, is said to be 18,75 as previously. The bigger children can step up to 40 cm. however, when thinking about the smallest once, 18,75 seems like a very good match with their size. The depth of the steps is changed from 15 to 18 cm, but still having the steps overlapping with 5 cm. This should give the smallest children a bit more space when having to navigate both up and down the steps. By overlapping the steps, it also creates more security as the children wont step down into a hole. The length of the steps was before set to be 30 cm. However, when talking about the importance of having support in one or each side of the product, the step would feel smaller for the youngest children. The dimensions should therefore be closer to 40 cm.

The team got a lot of information from using the method of shadowing, where the team just observed without interfering with the children. The team were able to get a better glimpse of how the children behave on steps, how they use both their hands, feet and knees during the whole situation. It was also very interesting to try and push the children to do something new that seemed a bit uncomfortable, to really challenge their capabilities and see what they in the end where able to do.

[Ill. 3.10]: Step shadowing at Kirsten and Hannes daycares

NEW INFO

Even the smallest children barely crawling, were able to take steps and quickly learn how to get up and down. New dimensions were set to Step depth: 18 cm. Step length: 40 cm.

NEXT UP

The team now wishes to go back into conceptualizing a solution before testing yet again. However, the chosen dimensions should still in the future be tested on a 1:1 mockup of the concept.

DEMAND

- The steps should not distract the children
- The solution should have side support for the biggest children
- The step dimension should be:
  step distance = 18,75 cm, depth= 18 cm and length= 40 cm.

IDEATION #4

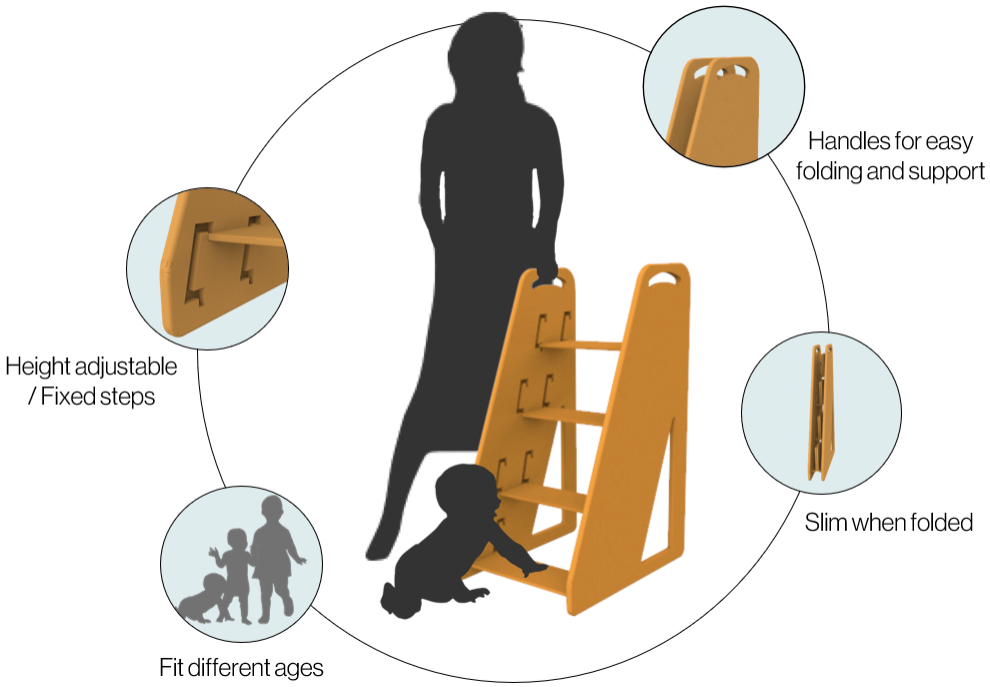
After doing a lot of observations on children using steps, the objective is now to further concept development. The goal is to end up with concept ideas in three directions, which should then afterwards be even further investigated. This ideation round makes use of methods such as brainstorming, on previous sketches created in ideation #3 and creating inspiration boards on folding opportunities. To then go more into details and get a better sense of the size ratio, 3D visualization was used when having to create three new concepts in each of their own category.

BRAINSTORMING

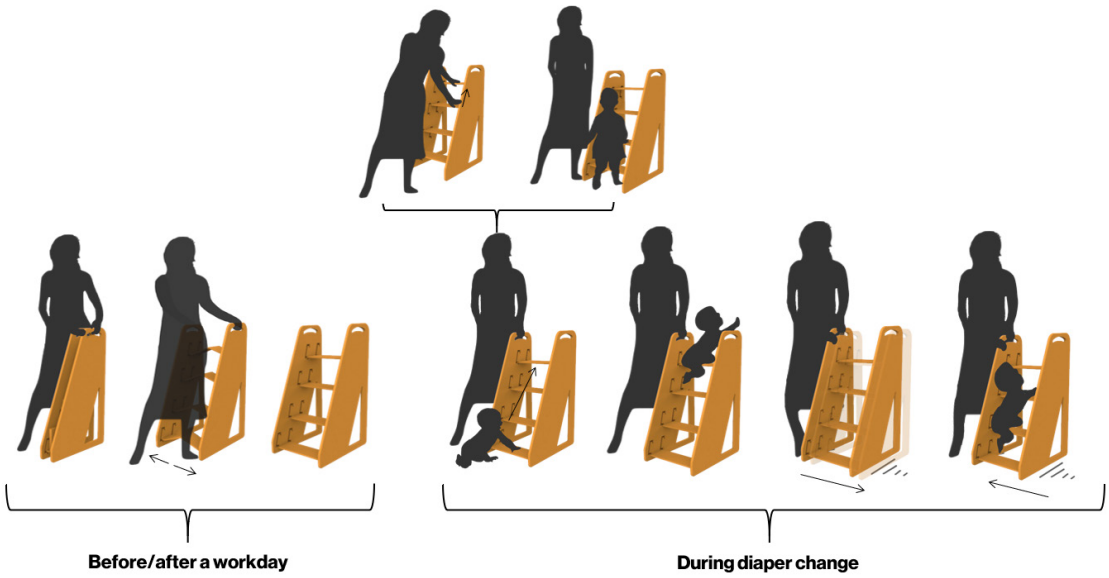
A brainstorm was first generated to find concept categories, see appendix 19. The categories found to further unfold was: “Foldable (Extreme)”, “Size adjustable (Fit different ages)”, “add on to existing solutions e.g., directly to changing matte” and “can help the children down (without lifting)”. Because of the daycare workers confined living spaces, the team also created an inspiration board of different kinds of folding options, see appendix 20.

FROM SKETCH AND CARDBOARD TO 3D

From looking at the ideas created in ideation #3 and the cardboard models, the team now started developing three 3D solutions as a reflection of the new categories combined with the concept ideas. The team chose to eliminate the thought of entertaining the child, as the observations showed how distractions can cause the children to slow down when having to use the steps. And, to not create an add-on product as the solution should be able to fit to as many surfaces as possible. The team then ended up with three new solutions all of them being foldable and one of them being size adjustable and one multifunctional as well.

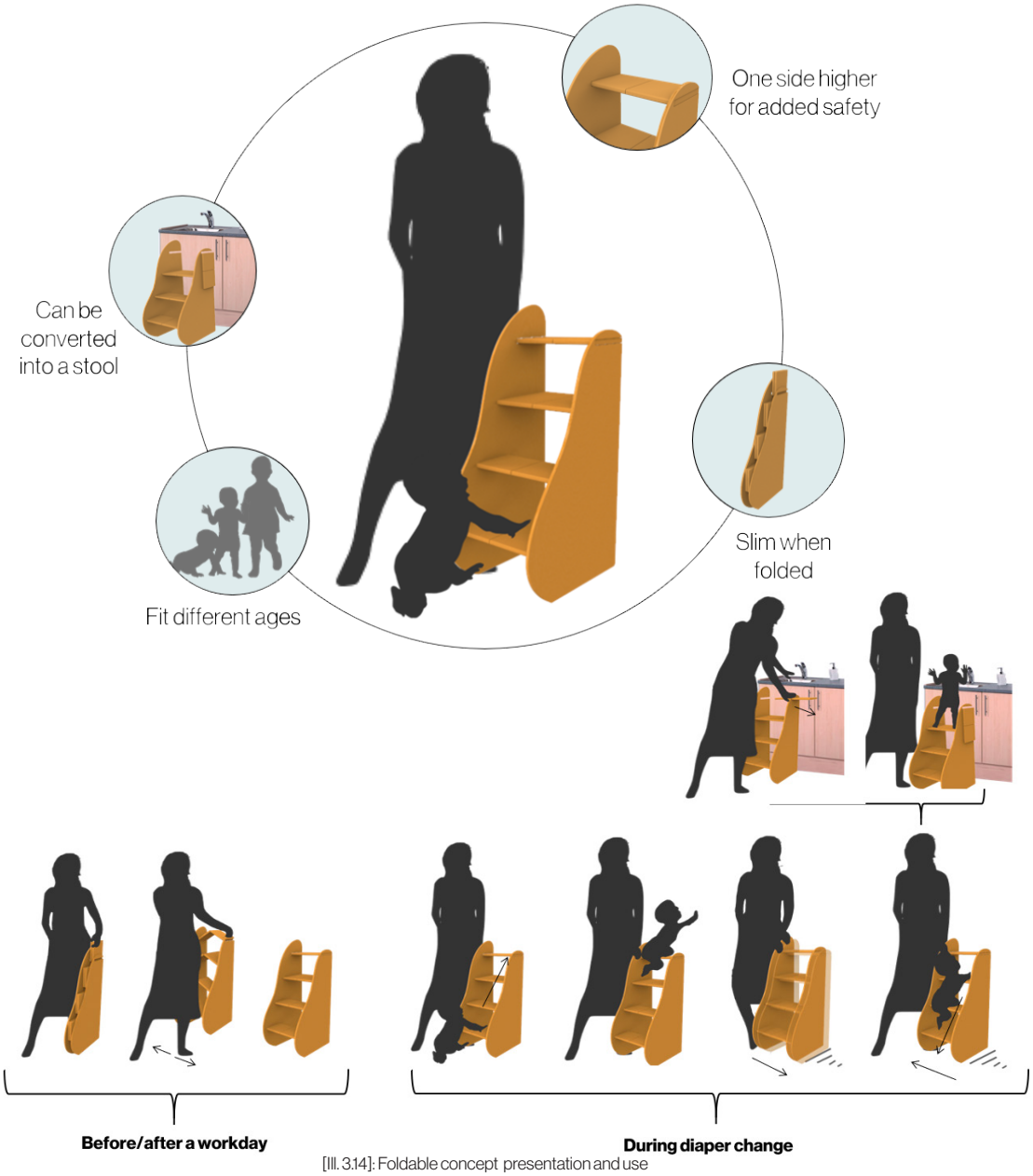


[Ill. 3.11]: Size adjustable concept presentation



[Ill. 3.12]: Size adjustable concept use

[Ill. 3.13]: Foldable concept presentation and use



[Ill. 3.14]: Foldable concept presentation and use

CONCLUSION

From creating the three concepts the team started speculating more about making sure that the aesthetics and the folding technique could correlate, and this is something the team want to investigate further. Another idea was also to instead of thinking about eliminating entertainment for the children, then maybe use it as a tool to motivate the children from step 1 all the way up to the upper step, this could be by storytelling or adding something on the steps, the balance of distractions should though still be there. When looking specifically at the concepts created, the team was very excited about the thought of having a multifunctional stepladder which could turn into a stool. A stool is especially during the Corona times used for when the bigger children must learn to wash their hands and sanitize. A 2 in 1 product would also mean that the private daycares or the municipality would have to buy one less product. The method of 3D sketching and visualization makes it possible for the team to easier get a grasp of the size and the overall idea behind the concept and thereby creating fast new ideas. However, the team also concluded that the concepts look too much alike to present them to the users.

NEW INFO Multifunctional products could be a good way to save both space and money for the users.

NEXT UP The team want to present concepts for the users, but more diverse than what was created in this round, and even concepts of which the team does not find suited but adding them in anyways just to get the daycare workers thoughts on them.

CONCEPT DIVERGENCE

After creating the three similar concepts in previous section, the team now wanted to create more diverse concepts for the users to easier distinguish between, and thereby ensure more precise feedback on which features and functions they would wish for a stepladder to have. The team used brainstorming to find new concept directions and afterwards created a new survey to enable the users to share their feedback.

From brainstorming, as seen in appendix 19, the team found 5 total concept directions, including the 3 directions from previous section:

1: A simple stepladder
2: Convert into a stool
3: Incorporated storage unit
4: Convert into a toilet assistance/small stool
5: Convert into a playful object

The team then shared the concepts with the users and had 33 responses. Overall concept 2 was the primary favorite, then followed by concept 1. Concept 4 and 5 both had very mixed responses, where the users either thought it was the best idea or the worst. Regarding concept 4, the users either loved or hated because of hygienical problematics or generally having to move the product from one room to another according to the use of it. And regarding concept 5 they either loved or hated the aspect of a diaper changing solution working as a “playground” area as well. A few points have been summarized for each concept on what worked, and what did not work:

C1

A very simple stepladder solution with support in both sides, primarily used to enable the child to get up onto the changing mat and down again.

- ✓ Choose yourself if you want decal decorations
- ✗✓ Side supports on both sides.
- ✗ Looks heavy and large.

[Ill. 3.15]: Concept 1, a simple stepladder

C2

A concept with side support in one of the sides. Includes product decals to enable storytelling to motivate the child from A to B. The stepladder can be converted into a stool and be used at a sink or tabletop for other purposes.

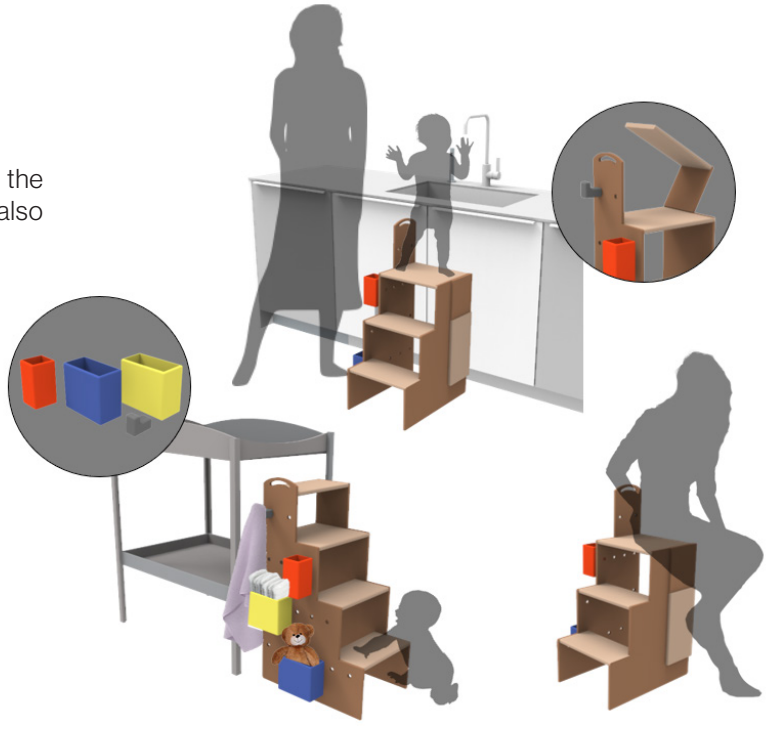
- ✓ Can help in multiple areas and activities.
- ✗✓ Third step is too high for changing clothes.
- ✗ Side support on just one of the sides.
- ✗✓ Animal decal.
- ✗ Looks heavy and large.

[Ill. 3.16]: Concept 2, convert into a stool

C3

A concept with a focus on storage solutions for the things necessary for diaper change, this solution also converts into a stool.

- ✗ Third step is too high for changing clothes.
- ✗ Storage solution being unsafe and distratc ting.
- ✗ Too open on the sides.
- ✗ Looks heavy and large.

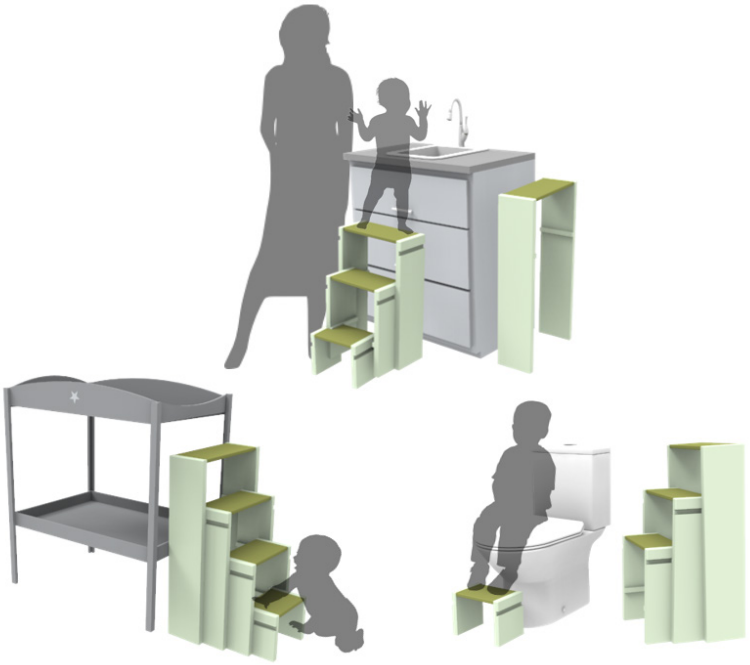


[Ill. 3.17]: Concept 3, incorporated storage unit

C4

A concept most suited for users having their changing table in the bathroom with the possibility to use it as assistance when the children learn to use the toilet. Can be divided into 4 individual steps.

- ✗✓ Individual steps.
- ✗ Steps not being able to be folded away when divided.
- ✗ Looks unstable when seperated.
- ✗ Too open on the sides.
- ✗ Looks heavy and large.



[Ill. 3.18]: Concept 4, convert into a toilet assistant/small stool

C5

A playful concept with incorporated slide and blackboard to be used in the play area.

- ✗ Combining play & diaper change.
- ✗✓ Multifunctional.
- ✗ Having to move from room-to-room.
- ✗ Looks heavy and large.

[Ill. 3.19]: Concept 5, convert into a playfull object

CONCLUSION

From creating a survey with five different concepts, the team had 33 users' feedback on which functions would work and which would be unnecessary. Often when using surveys, the respondents give vague responses. But the members of the different Facebook groups are really invested in the problem, and thereby in helping us. This verifies the need for a product like this and ensures an honest feedback on what works and what does not work.

NEW INFO

New information on what the users like and dislike in a stepladder, storage directly incorporated into the solution is a big dislike.

NEXT UP

Instead of just focusing on concept 2, which had the best feedback, the team wish to use the information to further investigate the concepts and try to improve them further. Alongside this, the team also wish to look further into how the solutions should be folded to ensure that when the concepts are presented to the user again, that they get a better understanding of how they themselves should interact with the product.

CONCEPT CONVERGENCE

The team chose to further investigate concept 2, 4 and 5 with the given feedback, to create improved ideas. Concepts 1 and 3 were left behind as concept 1 is merely a simple stepladder, and concept 3 had a lot of negative comments on having storage as a part of the product. The concepts were improved by looking into their pros and cons from the user's feedback, combined with creating mockups of how they possibly could be folded. The concepts are then again created in 3D software, to then easier present the solutions for the users in a survey.

CONCEPT 2

The concept still has the possibility to be converted into a stool and with a focus on storytelling using decal decorations, however, the decals should be a choice of which the users decide for themselves. Aesthetically the stepladder has been given more organic rounded shapes to make it seem more approachable. The organic shapes work as side supports and one side is larger than the other.

CONCEPT 4

The concept is still most suited for use in a bathroom/toilet, as it still has the possibility to be separated and used for different purposes, such as a footrest for the toilet. However, now it is not possible to separate it into 4 pieces, but only 3. The first step can be used as a small stool, and the upper step can be separated to create a stool for the children to wash their hands at a sink etc. Aesthetically it is changed into a softer and more rounded design with support handles at each step.

CONCEPT 5

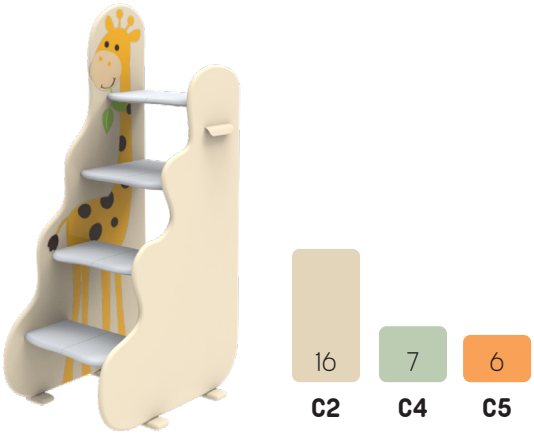
The concept includes less playtime, and only has entertainment as a part of the children getting down from the changing mat. This means that the solution should not be moved from room to room and not have a blackboard. Aesthetically it is a more geometrically design than the other solutions. To add support there are handles all the way up the steps on either side of the side supports.

SURVEY (29 RESPONSES)

The survey showed as seen in ill. 3.20. that concept 2 is a clear favourite amongst the users. They like the simplicity in the fold and that it can be changed into a stool, a lot of them however comment that is aesthetically might be too childish. The comments on concept 4 showed that they think it takes up too much space when folded and thereby needs more space when having to store it between uses. The comments on concept 5 showed that the slide would be inappropriate on a helping device for diaper change, they again point out that they would like to avoid playtime in the same area of which they change diapers.

CONCLUSION

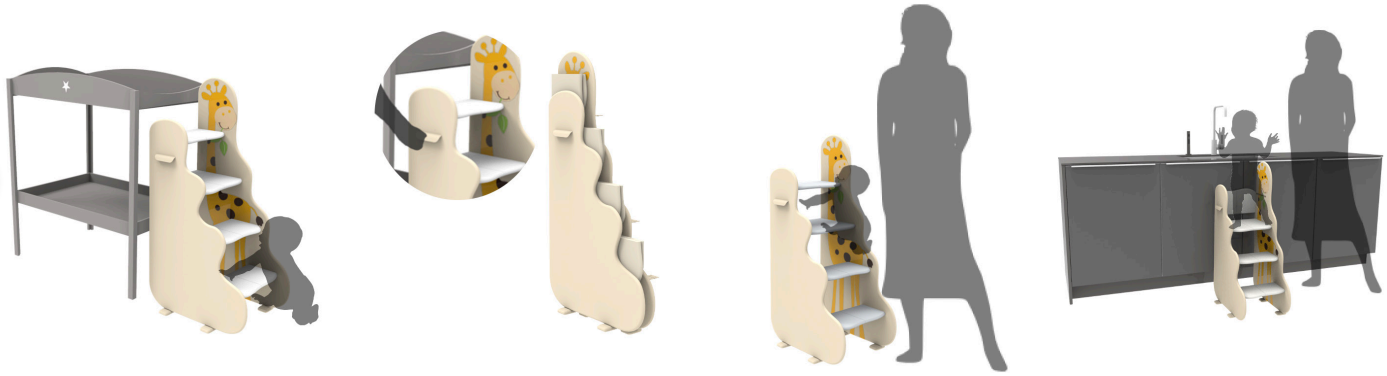
From creating three new concepts improved from the feedback given in the previous section, the team was now able to present three improved concepts for the users again. The survey answers showed that concept 2 was the favourite, and the team therefore chose to continue with this idea, this does not necessarily mean its way of folding, but the functions of a stepladder being able to convert into a stool. The overall method of parallel converging all concepts at once, reassured understanding of what could work for multiple solutions, while also creating new ideas. The method gave a lot of knowledge and better understanding of what the solution should be able to do, and what would be unnecessary. Modeling in cardboard was also a big help to understand the folding techniques better. The team made sure that all concepts where different in some sort of way, which made it easier to get more feedback on certain things. The team for example chose to have concept nr. 2 as a more organic, rounded and "childish" in its design language, whereas concept nr. 4 is heavier looking with straighter lines and then concept nr. 5 with a simpler design. Then when having to choose which concept direction to choose, the team could get more insight on the design, or other aspects, to make sure that the best features or ideas are put into the final concept.



[Ill. 3.20]: User responses favorite concept (C2)

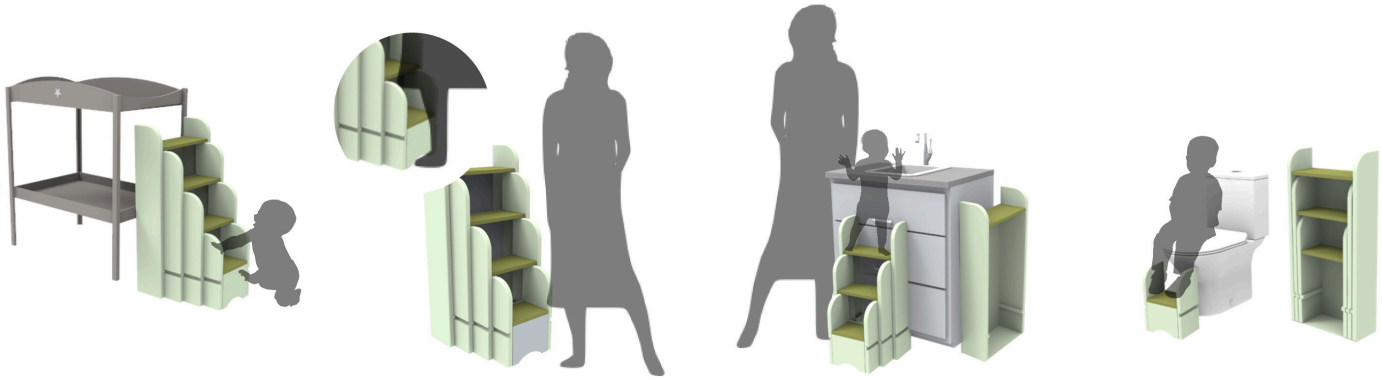
[Ill. 3.21]: Foldable mockups

C2



[Ill. 3.22]: Concept 2

C4



[Ill. 3.23]: Concept 4

C5

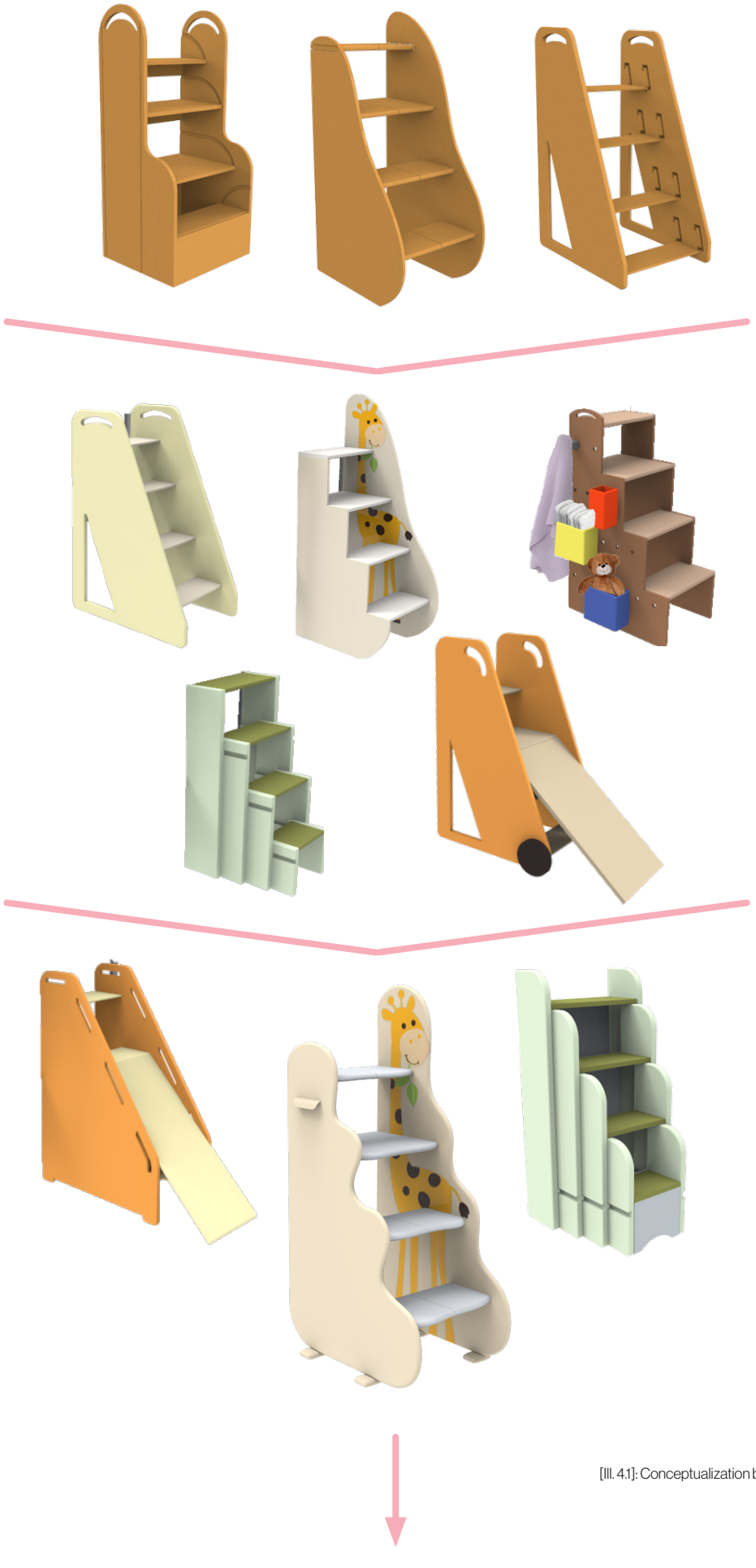
[Ill. 3.24]: Concept 5

NEW INFO The users prefer concept 2 that is able to convert into a stool.

NEXT UP The team now has to further investigate concept 2 to challenge the childish aesthetics

DETAILING

Through conceptualization, the team now has a set direction for the product. The users chose their favorite concept idea with its main feature being a 2 in 1 product, where the upper step can be taken out, enabling the stepladder to convert into a stool. This principle is now further detailed in the next sections “Detailing”, where the team will challenge the aesthetics and features of the product.



[Ill. 4.1]: Conceptualization before detailing

CHALLENGING THE AESTHETICS

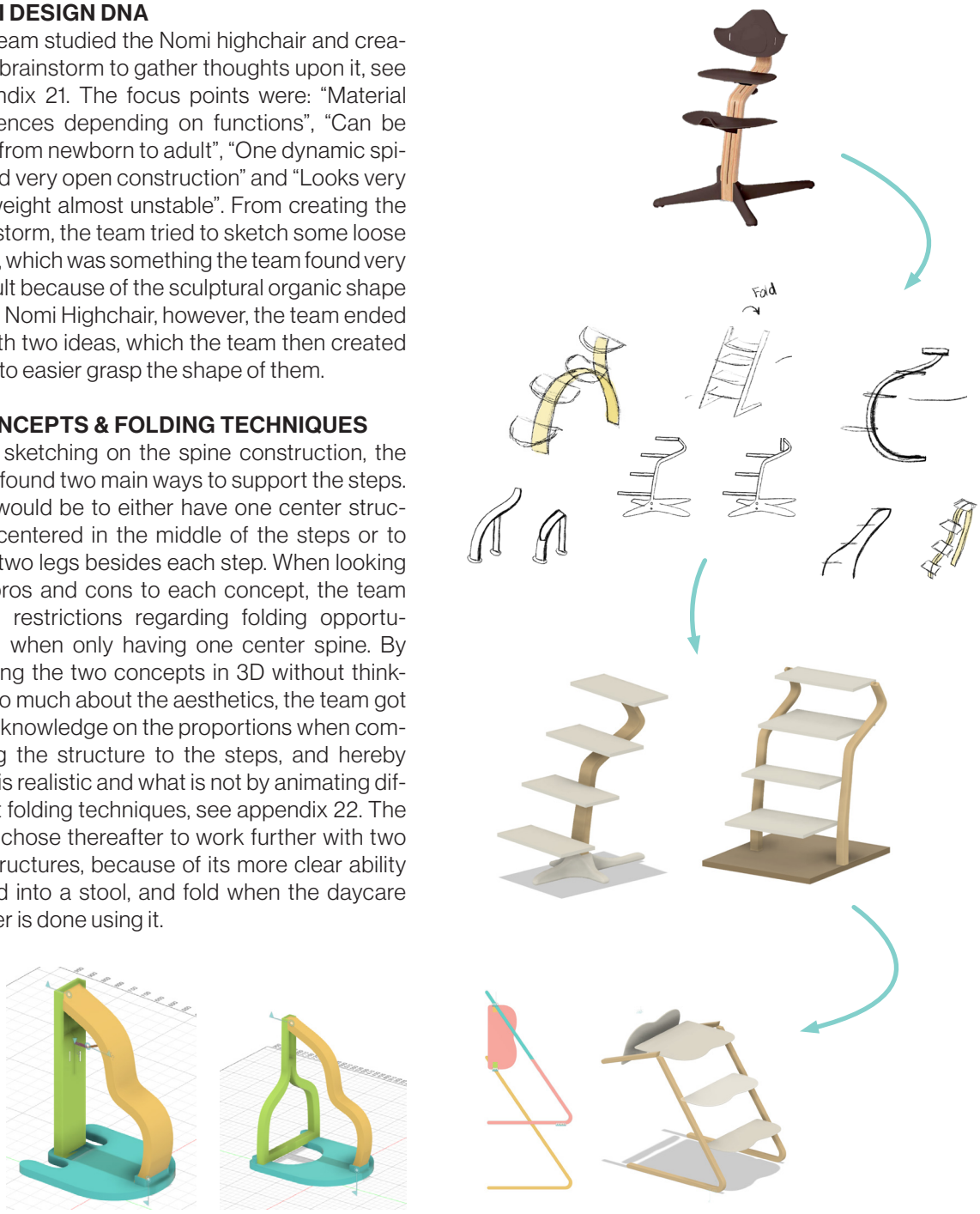
To challenge the more childish aesthetics of concept 2, chosen in the previous section, the team wanted to inspire from the Nomi Highchair designed by Peter Opsvik, which has a contrary modern and lightweight design. The team encountered the chair when visiting a family member, Mie, who also works as a daycare in the same municipal group as Hanne, they therefore look at each other as colleagues. Mie had been given one of the Nomi chairs by Jammerbugt municipality to test how the very active children would sit more down during mealtimes, when sitting in the Nomi chair. She mentioned a lot of positive things about the chair, such as being lightweight, very easy to clean as supposed to the Tripp Trapp chair and much more.

NOMI DESIGN DNA

The team studied the Nomi highchair and created a brainstorm to gather thoughts upon it, see appendix 21. The focus points were: "Material differences depending on functions", "Can be used from newborn to adult", "One dynamic spine and very open construction" and "Looks very lightweight almost unstable". From creating the brainstorm, the team tried to sketch some loose ideas, which was something the team found very difficult because of the sculptural organic shape of the Nomi Highchair, however, the team ended up with two ideas, which the team then created in 3D to easier grasp the shape of them.

2 CONCEPTS & FOLDING TECHNIQUES

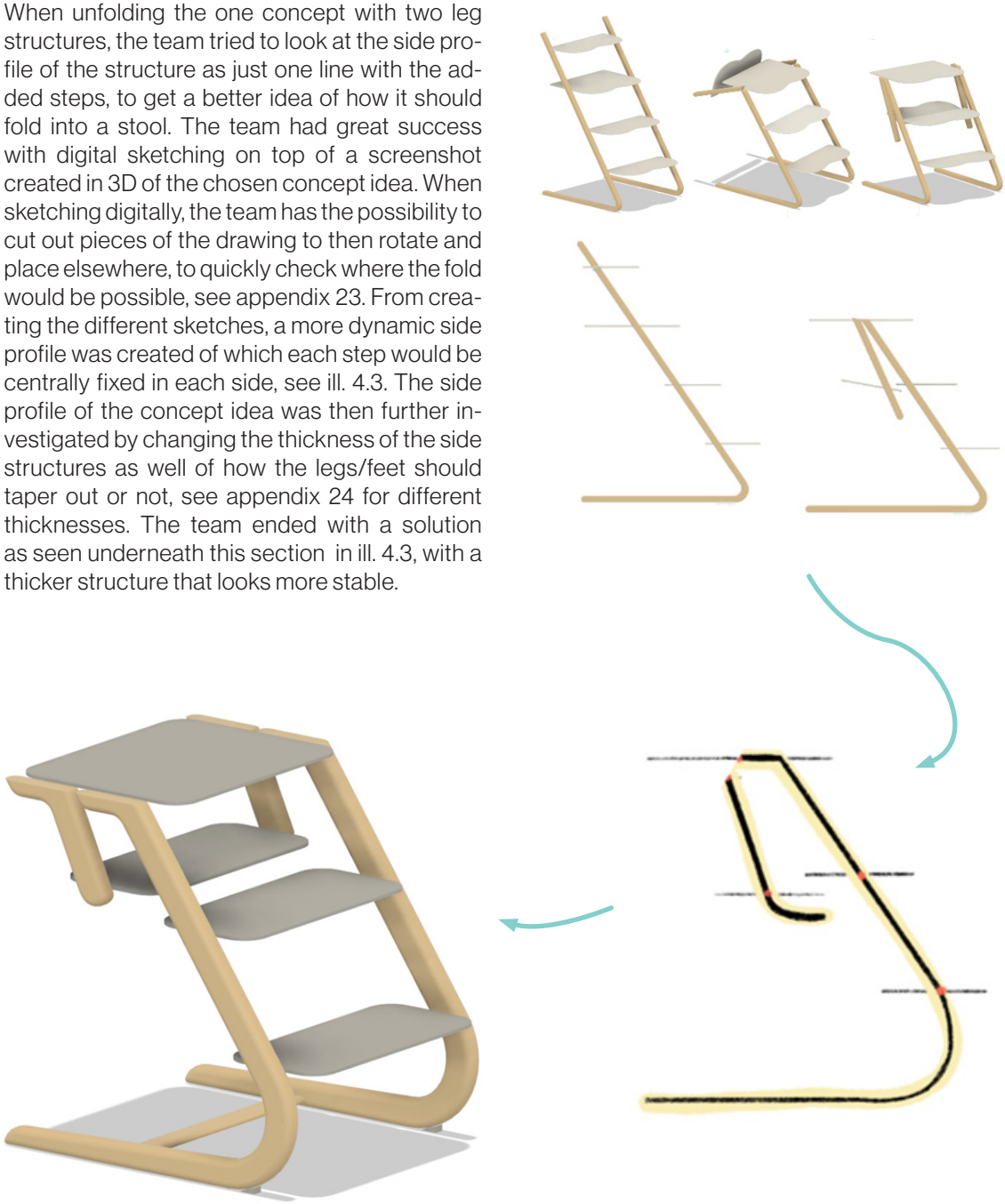
From sketching on the spine construction, the team found two main ways to support the steps. This would be to either have one center structure, centered in the middle of the steps or to have two legs besides each step. When looking into pros and cons to each concept, the team found restrictions regarding folding opportunities, when only having one center spine. By creating the two concepts in 3D without thinking too much about the aesthetics, the team got more knowledge on the proportions when comparing the structure to the steps, and hereby what is realistic and what is not by animating different folding techniques, see appendix 22. The team chose thereafter to work further with two leg structures, because of its more clear ability to fold into a stool, and fold when the daycare worker is done using it.



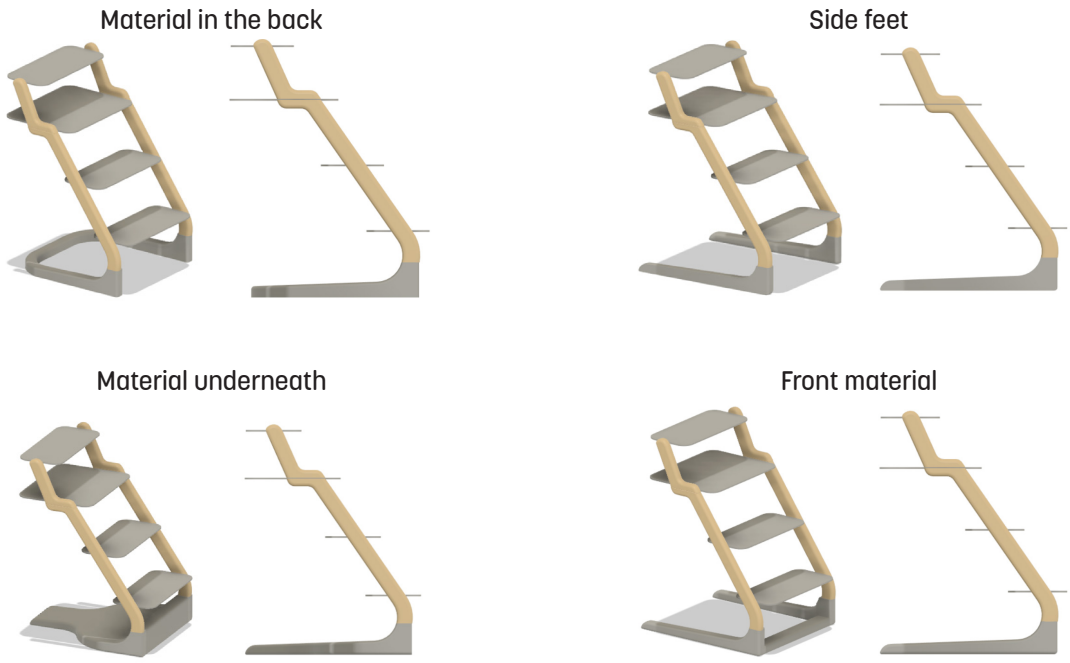
[Ill. 4.2]: From Nomi design DNA to 2 concepts/folding techniques

1 CONCEPT

When unfolding the one concept with two leg structures, the team tried to look at the side profile of the structure as just one line with the added steps, to get a better idea of how it should fold into a stool. The team had great success with digital sketching on top of a screenshot created in 3D of the chosen concept idea. When sketching digitally, the team has the possibility to cut out pieces of the drawing to then rotate and place elsewhere, to quickly check where the fold would be possible, see appendix 23. From creating the different sketches, a more dynamic side profile was created of which each step would be centrally fixed in each side, see ill. 4.3. The side profile of the concept idea was then further investigated by changing the thickness of the side structures as well of how the legs/feet should taper out or not, see appendix 24 for different thicknesses. The team ended with a solution as seen underneath this section in ill. 4.3, with a thicker structure that looks more stable.



[Ill. 4.3]: 1 new concept direction



[Ill. 4.4]: Feet development

FEET

The team then went on to look at feet structures for the concept, to add more depth and stability in the aesthetics. When having the same material in the bottom of the stepladder as the steps, the concept would have an overall nice balance and be looking more stable. The team created four types of feet ideas in 3D with the categories as shown in ill. 4.4, see appendix 25 for all 22 ideas. All 22 ideas were created very quickly in 3D as the base concept was the same and the team therefore just had to create 3D sketches on top, this method was very beneficial for the team to create new ideas in a very short amount of time. The team chose to work further with the solution where the leg structures are connected in the back of the stepladder, see ill. 4.5.

[Ill. 4.5]: Chosen "Material in the back"

NEW INFO — The team now has a very different option of concept design, when compared to the C2 concept chosen on page 42, the functions and requirements however still stay the same.

NEXT UP — The team now wish to talk to the users about this new more modern design, to get more insights into what they want and need. Before that, the team however first want to look into the shape of the steps, to ensure even more answers at once when visiting the users.

DEMAND — The materials the children interact with, should be easy to clean.

STEP SHAPE EXPLORATION

Before the team continued to work on the design of the overall stepladder, the team decided to look specifically into the shape of the steps. The shape of the steps could have a significant meaning for the overall design of the stepladder and is at the same time a part of the main functions of the product, meaning that the shape of the steps should ensure a stable journey for the children when crawling up and down.

A mapping of 80 step shapes was created with 20 base shapes, these shapes then go from geometric A to organic D, see ill. 4.7. The shapes were evaluated together with the daycare workers and closely related family members with knowledge on crawling children, and from this, one final shape was chosen 'B13'. The reason for choosing this specific shape of the step, was from doing the observations on the children earlier in the process, of which the steps on the white plastic stool at Hannes daycare, was the reason for the children falling down the stool when climbing, see ill. 4.6. The chosen shape B13 will then make it easier for the smaller children to crawl up, as their feet automatically are pushed out to the sides of the steps. The team also talked to the daycare workers about how the shape of the step also could make it easier for the children to navigate when crawling back down again. See the mapping in bigger size at appendix 26.

[Ill. 4.6]: Small children crawling on steps for the first time at Hannes

[Ill. 4.7]: Step shape mapping and choise of step B13

NEW INFO The team has settled upon a step shape in correlation with the daycare workers, to ensure a more secure and easy journey for the children when crawling both up and down the steps.

NEXT UP The team now must further investigate the design of the stepladder but using the new step shape as well.

DEMAND The shape of the steps should ensure support for the children as well as easy guidance on their way down.

USER INVOLVEMENT & STABILITY

Alongside getting response from the daycare workers upon the shape of the steps, the team also asked what their thoughts were on the new concept aesthetics. The responses gotten from the users were then used to further evaluate the solution and create new designs, to then end up with a possible new more modern design, more suited for the daycare workers. See appendix 27 for ca. 40 design changes created during this analysis.

USER RESPONSE

Firstly, the concept was shown to the daycare workers to ensure their opinions, and to verify the direction the team had changed into. The new concept was a big contrast to the previous one, as seen in ill. 4.8., which was very noticeable in the daycare workers responses.

The most significant thing to change in the concept was to ensure that the solution would look overall more stable and secure for the children to crawl up upon, including still having the side support for the children to either fall into if something happens, or to hold onto when crawling/walking up/down. The upper step especially looks bare, as there is nothing for the children to hold onto or support on. Both Hanne and Kirsten strongly point out that they would still like to buy the old concept, and Kirsten also missed the animal decal.

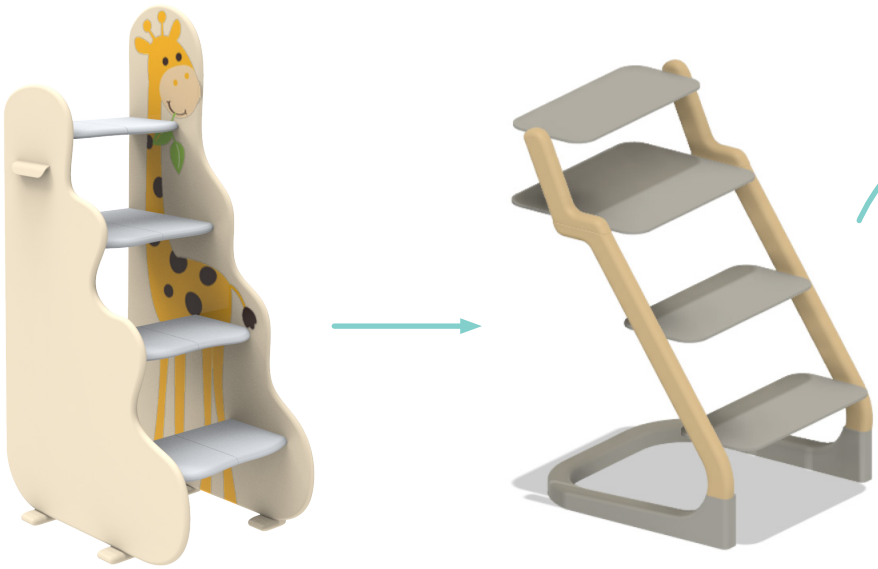
FURTHER DESIGN TESTING

The team then started to investigate what would make the solution look more stable, whether it would be a different leg structure shape or added side support in different types of ways such as a bigger leg structure to act as support in one, an added support on the outside of the leg structure or added support on the inside of the leg structure. This resulted in up to 40 different types of changes, and the team ended up with one specific favorite, as seen as the biggest solution in ill. 4.9, but the team showed the users three of the solutions, lowest on page 51, to get their feedback once again.

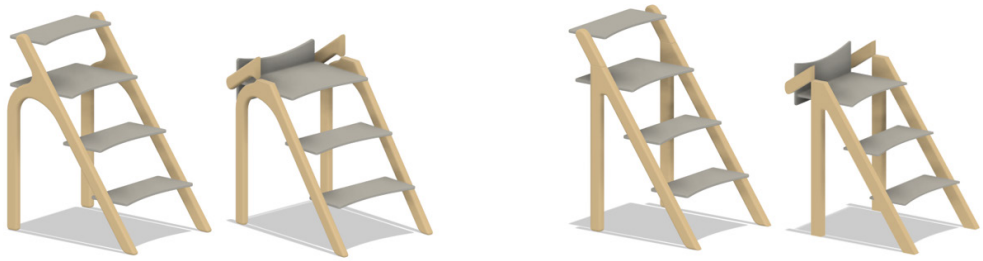
The response was that they think that the newer versions were very modern and is very smart in its appearance, but if they were to pick one to buy, they would still choose the old concept with the giraffe. Their main reason this time was the gap in the sides, inviting the other children to crawl underneath and making it look more unstable.

CONCLUSION

Even though the team find the new solution more dynamic, modern and interesting, the users are the once to have the biggest say in regards of the aesthetics. If they think it looks unpractical or unstable, then other daycare workers would think the same. And the team has to remember that the solution created should be a helping device, not something pretty for a modern family home, like the Nomi highchair.



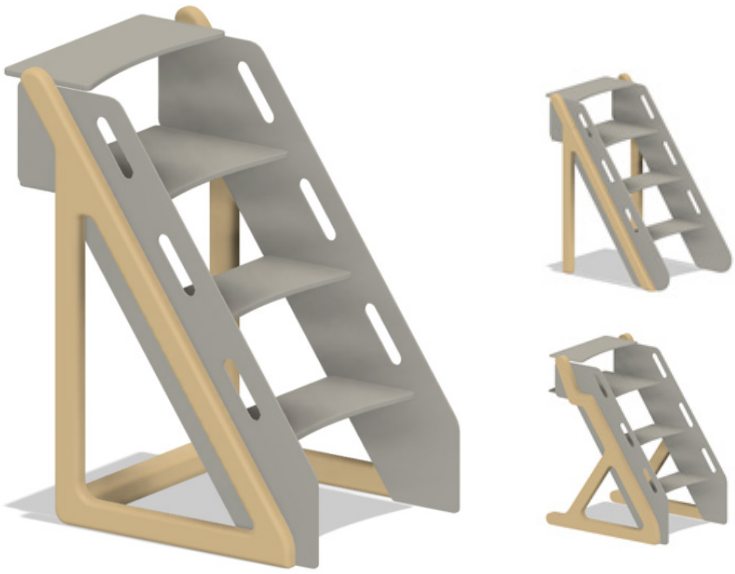
[Ill. 4.8]



Different leg shapes

Bigger leg structure

Added support out-side leg structures



Added support between leg structures give stability

[Ill. 4.9]

NEW INFO

The daycare workers prefer a solution with materials on both sides of the steps to add stability and security.

NEXT UP

The team now must evaluate the difference between the two concept directions, this new modern aesthetic vs. the old concept with the giraffe. The team then has to create a third direction more suited for the feedback that the daycare workers has given.

DEMAND

- The solution should look stable in its appearance

CONCEPT COMBINING

The objective of this study is to continue getting closer towards a final concept solution. This will be done by gathering insight of what was good and bad in the previous concepts when looking at the feedback from the users. A new concept direction should from this be created, where the goal is to get a new direction with multiple different solutions, which will then afterwards be changed accordingly to the chosen folding technique, depending on the users needs. During the process the ideas are taking into consideration with the daycares to get their validation on the chosen path. This is done to ensure a direction for the project, and to ensure that the team does not go into a direction once again, without the daycare workers finding it interesting as well.

Before the team continued designing new concept directions, the team found the pros and cons between the old giraffe concept and the new more modern concept. This was done by looking into the feedback from the users and by the teams own evaluation. See ill. 4.10 and 4.11 below, and appendix 28 for a more detailed evaluation scheme.

[Ill. 4.10]

[Ill. 4.11]

✓ **PROS**
Looks stable

Having the side structures as one solid, makes it possible to add decal stickers.

The rounded shape looks more safe and inviting for a child.

Support at the top step.

Not many surfaces to wipe of when cleaning.

X **CONS**
Looks heavy

Looks more immature and childish

The rounded shapes in the side structure does not prevent any accidents in case of a child falling.

The feet sticks out, one might tip over them.

✓ **PROS**
Looks modern and lightweight.

Holes in the side support act as handles.

The children are well supported on their way up and down.

The straighter line at the bottom front makes it look more stable when it comes to tipping forwards.

X **CONS**
Looks unstable with the lack of material in the bottom sides. The triangle hole worry the daycares that children can crawl under the stepladder

No support on the upper step.

Many surfaces or angles to wipe off when cleaning.

3 TYPES OF PRODUCT STRUCTURE

The team now briefly explored three new categories A: wooden plate attached outside plastic structure, B: plastic support attached onto wooden structure and C: A pure plastic stepladder. From evaluating the different solution categories, the team chose to continue working with category C of only having a product made from plastic, or in general one solid material without the need for adding extra on top. The reason for this decision is purely on function and the requirements from the daycare workers. The daycare workers prioritize the children's safety and hygiene above aesthetics. And in the categories A and B, the team found no argument or reason as to why extra material should be added on top, unless it was for aesthetical purposes. It would create lines that would have to be cleaned. See appendix 29 for multiple solution options, or ill. 4.12 for chosen ideas.

SHAPE DEVELOPMENT

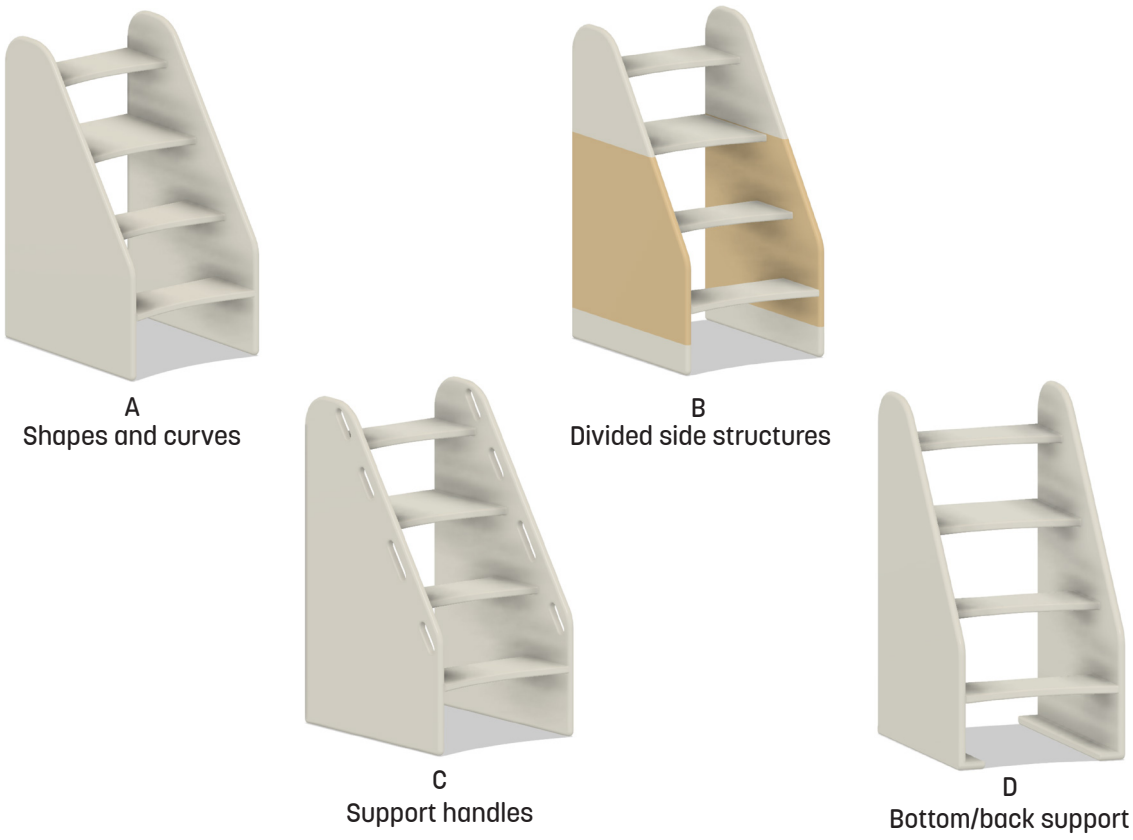
The shape of the stepladder is now further inspected into four topics: A: Different side structure shapes and curves, B: Division between side structures, C: Different possibilities of support holes/handles, D: Bottom/back support. The team wanted to start out, just looking at the basic shape of the side structures and then choose one of these. When a base shape is chosen, the team created ideas for other ways to change the appearance of the product, this could be by splitting the structure into multiple parts, having added interaction points for the bigger children to hold onto, on their way up the steps. Or by adding feet, to also add stability, but without them sticking out too much, for the daycare workers to trip over. The daycare workers were then presented to the four topics.

By talking to the daycare workers about the new direction with a stepladder made from only plastic, and the development of different ideas, the daycare workers confirmed that it was a good direction to go into, and a direction with multiple conveniences regarding the hygiene and safety of the children. Regarding the type of handles for the children, the daycare workers were very specific on the handles needing to be holes in the side structures, as it makes it less likely for the children to slide when pulling themselves up. The team then, I correlation with the users, chose the solution called C1 in appendix, as seen in ill 4.13, C, as the new base concept, which then must be further developed when looking into the folding technique. All the comments on the ideas can be found in Appendix 30.

A B C

Product structure

[Ill. 4.12]



[Ill. 4.13]

CONCLUSION

From creating numerous of different solution ideas yet again, the team is now back on track with a concept direction of which the users find very appealing. By setting the two concept ideas up towards each other and list pros and cons helped the team to know what to focus on when trying to combine them. During the new concept development, the team tried to evaluate more in between new solutions and writing it down alongside creating them. This made it easier to go back and look at the reflections, and thereby to only create necessary new ideas, rather than purely diverging. When talking to the users the team also got a quick validation on whether the direction was a good idea, before using too much time on it. The team had previously chosen a new direction of creating something very modern alike the Nomi highchair, but if the daycare workers do not find it interesting, it loses its purpose. The team therefore skips out any thoughts upon the Nomi highchair and purely focus on the functions of what the daycare workers need.

NEW INFO

A new concept direction was chosen and confirmed by the daycare workers. The focus should now be more on the functions rather than the aesthetics.

NEXT UP

Next up the team must look further into how the solution should be able to fold and look more into the handles. The team also must look more into choice of materials to ensure that the product is not too heavy, now that it has a lot of materials on the sides. If the product is too heavy, the team only creates a new problem.

DEMAND

- The materials the children interact with, should be easy to clean
- The solution should look stable in its appearance
- The sides of the steps should be closed off
- The front bottom construction should be shaped so it does not entail to tipping forwards

FOLDING POSSIBILITIES

As the team in previous section found a new base concept, which fitted more to the needs of the daycare workers, the team must now start investigating how the stepladder should be able to fold. This entails looking into the overall folding possibilities when looking at this specific concept shape and talk to the daycare workers on how they plan to store the solution both before and during the use of it. This section shows the teams work with 2D and 3D sketching on multiple solutions, creating solutions to show the daycare workers.

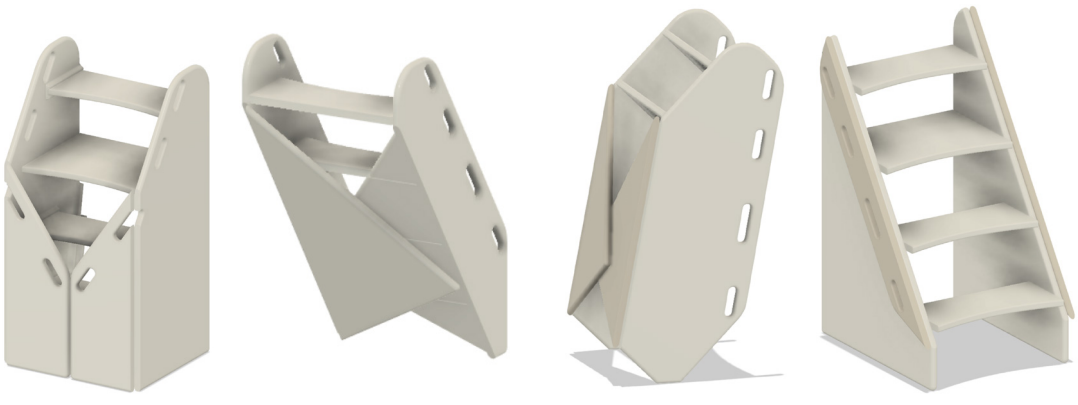
3D SKETCHING

The team found 13 solutions that could be transformed into a stool while also being able to fold into a smaller size for storage. See ill. 4.14 for some examples and appendix 31 for all of them. The team now wish to talk to the daycare workers on how they plan on storing their product both before and during use, as this could have a big impact on how small the product should be able to fold, and how it should fold. The team also wish to create a mapping of the created 3D solutions, showing the simplicity vs. foldability, to get a more visual evaluation on how they differ from each other. The method of 3D sketching has yet again, shown to be a powerful tool for the team. The team was able to create a various number of solutions in a short period of time, while also getting a better understanding of what is possible. The 3D enables for the team to have the exact dimensions, and thereby get a better insight into how big or small the product becomes when folding it.

USER SURVEYS & RESPONSE

The team created a survey to share on the four Facebook groups filled with daycare workers, including both private and municipal daycares. The overall question was, what they wished to do with the product in between use, and afterwards if they had any comments on the matter, see ill. 4.15 and appendix 32. The illustrations shown to the users were recycled from previous surveys, of which the users on Facebook had already seen and was a big fan of. This meant that the team could safely time on creating new illustrations and have less questions regarding a potential new solution. The team had a total of 127 responses.

The response from the users shows that most of them (55,6%) wish to just push the product to the sides during use, 14,3% answered “neither” of the options A-C. 27 of the respondents’ left comments on other ways to move the stepladder while use, or something for the team to be aware of. From the comments the team found some important insights: They would prefer if they could move the solution without having to turn their backs to the child, have to bend over and preferably be able to move it with just one hand, so that they have the possibility to always have one hand at the child. They mention it could be nice to have wheels under the solution, however, these should be able to lock. These insights also entail mostly towards solution A, where they can use their hip/legs to also move the solution with one hand on the solution and one hand on the child.



1,1 8 9 13

[Ill. 4.14]

In a previous survey, as shown on page 31, the team found that most of the users wish to just always leave the solution by the changing table, without necessarily folding it, or only doing so for the weekends. With this old survey and new survey, it entails that the folding of the solution does not have to be extreme, and that the prioritization should be on stability and interaction during use, than how small the solution can become.

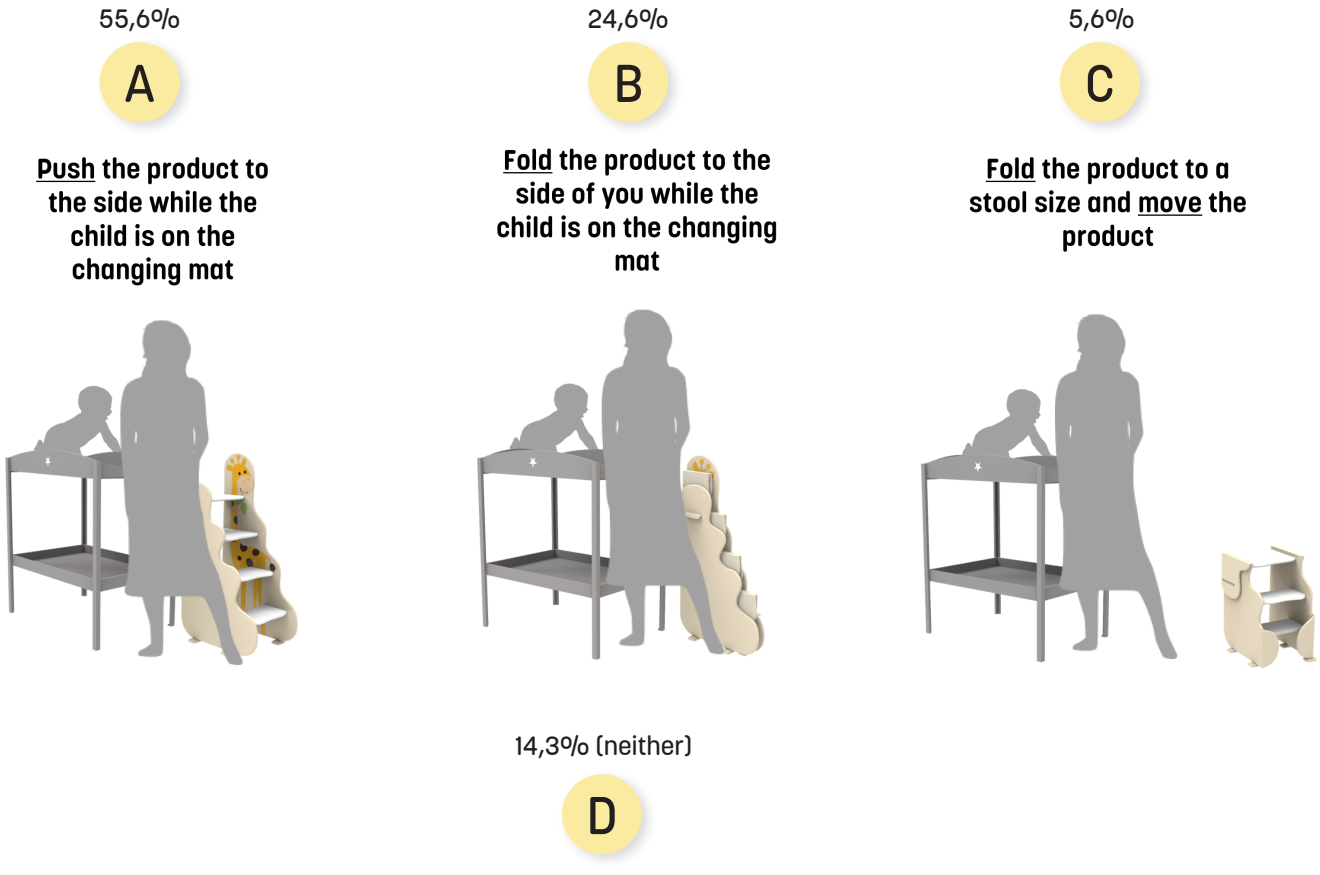
MAPPING

After looking into different types of folding opportunities for the concept idea and getting answers from the users on how they wish to interact with the product during use, the team wished to evaluate the folding possibilities in a mapping. The mapping was created with a focus on the number of interactions vs. the solutions foldability. See ill. 4.16.

When talking about the interactions and how realistic it would be for the daycare workers to do 9-11 interactions, the team chose to set a maximum of 4 interactions. This entails to solutions with lower foldability, however, the team also discussed that for each fold the solution should be able to do, the stability of the overall stepladder decreases, as a result of multiple moving parts. The team therefore also decided that the steps should always be fixed, as it would give more stability for when the children crawl up and down.

The team chose to go further with a combination between solution 13, and either 8 or 9, as they are very similar and does not require a lot of bending and distortions in the body to fold, when compared to some of the other solutions. These were chosen because of the added functions from solution 13 with being able to choose wether or not side support should be up or down, depending on the children's capabilities. If only one of the sides are up, it could give more space for the daycare workers to get closer to the smallest children when they start learning to crawl up and down the steps.

The team also decided to take solution 1,1 for



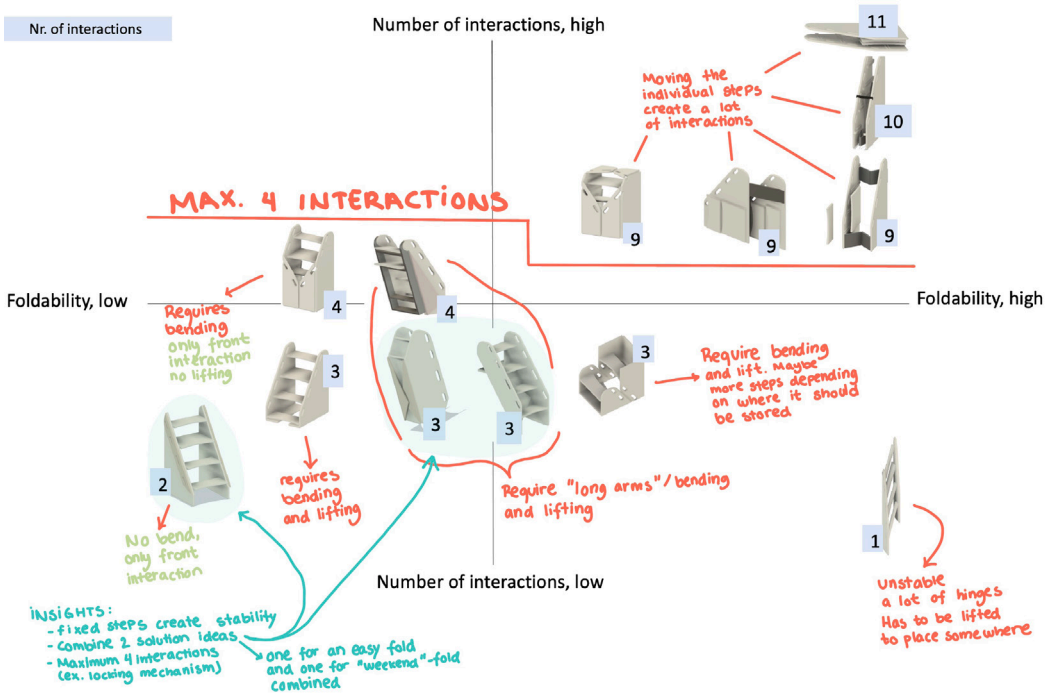
[Ill. 4.15]: Survey questions

further investigation, as seen on ill. 4.14., not to investigate the mechanism further, but to show this solution up against the new combination between 13 and 8/9 to the users. Solution 1,1 would overall have 1 less interaction and would not take up as much space on the floor when folded.

CONCLUSION:

After 3D sketching folding solutions on the new concept, getting insights from the users, and evaluating the solutions via mapping, the team ended up with two folding directions. One of which the team just wish to get the users feedback on, and one of which the team has to combine and work on before presenting to the users. The focus on the new solution should be that the daycare workers interaction with the product does not interfere with their connection to the child and the number of interactions is also outweighing the need for a solution that folds a lot because of general safety and time uptake.

By creating a mapping and brainstorming on the pros and cons, the team found a lot of insights in the different foldability solutions. These insights meant that fixed steps create stability, and the overall interactions number should be 5, excluding the locking mechanisms. The team found it very helpful to create a mapping, as it easier visualizes the differences between each solution, and make them easier to separate from each other. And by then brainstorming on top of the mapping, instead of just listing the thoughts besides, makes it easier to also navigate what the team found from each solution.



[Ill. 4.16]: Position mapping, foldability vs interactions

NEW INFO

The users wish to just push the product to the sides when the child is on the changing mat.

NEXT UP

Next up the team has to further explore the folding possibilities to ensure two solutions to present to the users in 1:1 size mockups. Further on, the team also need to investigate how the daycare workers should be able to move the solution during use.

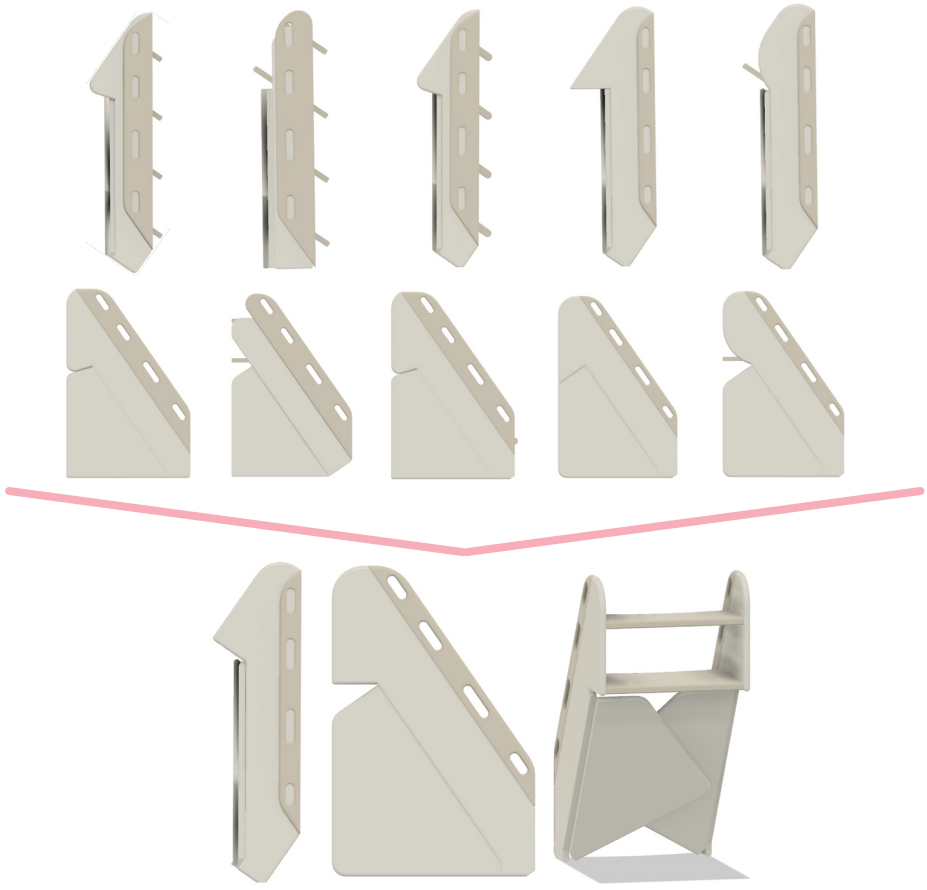
DEMAND

- The solution should be able to be pushed to the sides while still being stable when children crawl on it.

FURTHER FOLDING EXPLORATION

The team now started combining the solution chosen in previous section of folding possibilities. The team yet again used 3D sketching and modelling to quickly get 1:1 ratio idea. This section sums up the thoughts and ideas created during the exploration, see appendix 33 for more insights into the worksheet. The objective was to end up with one solution to compare with solution 1,1 from previous section.

The team first created 5 new solutions and alongside creating them, they got evaluated with text and arrows to locate their problematics. Afterwards all 5 solutions were compared by looks and how big they would be when folded. From evaluating the ideas, the team created 2 new where the steps should be covered both in the back and the front, when looking at it from a sideview. The team then ended up with 1 solution where the function of the stepladder decides the shape of the stepladder, see ill. 4.17. The sharp edge is a result of side structure following the depth of the third step which is longer than the others, to enable the solution to become a stool. The plates on the bottom of the stepladder folds under the steps hence the sharper line here, to ensure that it is able to fold underneath. When creating rounded fillets around the stepladder, it overall looks soft and stable. When folded, the new solution is 99 cm high and 27,2 cm deep.



[Ill. 4.17]: From 5 folding solutions to 1

NEW INFO

From creating 7 new solutions, the team chose to continue working with a solution with soft curves for where the daycare worker would potentially hold before turning the sides down under the steps for folding.

NEXT UP

The solution should now be created in a 1:1 model and verified by the users. The team only focused on the folding aspect at this point, meaning that the team has to look into how the stepladder converts into a stool.

USER TEST & 1:1 MOCKUPS

The team now wanted to create 1:1 models of the two folding concepts. The models were created in cardboard and then afterwards presented to one of the users Hanne and team member Marias closest family to get as much insight as possible. The team chose to work with cardboard to ensure a quick process where the team could build and secure insights in a matter of 24 hours. The team only wished to get insights from the daycare workers and not the children, as the folding is their' interaction with the product. For further test insights see appendix 34.

1:1 MODELS

The model was created by dividing technical drawings of the 3D model into A4 pieces, to then create a 1:1 template. This made sure that the cardboard model was just as the 3D model the team had been working on and secured an easy mockup process. The cardboard pieces were then glued together and taped in the places of which the solution should be able to fold, the tape in this case acted as hinges. To quickly sum up, mockup of solution 1,1 has a vertical fold where the two first steps are pushed back, making it possible to close the side structures in front of the steps. Mockup of the new solution chosen on page 58, shows a diagonal fold where to side panels fold underneath the steps, and the solution is tipped forward to lean up against a surface.

[Ill. 4.18]: 1:1 ratio mockup models of both folding solutions

TESTING INSIGHTS

From testing the two 1:1 cardboard models at Hannes daycare the team had multiple insights. Mockup 1,1 with the vertical fold had too many interactions compared to how little it folds. The mockup of the new concept worked impressively well, when folding it all seems like one total interaction of lifting the product as well as folding the sights. However, the cardboard model can be a bit deceiving, as the cardboard is very lightweight. Hanne also thought it was a great idea to have the option of whether the side supports should be folded up or down, depending on how much help the children need.

Regarding the lift itself, as seen on ill. 4.19, the team was a bit concerned on the fact that the daycare workers need to bend down to lift and fold, however, Hanne did not see this as a problem at all if the solution is lightweight. She points out how it is not any different than if she had to move her existing stool around.

When looking at how they fitted into Hannes context, the new concept idea with the diagonal fold fitted perfectly at the storage place she had in mind, whereas concept 1,1 with vertical fold did not, see ill. 4.20.

Hannes pointed out that the dimensions where very good regarding the height of each step to get up onto the changing mat, and also the height of which the children should stand, when the solution is converted into a stool. Overall, the new concept with the diagonal fold was a big hit.

MOVING THE SOLUTION

The team also talked to Hanne about how she would move the solution from the changing mat and over to the sink, and in this conversation talked about different types of rubber feet, felt feet or wheels. And her thoughts were that she would prefer for it to not have any feet, as that would mean she would have to lock these each time, and if they did not lock, she would feel like it would be too dangerous for the children to crawl up onto. She would prefer to have some rubber feet underneath, to make it more study when standing, and then either just dragging it on the floor, or easily just lifting it over to the sink, much like if she were to close it for storing it in between use.

[Ill. 4.19]: Video screenshots of Hanne lifting and folding solution in one quick go

[Ill. 4.20]: Space uptake of both folding solutions

CONCLUSION

From creating the two 1:1 scale sized mockups and testing them with the users, the team decided to further work on the diagonally folding solution, where the side supports can be folded 180 degrees backwards and the side supports can be folded 90 degrees under the steps. This solution overall seemed like a very intriguing helping device for the user, with a quick folding technique and a shape that would fit into smaller spaces as a replacement for another stool. It also showed a new feature added, with the side supports folding down, depending on what the child needs when crawling up, which the user was very pleased with.

When creating 1:1 scale mockups, it helps the team to visualize even better how the product looks and feels. When looking at the models in 3D software, everything seems very big and bulky, but when looking at them in a 1:1 scale, they look more approachable, and it makes it easier to understand what makes sense in regard to folding and interaction points. And overall, talking to the users and letting them try out the mockups, also makes it easier for them to understand the solution. They might have different thoughts on a solution when looking at it on a piece of paper, or on a screen, than when they see it in real life size and in the correct context. When they see it in a 1:1 size, they give better feedback as it makes them more sure on what they have to look at.

NEW INFO The team now has a finalized set direction with a concept and folding possibility.

NEXT UP Further on the team has to look deeper into the folding mechanism and possibly look into how decorations on the steps could be added to create an even bigger learning experience for the children. (parallel to giraffe concept)

SUPPORT HANDLES & 1:1 MOCKUPS

Before looking further into the folding mechanisms final details, the team wish to investigate other features in the stepladder, including the handles in the side structures for the children to use when crawling up and down the steps. The team created multiple 1:1 mockups to test on the children including a 1:1 wooden stepladder. The team also took inspiration from other products of which the children already interact with at the users. The overall objective by testing different sizes of mockups on the children, was to end up with final dimensions for the handle holes in the side structures. See appendix 35 and 36 for better insights into the process directly from the worksheets.

1:1 HANDLE SIZE MOCKUPS

Firstly, the team created mockups to find one measurement at a time, as seen in ill. 4.21. the team needed dimensions for A, B, C and D.

Test 1: Width A (Test from 10-50 mm)
A width of 20 mm. seemed to fit very well in their hands and their fingers were able to reach around the edges.

Test 2: Distance from edge to hole B (Test from 10-60 mm + using the 20 mm from test 1 A)
A length of 20 mm. made it possible for the children to reach around the cardboard with their fingers and get a good grip.

Test 3: Depth of hole C (Test from 20-35 mm)
A hole depth of 25 mm. made it possible for the children to have their fingers in the hole, and without it looking to cramped.

Test 4: Height of hole D (Test from 70-100 mm)
When comparing a hole height of 80 mm. to the size of the childrens hands at around 50 mm. it seemed like a good amount of extra space with 30 mm left.

[Ill. 4.21]: Handle tests

1:1 HANDLE PLACEMENT MOCKUP

The team now wanted to create a 1:1 wooden mockup of the total stepladder, to get the children to try the stepladder for the first time. By getting the children to walk on the steps, the team was able to get information of where the handles should be placed and how many of them there should be. The wooden mockup was created like the 1:1 cardboard models shown on ill. 4.18, by creating paper templates and cutting the material. The part of the side support where the holes are meant to be, was made of cardboard and tape, and firstly tested with no holes to see where the children place their hands. Afterwards holes were created to verify their placements.

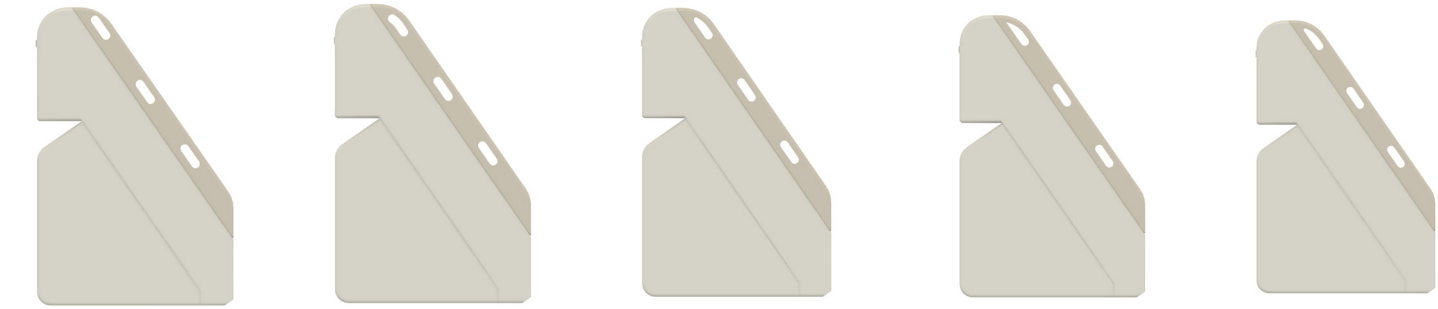
The tests showed that the children first of all is able to use the stepladder fully, both the bigger children but also the smallest who were only able to crawl. The observations showed that to fit both the small and larger children, three holes would be enough. See appendix 36 for observation photos and insights. The new handles therefore look as seen in ill. 4.23 picture 5.

CONCLUSION

From creating handle mockups and a 1:1 wooden stepladder mockup, the team was able to observe the children's behavior and find final measurements for the handles. The grip around the handle should be 20x20 mm. and the hole should be 25x80 in height and depth, to ensure space for the children to grip around the handle without bumping into other edges.
The team was also able to verify that the children were able to use the stepladder successfully regarding their age gaps.

By creating a 1:1 wooden mockup of the total stepladder, the team now had a better understanding of how the children would use the stepladder. Before the team had only seen the children crawl up on soft sofa mockups and other product types. The team now had the possibility to see the children get all the way up and down from the changing mat without the need of any help.

[Ill. 4.22]: Handle test on 1:1 wooden mockup



[Ill. 4.23]: Evolution of handle shape and placement

NEW INFO — The team has identified the dimensions and placements for the support handles.

NEXT UP — Next up the team wish to observe and to look only at how the children use the steps to fully verify them.

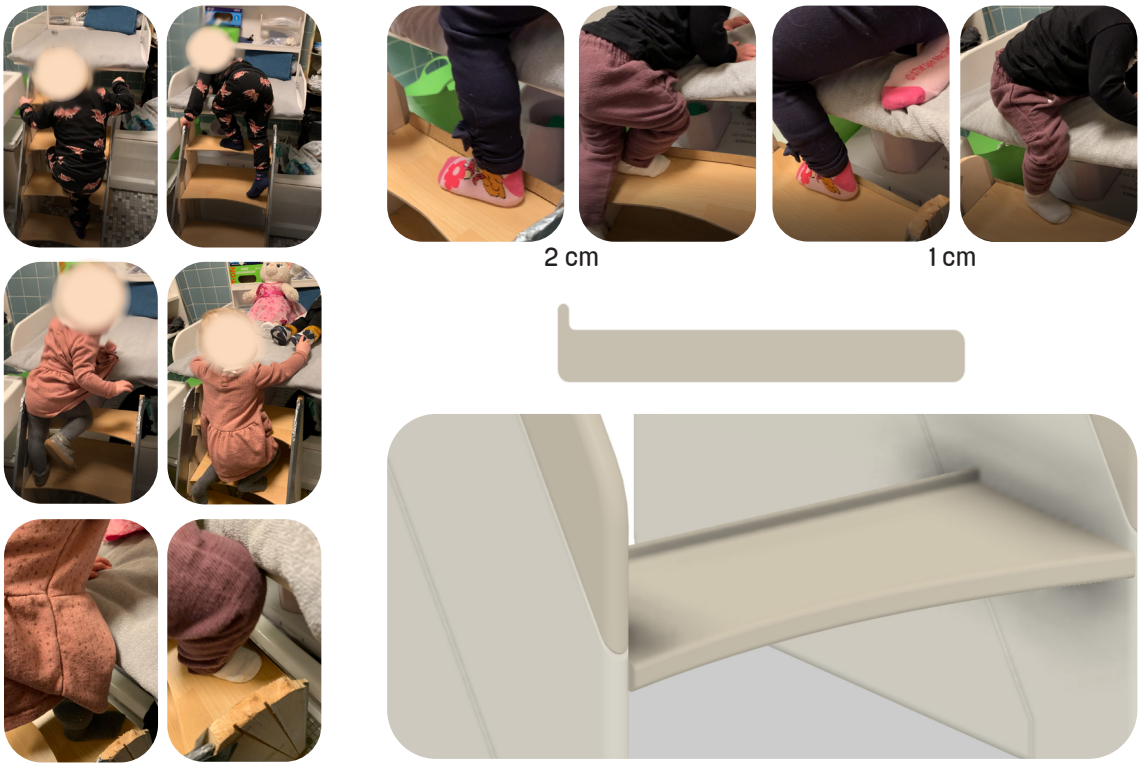
DEMAND
- The handles should fit a child's hand at approx. 45-50mm in length.

STEP VERIFICATION & NUDGING

As a follow up to the last section of testing the 1:1 wooden model, the team also observed the overall use of the stepladder, and not only the handles. As mentioned in previous section, the children of different capabilities were able to use the stepladder with no problem. The team however also wanted to look into details on how the children use the steps, and if something should be changed to create even more safety.

From the videos taken during the observations, the team found that the hypothesis of how the curve of the steps would both keep the children safe on the steps, but also guide them down easier, was true. The team saw how their feet were pushed to the side, and how the added material gave them more space to step on. The team also saw that they crawl down in a straighter line and follow the curve of the steps. See ill. 4.24.

Another observation was that the steps overall depth gave room for the children to still place their knees before crawling to the next step. However, the team saw a lot of coincidences where the children get very close to the back of the step, and even get their toes sticking out, see ill. 4.24.
The team therefore wished to add something to the steps in order to nudge the children to stay on the steps. The team could however not just close the step of, as the children also use the step edge to pull themselves up. The team then tried adding a 1 and 2 cm of cardboard material to the steps, see ill. 4.24., to see if it would have an effect on how the children would use the steps. It worked just as the team had anticipated and nudged the children to stay on the steps. The team therefore chose to add a step nudger of 1 cm at the back of every step. See appendix 36 for the observation insights.



[Ill. 4.24]: Step verification on 1:1 mockup and discovering step nudging

NEW INFO — The steps shape and dimensions are verified by testing on the children and the team added a step nudger to create more safety for the children.

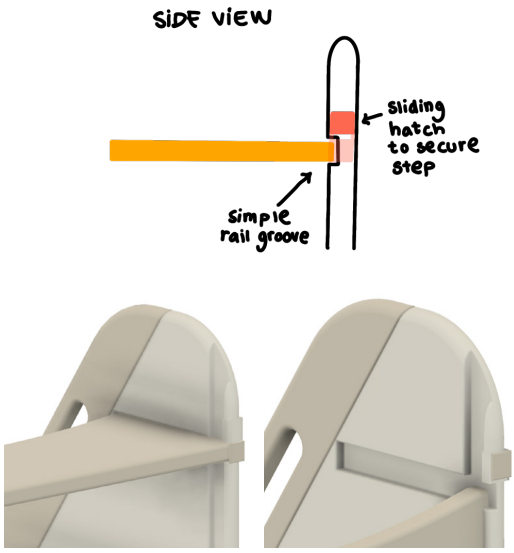
NEXT UP — Up next the team wish to look into how the stepladder should convert into a stool.

DEMAND
- The steps should nudge the children to stay on the steps.

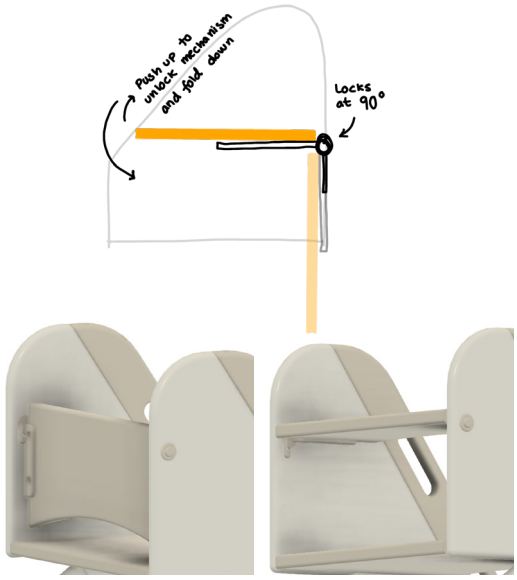
STOOL CONVERTION

The team had previously decided that the upper step should be able to be moved, to convert the stepladder into a stool, with the third step being longer than the rest. The team now wanted to further investigate the folding mechanisms for the upper step.

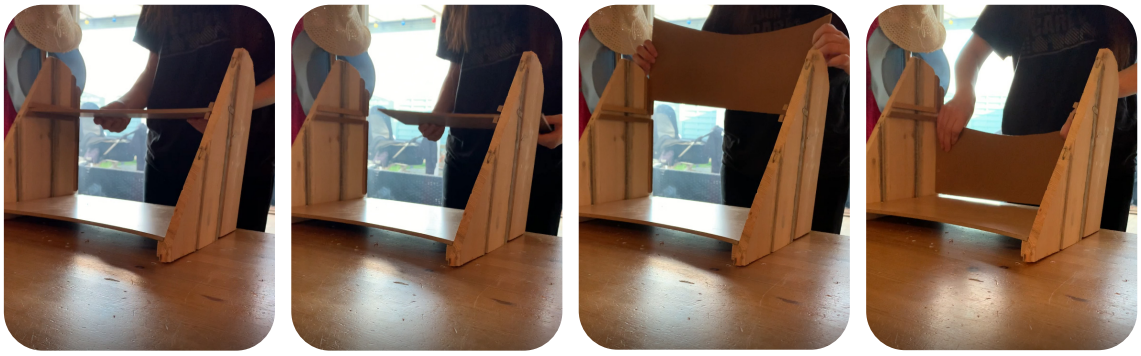
The team started 2D sketching on multiple different folding solutions, see appendix 37. From these ideas, the team chose to create two of the solutions in 3D, hereof a ratcheting hinge activated by a button, locking itself in place at 0 and 90 degrees. And a simple rail system with a slidable hatch to lock the step in and out of place. See ill. 4.25 and 4.26. The team chose to share the two 3D ideas with the users as soon as they were created, to get their thoughts on them. The users preferred the simple manual railing system, where they themselves have to take the step out from one rail and into another, as they felt this solution would be the safest. The team therefore chose to work further with this solution and created a 1:1 model to test sliding the step in and out. The model was tested by Kirsten from the user panel and verified to be a good solution. See ill. 4.27.



[Ill. 4.25]: Sliding upper step solution



[Ill. 4.26]: Ratcheting hinge step solution



[Ill. 4.27]: Tests on a 1:1 wooden mockup of sliding upper step

NEW INFO

The team found a solution for how the upper step converts the stepladder into a stool.

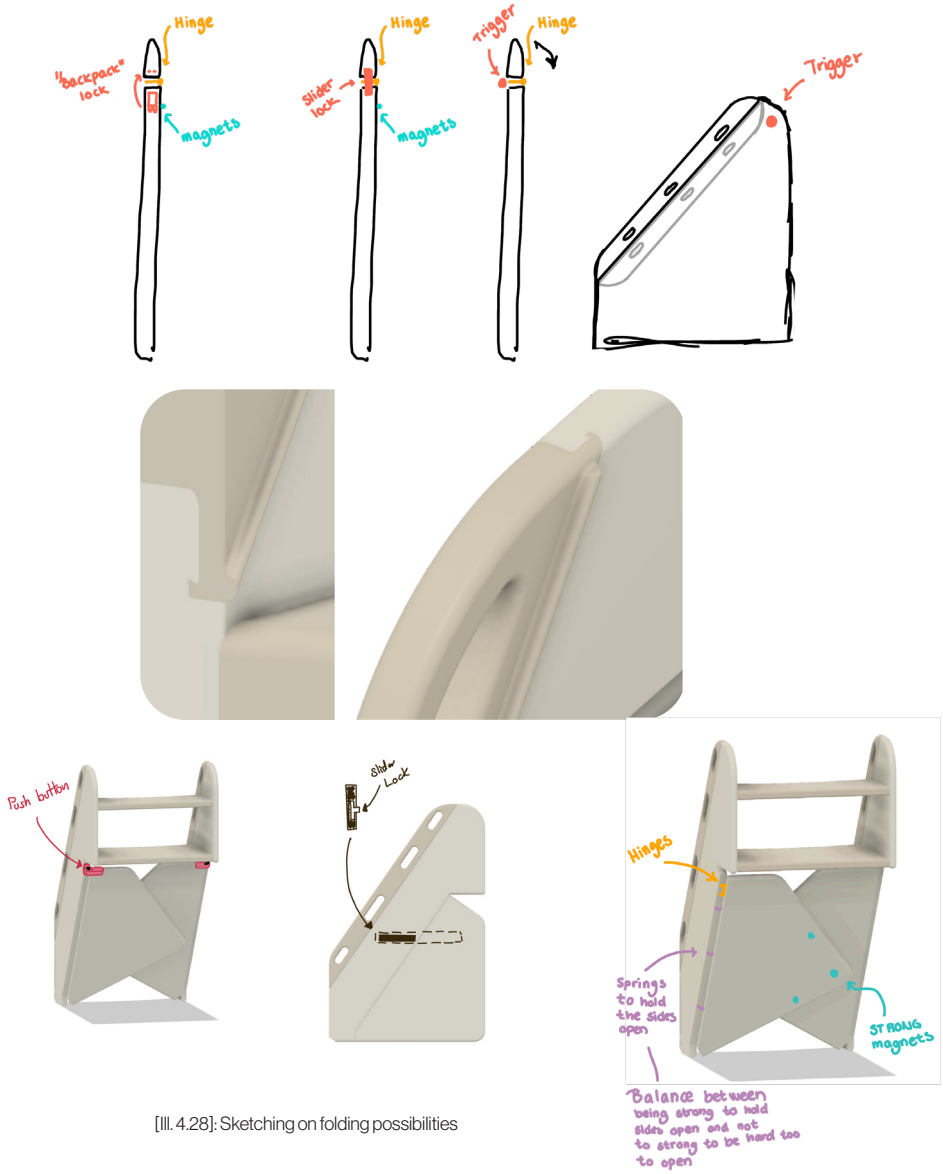
NEXT UP

Later the team have to look into how the hatch lock is designed, and how the railing system is secure enough for the steps to be fastened enough while being easy to take out.

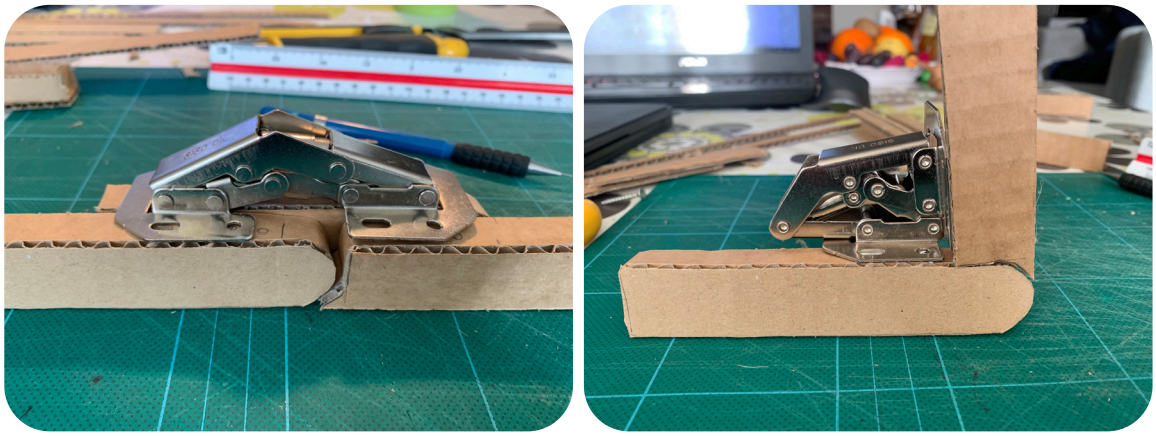
FOLDING MECHANISMS & INTERACTION

The team now wanted to look further into the folding mechanisms needed in the product, both regarding the support handles and the bottom sides for folding the whole stepladder.

As seen in appendix 38, the team created multiple solutions by sketching on both the folding side supports and the folding stepladder sides. By taking multiple types of solutions into account and evaluating them, the team ended with two solutions.
The side support handles should have extended plastic grooves to click in and out of place. An important factor should be for it to be tight enough for the handles to still be stable when the children use them, while also not being too hard for the daycare workers to open and close.
The folding sides underneath the steps should fold by having two spring hinges in each side. These spring hinges are strong enough to ensure that the sides can safely stay open and be held closed in a 90-degree angle. To verify the hinge, the team created mockups in both wood and cardboard. This mockup also helped the team define the shape to enable to hinge to close fully, without leaving any gaps.
When then looking into the interaction point for the daycare workers to fold and unfold the sides, the team created yet again multiple options on how this could be done, either by just creating a different type of surface to make the users aware of interaction, or by adding a handle. The team talked to the daycare workers about these options, and the daycare workers preferred if there could be a handle of some sort. See appendix 39 for test pictures.



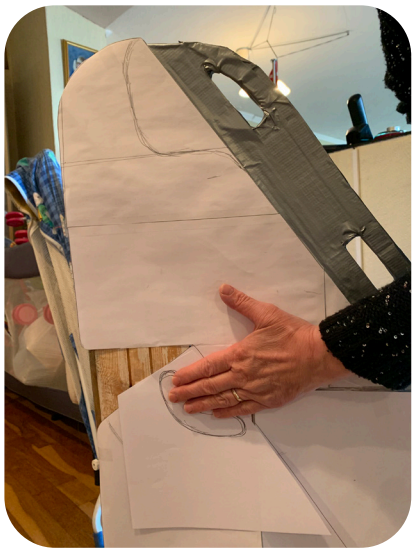
[Ill. 4.28]: Sketching on folding possibilities



[Ill. 4.29]: Spring hinge mockup cardboard

[Ill. 4.30]: Second spring hinge mockup in cardboard and wood

[Ill. 4.31]: Folding interaction points



[Ill. 4.32]: Interaction points mockup test

NEW INFO

The team looked into how the mechanisms should work for both the sides folding under the steps and the support handles.

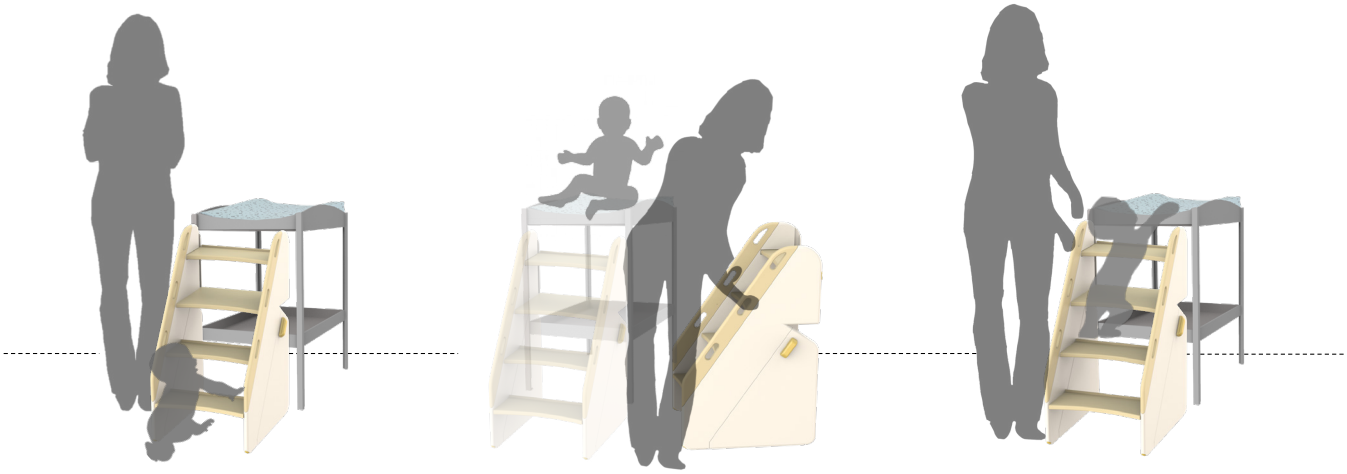
SOLUTION PRESENTATION: TRINI

The solution can now be presented as Trini, a 2 in 1 helping device for the daycare workers, to ensure the children getting up and down from the changing matte, ensuring less injuries for the daycare workers. And can be used for both the small and elder children with different capabilities.

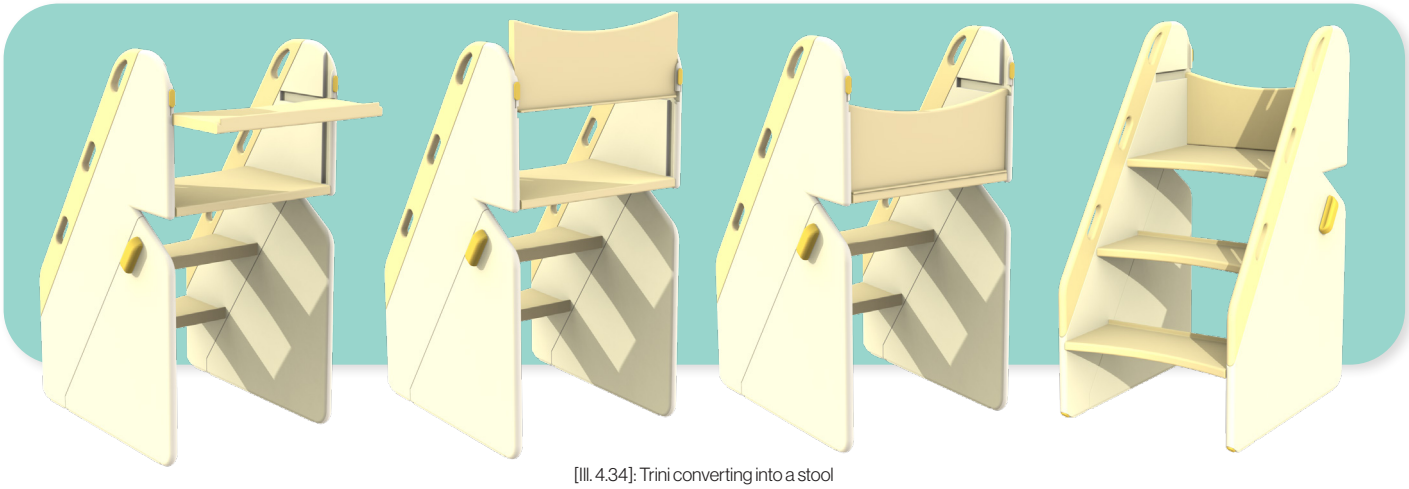
The daycare worker choose herself whether she wishes to fold the stepladder on a daily basis. If so, the daycare worker just have to fold out the sides from underneath the steps, and place the stepladder in front of the changing mat. The child is then able to crawl up onto the changing mat, with or without any side supports folded up, depending on what the daycare workers chooses. Trini then has rubber feet, to protect the surface of which it stands on when the daycare workers push it to the sides before changing the diaper on the child. She then push the stepladder back again, and let the child crawl down by themselves, or with a little help.

Trini can also be converted into a stool by opening a sliding hatch in front of the fourth step, enabling the daycare workers to slide out the step and then sliding it vertically down the other rail, ensuring stomach support for the children when using the third step as a stool step.

Trini should be made from plastics to ensure a lightweight interaction, and to ensure an easy cleaning process with good resistance towards cleaning chemicals. To ensure that Trini fit into different types of homes, it should be made in different colors and with the opportunity to choose whether to have decorations on the product. As seen in ill 4.35. a version is showed with paw prints on each step, these should motivate the children to follow the prints all the way up onto the changing mat. The paws could be changed with numbers in different colors, adding more daily learning experiences for the children, counting their way up onto the changing mat.



[Ill. 4.33]: Trini use between children crawling up and down



[Ill. 4.34]: Trini converting into a stool

[Ill. 4.35]: Trini different colors

GROUP CHANGE & DESIGN CHANGE

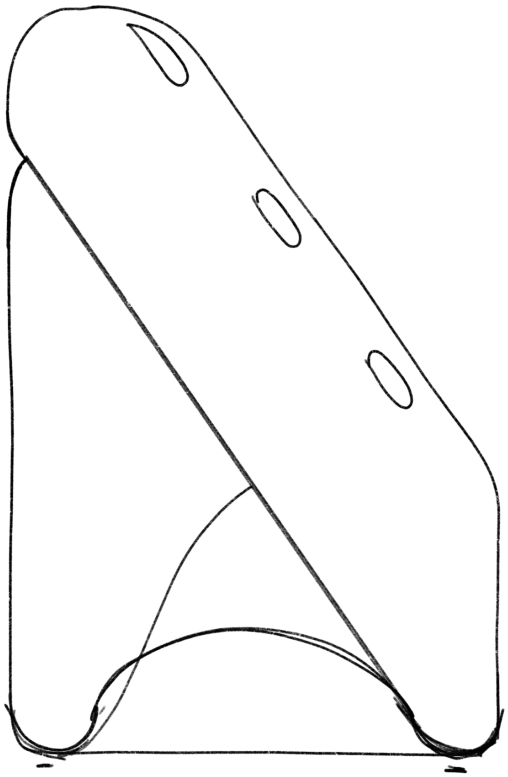
After presenting the solution Trini at the fourth milestone in spring 2021, the team split up as a consequence of Marias sick leave. When returning to the project in October 2021 in part time, the team had unfinished details in the Trini solution that needed a lot of testing, such as whether the safety would be high enough when having to fold the support handles and for when converting the stepladder into a stool.

The decision was therefore made to strip down the functions of Trini and create a simpler stepladder, not being able to convert into a stool and always having the handle supports open, however, it still solves the main problem of getting the children up onto the changing mat and down again, while still being able to fold in between use.

When not needing the third step to be elongated to act as a stool platform, all four steps could now be identical, this creates a simpler production, but also enables a shape change in the overall product. Before, the side structures had a triangle shape, because of the third step being elongated and the sides being able to fold underneath the steps. Now, this tri-angle can be demolished, and the folding crease can start between the third and fourth step. This however created a very heavy looking model, as seen in ill 4.36. as the side structures now did not have any gaps of air as before. A choice was therefore made to create a new triangle at the bottom of the stepladder side structures, to make it both look less heavy, but also to decrease unnecessary material, see sketch on ill. 4.37. This invited to an idea of adding more shape onto each now four individual feet, to make them look identical. This gives the design some soft yet strong curves just as a gorilla standing on all hands and feet combined with a baby elephant.

To ensure that the two side structures are still able to fold 90 degrees underneath the steps, the right side is shorter in a length equal to the thickness of the left side structure, to enable it to fold 90 degrees on top of the other side. Shape wise, it creates a small subtle curve in the right side, which is not represented in the left side, see ill. 4.38.

[Ill. 4.36]: Design without third step gap



[Ill. 4.37]: Sketches on material removal

[Ill. 4.38]: New Trini design with cut down functions

NEW INFO The functions of the Trini design have been cut down to a simple wooden solution.

NEXT UP Now it is necessary to investigate how the solution should be produced, now as the materi-al has been changed from plastic to wood, and in this case also to look into how heavy the solution will end up being.

IMPLEMENTATION

After having finalized a product solution Trini, the more te-chnical aspects must be consid-ered. This regards the pro-duction and specific choice of materials and looking into the strength and weight of the overall product. This following re-port segment will also lead to business strategies and the value of the Trini solution.

MATERIALS & PRODUCTION

The objective of this section is to give an overview of what thoughts the team had regarding materials and production, and in this case needed calculations and FEM simulations to verify both the type of material but also the needed dimensions to ensure enough strength.

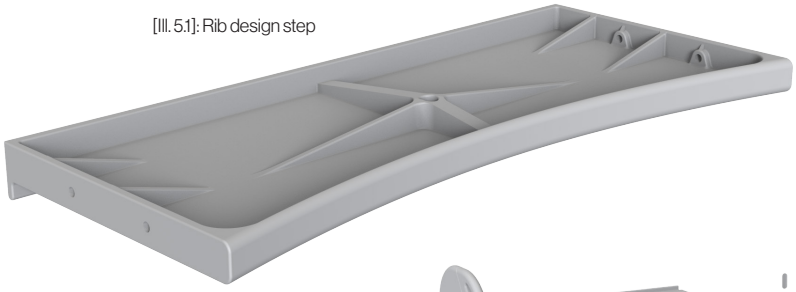
OLD TRINI CONCEPT (plastic)
When looking into the first Trini concept on page 68/69, the team had made the decision to make the solution from plastics. This was a result of working on the Nomi Highchair inspiration, and with the wish to have a material resistant towards harsh chemicals and for the number of times the daycare workers have to clean the stepladder during a work week. After looking into multiple thermo plastics and reflecting on what the Nomi chair was made of, [Evomove.com], the team chose to settle on polypropylene (PP). Some of the great benefits are that it can be made into a very sturdy and hard material, in whatever color the team desires. It is also recyclable, easy to get hands on as it is the second most used type of plastic and can stand up to the DS/EN 71-3 safety certification. [plast.dk]

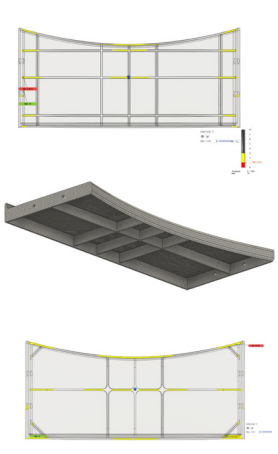
When looking into the production of the plastic materials, choosing plastics meant a lot more outsourcing and advanced production techniques needed, and in this case the team chose that the plastic parts should be injection molded.

If the solution were to be created in a solid plastic material with the thickness of 20 mm throughout the hole product, the weight of the total stepladder would be 18,7 kilos. The team had a big wish for the solution to maximum weigh 6 kilos, as this would mean that the product does not require any heavier lifting than what the daycare workers already do. However, knowing that the wish for maximum 6 kilos was very optimistic, the team at least said that the solution should at an absolute maximum weigh 19 kilos, as some of the biggest children weigh. The team however still wanted to optimize the solution in regards of the weight as much as possible, both for the interaction of the daycare but also to minimize waste of materials.

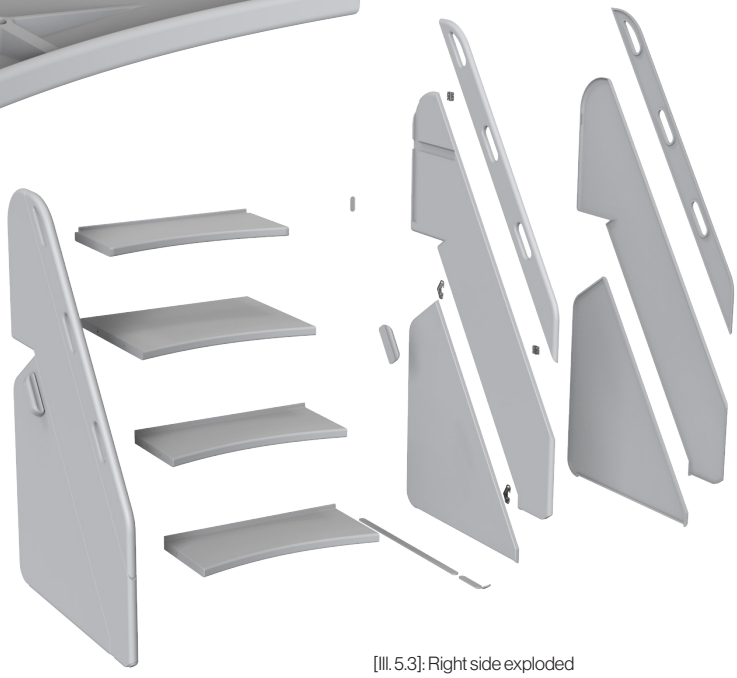
The team therefore looked into splitting all side structures into two separate molds each and also creating ribs underneath each step to add strength with as little material as possible. This would require a total amount of 22 molds, see illu. 5.3.

[Ill. 5.1]: Rib design step





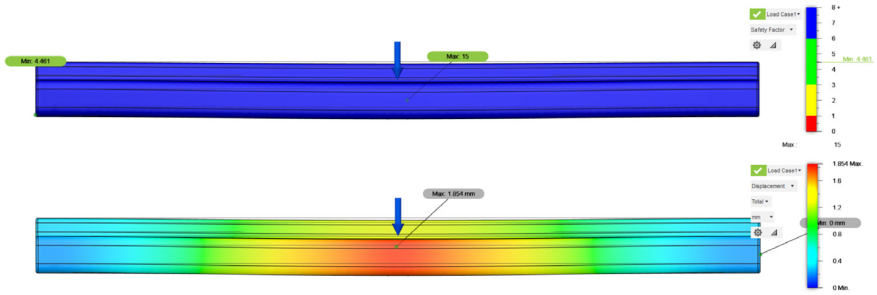
[Ill. 5.2]: Rib designs



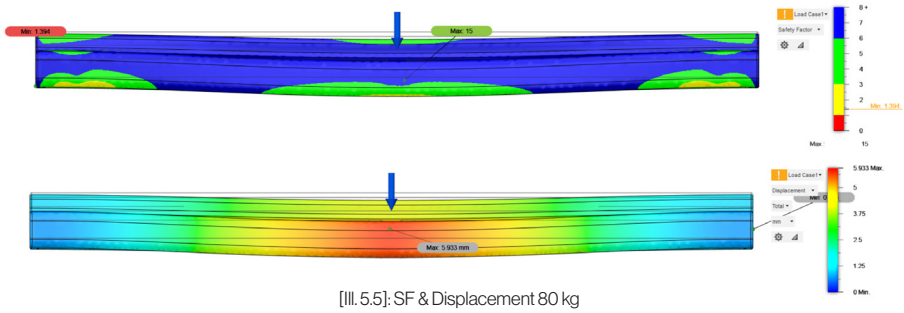
[Ill. 5.3]: Right side exploded

The team tried a lot of different types of ribs and created FEM simulations on them, however, this would require more knowledge of rib design to fully accomplish, see ill. 5.2. The rib design ended as seen in ill. 5.1 when the team stopped working on the solution. When looking into calculating on the solution, on previous semesters, the students would have made sure to have hand calculations before creating FEM simulations. This was done to ensure that the results matched each other. However, when creating more advanced steps, and especially when dealing with shape optimization, the hand calculations did not make sense. They would be too vague to conclude anything from. The team therefore chose to only to FEM simulations.

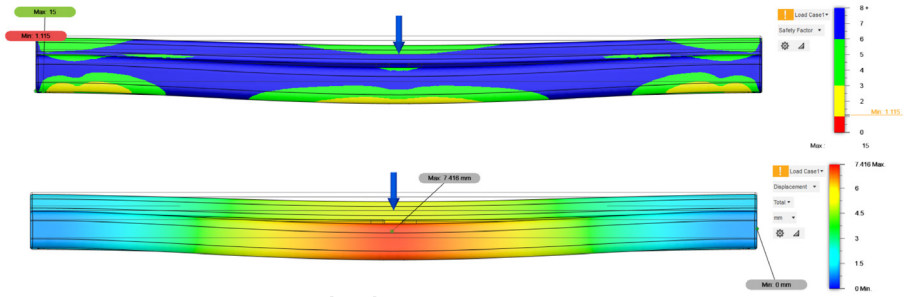
When looking at the displacement and safety factor as seen in ill. 5.6, for 25, 80 and 100 kilos, the solution would still be too thin, as the solution would have a displacement of 1,8 mm with only caring 25 kilos on a step. Even though 1,8 mm is not much on a plastic material, it still is a big displacement comparing to the weight. The team wished for the solution to be able to withstand if an adult would use the stepladder, meaning withstanding up to approx. 100 kilos. If a person of 100 kilos would stand on this solution, it would have a displacement of 7,4 mm and a safety factor on 1,15.



[Ill. 5.4]: SF & Displacement 25 kg



[Ill. 5.5]: SF & Displacement 80 kg



[Ill. 5.6]: SF & Displacement 100 kg

NEW TRINI SOLUTION (wood)
When looking into the new Trini design with the cut down functions, plywood was chosen as a cheaper material, both regarding the material cost itself, but also regarding cheaper production methods. The plywood can easily be cut by a laser cutter and then afterwards roughly sanded to ensure the softer edges and then lastly finely sanded down.
When looking into what plywood normally is composed of, pine wood is very common. The psychical material for the 3D model in 3D software is therefore set to Pine, to calculate the weight of the total stepladder. This includes 4 different side structures and 4 steps. Instead of having an overall product thickness of 20 mm resulting in 10,2 kilos. the new design should just be made of 15 mm resulting in 7,8 kilos. as the material now is solid.

To ensure that the product it still easy to clean, the wood should be lacquered with a mat wood lacquer.

ASSEMBLY
The laser cut side pieces for the stepladder is assembled with the steps by screws through "step connectors" on each side of the steps, existing of a triangular piece of wood with two screws going into the step and two screws into the side structure. The bottom side structure is connected to the upper support structure with simple hinges, to ensure that the side structure can fold underneath the steps. To ensure that the hinges stay open when the stepladder is unfolded and in use, a latch is placed on either side between the second and third step, to ensure that the sides can be locked into place.

CONCLUSION
The new solution is made of 15 mm plywood that should be cut by laser and afterwards sanded to ensure soft fillets. The four pieces of side structure parts, four steps, screws, hinges, and latches end up with a total weight of 7,8 kilos, ensuring a lighter solution for the daycare workers. Even though 7,8 kilos are more than the weight of the smallest children, one has to think that the daycare workers do not have to lift the solution more than maximum twice a day, and in some cases maybe only twice a week, depending on how they prefer to store it through their day and week. The solution therefore still creates a big difference in helping the daycare workers during their workday.

[Ill. 5.7]: Finished Trini with hinges & latches

[Ill. 5.8]: Step connector with 4 screws

DEMAND

- The material should be easy to clean
- The product should maximum weigh 19 kilos
- The product should be able to withstand 100 kilos

FINAL SPECIFICATIONS

INTERACTION	
REQUIREMENT	PAGE SOURCE
The product should assist the daycare workers before and after diaper change, to ensure less harmful lifts	11, 14, 23
The product must be safe for the children to interact with	14, 29
Children must be able to themselves crawl up onto the changing matte and down again	26
The product should support the children when crawling up and down	35
The steps should nudge the children to stay on the steps	64
The product should be usable for crawling and walking children up to 4 years of age	29

STAKEHOLDERS & MARKETING	
REQUIREMENT	PAGE SOURCE
The product should fit to all three stakeholders	9, 18
Estimated max price point at around 3000 DKK	18

MATERIALS & PRODUCTION	
REQUIREMENT	PAGE SOURCE
The product should be easy to clean	14, 48, 54, 75
The step dimensions should fit the children's crawling and walking patterns and behaviors	35
The handles should fit a child's hand	63
The product should at a maximum weigh 19 kilos	75
The product should be able to withstand 100 kilos	75

AESTHETICS & FUNCTIONS	
REQUIREMENT	PAGE SOURCE
The product need to fit into a maximum area of 90 cm deep and 95 cm high.	14, 29, 32
The product should fit to different types of changing table solutions	29
The product should be foldable	31
The product should look aesthetically welcoming and safe for a child to use	33
The product should not distract the children during use	35
The shape of the steps should ensure support for the children as well as easy guidance on their way down	49
The product should look stable in its appearance	51, 54

BUSINESS & SCALABILITY

This section shows the thoughts behind the scalability and execution plan of Trini. This includes foreseeing the further development of Trini and price calculations for the first version. The team chose to work on the project with a startup point of view, the thoughts behind the product and startup values can be seen in the created business model canvas on page 78.

When looking at the two concepts created, the plastic and wooden Trini, there is a big difference in both the needed product production methods and product complexity. If the team were to start selling Trini without needing too big investments, the best solution would be to start with the wooden Trini as an MVP (Minimum viable product) [Ries, E. 2011] and then further develop on the plastic version for the second or third release.

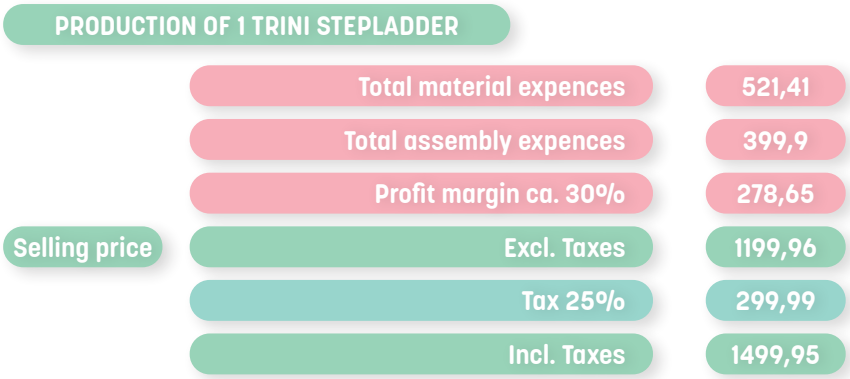
When looking into the price of the first edition Trini, the price point was from the daycare workers and municipality previously set to be maximum 3000, however, this was when the solution was a 2 in 1 product and could convert into a stool. The price should therefore be lower now, as the product does not give as much value to the daycare workers as before, however, the product should be evidently cheaper as the production is much cheaper. The price on the production and materials was calculated as seen in ill. 5.9, also check calculations on appendix 40, and when adding taxes etc. the total cost for one Trini stepladder should be 1499,95.

Trini (MVP)
The first edition Trini that will be released should therefore be the wooden solution presented in this report. The focus is a cheap foldable solution that focuses on solving the problem for the daycare workers, while being able to fit into their confined living spaces.

Trini 2.0
The second edition of Trini will be much alike the plastic version of which the team had developed. Meaning a bit more expensive 2 in 1 solution able to convert into a stool with foldable handles. This version will be more expensive but add much more value regarding more functions and a material more resistant towards cleaning.

Trini Plus
The third edition of Trini should be a more exclusive version of Trini 2.0, with buttons to unlock the different locking mechanisms. These buttons should be much alike the once on prams, where the daycare workers just have to push the buttons to then relief the mechanisms. This version would perhaps also have a more simple and modern solution for converting the upper step into a stool.

Product line
The company would overall also look into other aspects of how to improve the daily work environment for the daycare workers. The primary focus should always be the daycare workers, and not to make products suited for children or parents.



[Ill. 5.9]: Price calculation on 1 Trini

BUSINESS MODEL CANVAS

Key Partners

The **production** is **outsourced** through Key Partners facilities, such as cutting and sanding the wood, assemble and lacquering.

Key Activities

The Key Activities are ensuring good supply chain management, to ensure parts for repairing products, and to keep delivering new once.

The **Production** activities, such as designing, making and delivering products in good quality is the main activity, and the next one being further **Problem Solving**, to solve more problems for the Customer Segments.

Key Ressources

The Key Resources are **Physical** and **Human** resources.

It is important to have warehouse space for product stock, for service employees both taking calls, e-mails and driving out to the customers to offer help.

Cost Structure

The Cost Structure is mostly based on being Cost-driven, to aim on creating the leanest possible Cost Structure, however, the Value Propitiation also push towards us being Value-Driven, as the product gives a lot of value to the customers. **A balance should therefore be created between the Cost-Driven and Value-Driven.**

From the production and salaries, there is a lot of **Fixed Costs**. The income pr. Product will vary, depending on the bargains made from municipalities, and percentage from working as a daycare.

Value Propositions

Trini help the customers **reduce their daily risks of injuries**, by offering an **affordable foldable** stepladder solution for the children to climb up and down from the changing mat themselves, **created specifically to children from approx. 8 months of age.**

Customer Relationships

The Customer Relationship is based on **personal assistance with human interaction**. This ensures that all customers have the ability to talk to real customer representatives either by e-mail, through calls and when having to get service on the product.

Customer Segments

Niche market for the most important customer group: **Daycare workers, both private and municipal.**

Segmented: Everyone that either work with children, or need help in their daily activities at home or in an institution.

Channels

Awareness & evaluation: We wish to catch the daycare workers awareness when they shop for new products in stores like BabySam and stores alike, with an in store showcase. There should also be made an effort into contacting all municipalities to inform them on this new solution, and the benefits, and offering a good price. Lastly, a product flyer should be delivered in the daycare workers mailboxes, to spread the awareness directly to the users.

Purchase & delivery: Trini will be sold on our own website, through our sales forces when calling from looking at the flyers and through partner stores like BabySam. The organization is open for contract deals directly to the municipality or stores who already have contracts with multiple municipalities.

After sales: We will have a team of customer service, who take care of the customers from the website, and the customers making calls. When a product might need repairing, the organization sends out own repairing services home to the daycare workers.

Revenue Streams

The Revenue Streams are **Asset Sale** – The Customers do with it what they want when they receive the product. We can repair it and the customer would only pay for the changed parts – unless it is a matter of warranty.

We expect a **medium to high revenue** from a **medium number of sales**, as the primary Customer Segment is in a niche market. The private daycare workers are able to get **percentage off**, the municipalities can get better **bargains** depending on how many they buy. Private parents and non-work related Customers **pay full price**.

EPILOGUE

After showing the final solution created and the implementation considerations regarding production and business strategies, the report will now be finished off with an overall pro-cess conclusion and reflection, and then lastly show a literature list and illustration list with the sources used in this report.

CONCLUSION

This project resulted in the creation of Trini, a stepladder created for the specific purpose of assisting the in-home daycares in their daily routine of changing the children's diapers.

Studies created in this project show that the daycare workers are daily put into danger as they lift and carry the children up to 70 times during a workday, depending on the children's own capabilities. These children vary in weight from 6,5 to 19 kilos, depending on their age. This results in the daycare workers ending up with work related injuries from lifting up to 1 ton during a workday, without any type of assistance or helping devices. From creating observations, the team found that the diaper changing situation is the one activity that needs the most lifting, up to 8 times pr. Day pr. Child.

Through various of research and a lot of design iterations, the team created Trini. Trini help to minimize the daily injuries as it enables the children from approx. 8 months of age, at the average crawl age, to themselves get up and down from the changing mat. The daycare workers just have to unfold Trini and place it in front of the changing mat, and then the children themselves will do the work for them. Not only does this help the daycare workers with up to x percent of their daily lifts, but it also gives the children a better learning environment both mentally and physically.

By testing and observing both the daycare workers and the children's behavior, the team could pinpoint which functions the solution should have and how they should be presented in the product, and hereby make these features correlate to an aesthetical design, whether it be the shape of the steps or the side support with handles in them etc.

The report sums up the process from finding the problem in autumn 2020, to creating a proposal for a product concept with thought out scalability opportunities and hand in, in November 2021.

REFLECTION

This master thesis was overall proceeded through a common appreciation of structured work aesthetics. Both team members truly appreciate having the process well-structured to ensure a schedule with room for unforeseen design changes or in case the team had to pivot. This ensured the team to be able to create a lot of iterations, and still having the ability to investigate different directions without necessarily ending up choosing them, depending on the user's feedback.

The team also experienced several challenges and obstacles along the way, first of all, the team had to create their master thesis from home, as a consequence of the Corona lock down. The team therefore not only chose a subject that would motivate them, but also of which they would have closely related people to still be able to visit and test on. The team however did not expect the big support on the online Facebook groups. The team was able to get up to 100+ respondents from surveys created, and even though surveys in some cases have to be taken with a grant of salt, these daycare workers seemed very sincere and passionate about the subject as a lot of them suffer from these work-related injuries. The team got the best of the lock down, with not only a lot of help from the users, but also generally found it easier to concentrate working from home and having online meetings together throughout the day to still stay connected and work close together as a team.

After the third and final milestone, the team split up. And even though the team had created most of the project at this point, it still created a lot of frustration for both team members. This resulted in both team members having to individually take some quick decisions in the end of the project period for the overall final details and implementation in the design, but also regarding creating the reports. In this reports case and design, it had the consequence of lacking reflections from working on parttime, but still needing to finish for a certain deadline. The project therefore both showed periods of which the team had good time to dive into details, and moments of which a decision just had to be made in five minutes. Both of which these situations can have a benefit of trying, for when having to prepare for working at a design company after University.

The team together worked through a lot of methods throughout the process, of which digitally sketching, and 3D sketching/modelling was the most prominent. The team was able to create a lot of different designs from drawing on top of 3D pictures or purely 3D sculpturing new designs in a matter of minutes. This project therefore shows a lot of different variations each time the team had to investigate a feature, most of these however only presented in the appendix to keep the report under 100 pages. The team always tried to diverge as much as possible in the time space available for each activity, to ensure a lot of different possibilities before converging down to a specific solution. To ensure a well evaluated converging process, the team used 'Clustering' as a gathering method a lot, to ensure the team to find patterns and evaluating not only each part possibility, but also evaluating the overall patterns against each other.

This project overall offered a lot of learning in both an educational aspect, but certainly also on a very personal level.

LITERATURE LIST

At.dk. 2021. Dagplejerne løfter mindre. [online] Available at: <https://at.dk/arbejdsmiljoeproblemer/ergonomi/inspiration/dagplejerne-loefter-mindre/> [Accessed 2 February 2021].

At.dk. 2021. Løft, træk og skub. [online] Available at: <https://at.dk/regler/at-vejledninger/loeft-traek-skub-d-3-1/> [Accessed 2 February 2021].

Avisen.dk. 2015. Murer-Torben tog piller hver dag i 10 år for at holde til jobbet. [online] Available at: <https://www.avisen.dk/murer-torben-tog-piller-hver-dag-i-10-aar-for-at-hol_350995.aspx> [Accessed 2 February 2021].

Babyklar.dk. 2021. Børnehave opstart – praktisk info og tips til god indkøring. [online] Available at: <https://www.babyklar.dk/boern/boernehave.html> [Accessed 2 February 2021].

Bech-Jørgensen, L. & Rohde, A. (August 2019). Babyboom giver behov for flere daginstitutioner. DI. [Online] Available at: https://www.danskindustri.dk/offentlig-privatsamarbejde/analyser/arkivmappe---analyser/analysearkiv/2019/8/babyboom-giver-behov-for-flere-daginstitutioner/ [Accessed 01 February 2021]

Bech Massen, M. & Lindskov, J., (June 2017). Dagplejens historie 1966-2016. FOA. [Online magasine] Available at: http://applikationer.foa.dk/publikationer/pjece.asp?id=2330 [Accessed 01 February 2021]

Børne- og Undervisningsministeriet. 2021. Dagpleje og daginstitutioner. Borger.dk. [Online] Available at: https://www.borger.dk/familie-og-boern/Boernepasning/Dagpleje-vuggestue-boernehave-og-privat-pasning [Accessed 02 February 2021]

Design Thinking for Educators. (2012). 2nd ed. IDEO, pp.14 – 16

Dubberly, H., (2004): "How do you design?", Dubberly Design Office.

Evomove.com, A/S, E., 2021. Mål på emballage, højde og vægtangivelser på Nomi højstol og skråstol. [online] Evomove.com. Available at: <https://evomove.com/dk/om-nomi/nomi-specs> [Accessed 13 April 2021].

Fagbladet FOA. 2018. 4 ud af 10 har smerter: Ansatte i dagtilbud løfter for meget. [online] Available at: <https://www.fagbladetfoa.dk/Artikler/2018/11/02/4-ud-af-10-har-smerter-Ansatte-i-dagtilbud-loefter-for-meget> [Accessed 2 February 2021].

Fyens.dk. 2005. Dagplejere plages af skader. [online] Available at: <https://fyens.dk/artikel/dagplejere-plages-af-skader> [Accessed 2 February 2021]

Glavind, N & Pade, S,. (Nov 2020). Udviklingenstendenser dagpleje og daginstutioner 2020. FOA. [Online magasine]. Available at: https://applikationer.foa.dk/Publikationer/pjece.asp?id=2472 [Accessed 01 February 2021]

Mariagerfjord commune. 2021. Forskelle mellem kommunal dagpleje og privat pasningsordning. [Online magasine] Available at: https://www.mariagerfjord.dk/da/Dagplejen/Search?w=Forskelle%20mellem%20kommunal%20dagpleje%20og%20privat%20pasningsordning&ALL=True [Accessed 02 February 2021]

Measures Of Man: Tilley, A. and Associates, H., 1993. The Measures Of Man And Woman. New York, pp.12-14.

Online Dreams (2018) Guide til den optimale puslebord højde [Online] Available at: https://puslebordguide.dk/guide-optimale-puslebord-hoejde/ [Accessed 19 February 2021]

plast.dk. 2021. Det Store Plastleksikon: Alt hvad du skal vide om plast | plast.dk. [online] Available at: <https://plast.dk/det-store-plastleksikon/> [Accessed 13 April 2021].

Pressemeddelse 2018: "Børns alder ved start i dagtilbud". [online] Available at: <https://sm.beru.dk/media/28937/kort_fortalt_boerns_alder_ved_start_i_dagtilbud.pdf> [Accessed 2 February 2021]

Ries, E., 2011. The Lean Startup. Crown Publishing Group

Sanders, E., 2006, "Design Research in 2006", Design Research Society

Sarasvathy, S., 2001. What Makes Entrepreneurs Entrepreneurial?. University of Virginia: The Darden Graduate School of Business Administration.

Sarasvathy, S., 2008. Effectuation: Elements Of Entrepreneurial Expertise. Edward Elgar Publishing, Inc.

Slyngebarn.dk. 2007. Dagplejere - spyt ud - Slyngebarn. [online] Available at: <https://slyngebarn.dk/forum/showthread.php?t=21953&page=> [Accessed 2 February 2021].

Stokholm, Marianne (2014) Problem based learning versus design thinking in team-based project work. I: International conference on engineering and product design education, 05.09.2014, (Article)

Sygeboern.dk. 2018. Drenge 0-5 år - sygebørn.dk. [online] Available at: <https://www.sygeboern.dk/trivsel-vaekst/drenge-0-5-aar> [Accessed 2 February 2021].

Tollestrup, C., 2004. Value and Vision-based Methodology in Integrated Design.

U.S. Consumer product safety commission (2008) Public playground safety handbook [Online] Available at: http://www.rfabc.com/Assets/RFABC+Digital+Assets/pdf/playsafe.pdf?fbclid=IwAR2SRyzNdEa-cJdYHTsxpZUGXTHPPHOm9I-ampSMSvgWHjWnc5i_6IGY4vY [Accessed 19 February 2021]

UVM. 2020. Private pasningsordning. Børne- og undervisningsministeriet. [Online] Available at: https://www.uvm.dk/dagtilbud/typer-af-tilbud/private-pasningsordninger. [Accessed 02 February 2021]

ILLUSTRATION LIST

[Ill. 1.11] pleje, S., Væghængt puslebord i metal, H. and puslebord, V., 2021. Væghængt puslebord i metal, Hvid. [online] Dagplejenet.dk. Available at: <https://www.dagplejenet.dk/shop/vaeghaengt-puslebord-i-2772p.html> [Accessed 23 November 2021].

[Ill. 1.12] Pressalit.com. 2021. Pusleborde til institutioner, børnehaver, vuggestuer og sygehuse - Pressalit. [online] Available at: <https://pressalit.com/da-dk/pusleborde/> [Accessed 23 November 2021].

[Ill. 1.13] pleje, S. and Pia Puslebord med 2 hylder, H., 2021. Pia Puslebord med 2 hylder, Hvid. [online] Dagplejenet.dk. Available at: <https://www.dagplejenet.dk/shop/pia-puslebord-med-1953p.html> [Accessed 23 November 2021].

[Ill. 1.14] Babysaminst.dk. 2021. Fritstående El-puslebord m/ sanitet og 2 kurve - BabySam Institution. [online] Available at: <https://www.babysaminst.dk/fritstaaende-el-puslebord-1330x850-mm-onesize-1> [Accessed 23 November 2021].

[Ill. 1.15] Pixizoo. 2021. Tiny Republic puslepude, Snow Flake - Hvid. [online] Available at: <https://www.pixizoo.dk/tiny-republic-puslepude-white> [Accessed 23 November 2021].

[Ill. 1.16] AJ. [online] Available at: <https://www.ajprodukter.dk/skole-institution/dagpleje-og-bornehave/skifterum/trappe-til-puslebord/18640850-19435381.wf?productId=19435408&gclid=CjwKCAiAsOmABhAwEiwAEBR0ZtwXpLrDygR4PGI7tp3ZJilkvH6s1cgMPI0mYjHXGOavtTRGzaaMtxoCGw8QAvD_BwE> [Accessed 23 November 2021].

[Ill. 1.17] pleje, S. and puslebord, S., 2021. Stige til puslebord. [online] Dagplejenet.dk. Available at: <https://www.dagplejenet.dk/shop/stige-til-puslebord-2872p.html> [Accessed 23 November 2021].

[Ill. 1.18]
Ajprodukter.dk. 2021. Om os. [online] Available at: <https://www.ajprodukter.dk/om-aj/4511402.wf> [Accessed 23 November 2021].

Babydan.dk. 2021. [online] Available at: <https://www.babydan.dk/> [Accessed 23 November 2021].

Babytrold.dk. 2021. Historien bag BabyTrold. [online] Available at: <https://www.babytrold.dk/shop/cms-om-babytrold.html> [Accessed 23 November 2021].

Donebydeer.com. 2021. Done by Deer | Nordic Design | Interior and Toys for Children. [online] Available at: <https://www.donebydeer.com> [Accessed 23 November 2021].

Fagerlundstaalmontage.dk. 2021. KONTAKT. [online] Available at: <http://www.fagerlundstaalmontage.dk/kontakt.html> [Accessed 23 November 2021].

H., 2021. Hoppekids | Kid's beds with the nordic swan ecolabel. [online] Hoppekids | Kid's beds with the nordic swan ecolabel. Available at: <https://www.hoppekids.com/> [Accessed 23 November 2021].

Leander | Dansk design - Baby & børnemøbler. 2021. Pusle. [online] Available at: <https://leander.com/dk/pusle/> [Accessed 23 November 2021].

Ropox. 2021. Maxi2. [online] Available at: <https://ropox.dk/produkter/maxi2-puslebord/#oversigt> [Accessed 23 November 2021].

Pressalit.com. 2021. Pusleborde til institutioner, børnehaver, vuggestuer og sygehuse - Pressalit. [online] Available at: <https://pressalit.com/da-dk/pusleborde/> [Accessed 23 November 2021].

Sebra.dk. 2021. Sebra Sengen. [online] Available at: <https://www.sebra.dk/> [Accessed 23 November 2021].

[Ill. 3.1]
Ajprodukter.dk. 2021. Trappe til puslebord Klattra. [online] Available at: <https://www.ajprodukter.dk/skole-institution/institutionsmobler/skifterum/trappe-til-puslebord/18640850-19448861.wf?productId=19448871> [Accessed 23 November 2021].

Babysaminst.dk. 2021. Odder Sammenklappelig letvægtsstige - BabySam Institution. [online] Available at: <https://www.babysaminst.dk/odder-sammenklappelig-letvaegtsstige-onesize> [Accessed 23 November 2021].

Coolshop.dk. 2021. Baby Dan - To-trins Skammel - Hvid. [online] Available at: <https://www.coolshop.dk/produkt/baby-dan-to-trins-skammel-hvid/234TD6/> [Accessed 23 November 2021].

IKEA. 2021. BEKVÄM Taburet, asp - IKEA. [online] Available at: <https://www.ikea.com/dk/da/p/bekvaem-taburet-asp-10225589/> [Accessed 23 November 2021].

IKEA. 2021. TROGEN Køkkenstige/børnetaburet, gul, 40x38x33 cm - IKEA. [online] Available at: <https://www.ikea.com/dk/da/p/trogen-kokkenstige-bornetaburet-gul-80371520/> [Accessed 23 November 2021].

Lekolar.dk. [online] Available at: <https://www.lekolar.dk/sortiment/mobler-indretning/puslerum/tilbehor/ trappestige-til-puslebord/> [Accessed 23 November 2021].

Puslebord, S. and Puslebord, S., 2021. Stige til Puslebord. [online] Daycare1.dk. Available at: <https://daycare1.dk/shop/stige-til-puslebord-481p.html> [Accessed 23 November 2021].

Silvan.dk. 2021. Klapbar trappestige med 2 trin, maks. 150 kg - Køb Stiger & stillads online | SILVAN. [online] Available at: <https://www.silvan.dk/norstep-trappestige-2-trin?id=2620-8446031> [Accessed 23 November 2021].

vuggestue, S., 2021. Sammenklappelig skammel til vuggestue. [online] Handahldesign.dk. Available at: <https://handahldesign.dk/shop/4-ergonomiske-paaklaedningsmoebler/15-paaklaedningsbaenk-sammenklappelig-3-trin/> [Accessed 23 November 2021].

[Ill. 3.2] Puslebord, S. and Puslebord, S., 2021. Stige til Puslebord. [online] Daycare1.dk. Available at: <https://daycare1.dk/shop/stige-til-puslebord-481p.html> [Accessed 23 November 2021].

[Ill. 3.3] IKEA. 2021. BEKVÄM Taburet, asp - IKEA. [online] Available at: <https://www.ikea.com/dk/da/p/bekvaem-taburet-asp-10225589/> [Accessed 23 November 2021].

[Ill. 3.4] Babysaminst.dk. 2021. Odder Sammenklappelig letvægtsstige - BabySam Institution. [online] Available at: <https://www.babysaminst.dk/odder-sammenklappelig-letvaegtsstige-onesize> [Accessed 23 November 2021].

[Ill. 3.5] Silvan.dk. 2021. Klapbar trappestige med 2 trin, maks. 150 kg - Køb Stiger & stillads online | SILVAN. [online] Available at: <https://www.silvan.dk/norstep-trappestige-2-trin?id=2620-8446031> [Accessed 23 November 2021].

[Ill. 3.6] Ajprodukter.dk. 2021. Trappe til puslebord Klattra. [online] Available at: <https://www.ajprodukter.dk/skole-institution/institutionsmobler/skifterum/trappe-til-puslebord/18640850-19448861.wf?productId=19448871> [Accessed 23 November 2021].

Appendix 3
At.dk. 2021. Dagplejerne løfter mindre. [online] Available at: <https://at.dk/arbejdsmiljoeproblemer/ergonomi/inspiration/dagplejerne-loefter-mindre/> [Accessed 23 November 2021].

Appendix 4
Afd. for Vækst og Reproduktion, R., 2014. Højde- og vægtkurver pige - Danske vækstkurver 2014. [online] Xn--vkstkurver-d6a.dk. Available at: <http://www.xn--vkstkurver-d6a.dk/pige.html> [Accessed 23 November 2021].

Afd. for Vækst og Reproduktion, R., 2014. Højde- og vægtkurver dreng - Danske vækstkurver 2014. [online] Xn--vkstkurver-d6a.dk. Available at: <http://www.xn--vkstkurver-d6a.dk/dreng.html> [Accessed 23 November 2021].

WHO.int. 2021. [online] Available at: <https://cdn.who.int/media/docs/default-source/child-growth/child-growth-standards/indicators/motor-development-milestones/graph--windows-of-achievement-for-six-gross-motor-milestones04ac44c38d96466498e7633d9d44c7e6.pdf?sfvrsn=ea3a0241_0> [Accessed 23 November 2021].

Appendix 7
AJ. [online] Available at: <https://www.ajprodukter.dk/skole-institution/dagpleje-og-bornehave/skifterum/trappe-til-puslebord/18640850-19435381.wf?productId=19435408&gclid=CjwKCAiAsOmABhAwEiwAEBR0ZtwXpLrDygR4PGI7tp3ZJilkvH6s1cgMPI0mYjHXGOavtTRGzaaMtxoCGw8QAvD_BwE> [Accessed 23 November 2021].

AJ. [online] Available at: <https://www.ajprodukter.dk/skole-institution/dagpleje-og-bornehave/skifterum/puslebord/18640850-25794951.wf?productId=25794953> [Accessed 23 November 2021].

AJ. [online] Available at: <https://www.ajprodukter.dk/skole-institution/dagpleje-og-bornehave/skifterum/puslebord/18640850-19442145.wf?productId=19442119> [Accessed 23 November 2021].

AJ. [online] Available at: <https://www.ajprodukter.dk/skole-institution/dagpleje-og-bornehave/skifterum/puslebord/18640850-19445547.wf?productId=19445580> [Accessed 23 November 2021].

Babysam. [online] Available at: <https://www.babysam.dk/pusleplade-b84xd13xh66-cm-onesize> [Accessed 23 November 2021].

Babysam.dk. 2021. Bounce Bounce Baby 2-i-1 legetrampolin og bord - Babysam.dk. [online] Available at: <https://www.babysam.dk/bounce-bouncebaby-2-i-1-legetrampolin-og-bord-onesize?gclid=CjwKCAiAv_KMBhAzEiwAs-rX1FXUue4ZP4PqG0hdXTbHGp-Xipnuys2RN0u67XxOSbVCwDTRVVNM5hoCZZwQAvD_BwE> [Accessed 23 November 2021].

Babysam.dk. 2021. Skammel, to trin, grå - Babysam.dk. [online] Available at: <https://www.babysam.dk/skammel-to-trin-graa-onesize> [Accessed 23 November 2021].

Babysaminst.dk. 2021. Fritstående El-puslebord m/ sanitet og 2 kurve - BabySam Institution. [online] Available at: <https://www.babysaminst.dk/fritstaaende-el-puslebord-1330x850-mm-onesize-1> [Accessed 23 November 2021].

Babysaminst.dk. 2021. Odder Sammenklappelig letvægtsstige - BabySam Institution. [online] Available at: <https://www.babysaminst.dk/odder-sammenklappelig-letvaegtsstige-onesize> [Accessed 23 November 2021].

Babysaminst.dk. 2021. Væghængt El puslebord 85x133 cm plade kan vippes - BabySam Institution. [online] Available at: <https://www.babysaminst.dk/vaeghaengt-el-puslebord-85x133-cm-plade-kan-vippes-onesize> [Accessed 23 November 2021].

Babyshower.dk. 2021. Tilbehør til vogne. [online] Available at: <https://babyshower.dk/shop/stige-til-krybbe-puslebord-step-stigen-9808p.html> [Accessed 23 November 2021].

Pixizoo. 2021. Leander Matty puslepude - Dusty Grey. [online] Available at: <https://www.pixizoo.dk/leander-matty-puslepude-dusty-grey?gclid=CjwKCAiAjeSABhAPEiwAqfxURWADh1k01LzOlV0tx2iXQLBLjhlByhFxeTVskpO4xFOzgKVrQsoghhoCPLwQAvD_BwE> [Accessed 23 November 2021].

Pixizoo. 2021. Tiny Republic puslepude, Snow Flake - Hvid. [online] Available at: <https://www.pixizoo.dk/tiny-republic-puslepude-white> [Accessed 23 November 2021].

pleje, S. and BabyTrold puslebord væghængt i træ, H., 2021. BabyTrold puslebord væghængt i træ, Hvid. [online] Dagplejenet.dk. Available at: <https://www.dagplejenet.dk/shop/babytrold-puslebord-vaeghaengt-1723p.html> [Accessed 23 November 2021].

pleje, S. and Pia Puslebord med 2 hylder, H., 2021. Pia Puslebord med 2 hylder, Hvid. [online] Dagplejenet.dk. Available at: <https://www.dagplejenet.dk/shop/pia-puslebord-med-1953p.html> [Accessed 23 November 2021].

pleje, S. and Puslebord Vera, G., 2021. Puslebord Vera, sammenklappelig, Grå. [online] Dagplejenet.dk. Available at: <https://www.dagplejenet.dk/shop/puslebord-vera-sammenklappelig-2920p.html> [Accessed 23 November 2021].

pleje, S. and Puslehynde til væghængt puslebord, G., 2021. Puslehynde til væghængt puslebord, Grå Skai. [online] Dagplejenet.dk. Available at: <https://www.dagplejenet.dk/shop/puslehynde-til-vaeghaengt-2720p.html> [Accessed 23 November 2021].

pleje, S., Væghængt puslebord i metal, H. and puslebord, V., 2021. Væghængt puslebord i metal, Hvid. [online] Dagplejenet.dk. Available at: <https://www.dagplejenet.dk/shop/vaeghaengt-puslebord-i-2772p.html> [Accessed 23 November 2021].

Pressalit.com. 2021. Puslebord, 800 x 1400 mm, elektrisk højderegulérbart, med sanitet og standardarmatur - Pressalit. [online] Available at: <https://pressalit.com/da-dk/pusleborde/pusleborde-lavtgaaende-og-vaeghaengte/puslebord-800-x-1400-mm-elektrisk-hoejderegul/p-r8684000/> [Accessed 23 November 2021].

pleje, S. and puslebord, S., 2021. Stige til puslebord. [online] Dagplejenet.dk. Available at: <https://www.dagplejenet.dk/shop/stige-til-puslebord-2872p.html> [Accessed 23 November 2021].

Appendix 12

Ajprodukter.dk. 2021. Pladegodsvogn, 500x370x900 mm. [online] Available at: <https://www.ajprodukter.dk/lager-industri-vaerksted/transport-loft/pladevogne/pladegodsvogn/29850653-19435769.wf?productId=19435759&gclid=Cj0KCQiA1KiBBhCcARIsAPWqoSpfGXSx-qVW5553s_IEwNjjLjjmOg6tVdA2VZG402aIQziZVeOeNqJ4aAlq9EALw_wcB> [Accessed 23 November 2021].

Ajprodukter.dk. 2021. Tøndeløfter med manuel rotation. [online] Available at: <https://www.ajprodukter.dk/lager-industri-vaerksted/miljo/tondeloft/tondelofter-med-manuel-rotation/29300967-19454730.wf?productId=19454719&gclid=Cj0KCQiA1KiBBhCcARIsAPWqoSquL-3hL1hyM04c8Br4zmxkEjwgD01YVHT3NwYtl9sm7tXBedYci5X0aAuE-EALw_wcB> [Accessed 23 November 2021].

Astrupby.mono.net. 2021. Astrup - De aktives by i Vendsyssel - Ny trampolin. [online] Available at: <http://astrupby.mono.net/26209/Ny%20trampolin> [Accessed 23 November 2021].

Cotonshoppen.dk. 2021. Blower, badekar og trimmebord til hunde. [online] Available at: <https://cotonshoppen.dk/blower-badekar-og-trimmebord-365/> [Accessed 23 November 2021].

e-home. 2021. Hydraulisk behandlingsbord til hunde · e-home. [online] Available at: <https://e-home.dk/produkt/hydraulisk-behandlingsbord-til-hunde/> [Accessed 23 November 2021].

fundament, H., 2021. Hjælp hvis huset synker - huse uden støbt fundament. [online] Handyman.dk. Available at: <https://handyman.dk/handyman/andet/hjaelp-hvis-huset-synker-huse-uden-stoebt-fundament/?side=6> [Accessed 23 November 2021].

Guldmann. 2021. Det gode råd: Hjælp til løft af overkrop. [online] Available at: <https://www.guldmann.com/dk/om/nyheder-og-events/news/det-gode-rad-hjaelp-til-loft-af-overkrop> [Accessed 23 November 2021].

Handicare Denmark. 2021. ReTurnBelt - Handicare Denmark. [online] Available at: <https://www.handicare.dk/product/returnbelt/> [Accessed 23 November 2021].

Hmi-basen.dk. 2021. [online] Available at: <https://hmi-basen.dk/blobs/produktblade/104.pdf> [Accessed 23 November 2021].

Hmi-basen.dk. 2021. Hjælpemiddelbasen - Børne originalsejl, lav fra A.P. Botved A/S. [online] Available at: <https://hmi-basen.dk/r11x.asp?linkinfo=16499> [Accessed 23 November 2021].

immo. 2021. Ergoport | Respektfuld Håndtering af PRM-passagerer | IMMO A/S. [online] Available at: <https://immodenmark.dk/produkter/ergoport/> [Accessed 23 November 2021].

Jern & Maskinindustrien. 2021. Lifte, der sakser tunge løft væk. [online] Available at: <https://www.jernindustri.dk/announcement/view/121079/lifte_der_sakser_tunge_loft_vaek> [Accessed 23 November 2021].

Jungheinrich-profishop.dk. 2021. Tøndeløfter med styrestangsløft | Jungheinrich PROFISHOP. [online] Available at: <https://www.jungheinrich-profishop.dk/Toendeloefter-med-styrestangsloeft-24594-197983/?gclid=Cj0KCQiA1KiBBhCcARIsAPWqoSroqJ2lWvtp7JDSLPQuQwd-NoALQXaGsFqCycSyu7Uq5jCDzQeWKFYQaArQoEALw_wcB&Shop=b2c&sd=true&wmc=pla&ef_id=Cj0KCQiA1KiBBhCcARIsAPWqoS-roqJ2lWvtp7JDSLPQuQwdNoALQXaGsFqCycSyu7Uq5jCDzQeWKFYQaArQoEALw_wcB:G:s&s_kwcid=AL!8053!3!425875338390!!!u!1146614657486!!9641860983!98872264923> [Accessed 23 November 2021].

Liftup.dk. 2021. Liftup - lifting people - Velfærdsteknologi - Hjælpemidler til ældre og handicappede. [online] Available at: <https://www.liftup.dk/da/produkter/assistep/> [Accessed 23 November 2021].

Liftup.dk. 2021. Raizer fra Liftup. [online] Available at: <https://www.liftup.dk/da/produkter/raizer/> [Accessed 23 November 2021].

Lomax.dk. 2021. Autoværktøj. [online] Available at: <https://www.lomax.dk/flere-produkter/autoudstyr/autovaerktoej/rawlink-vaerksted-skran-2-tons-80067690/?pla=1&gclid=Cj0KCQiA1KiBBhCcARIsAPWqoSogcPro11D9PDlj5da00Buo3enB1GqVu4FTWnys4laVHqOS-4N2jyy0aAvuQEALw_wcB> [Accessed 23 November 2021].

Lomax.dk. 2021. Mobilt løftebord højt løft, 350 kg, 350-1300 mm. [online] Available at: <https://www.lomax.dk/lager/vogne-og-transportudstyr/loefteborde/mobilt-loeftebord-hoejt-loeft-350-kg-350-1300-mm-9904330/?pla=1&gclid=Cj0KCQiA1KiBBhCcARIsAPWqoSrkajN2ATD48E5b_gkj5GPtHAaQ7MTYRVgRlid44lfG5ytjF2u-228aAkl9EALw_wcB> [Accessed 23 November 2021].
Lomax.dk. 2021. Multihavebør BD 1000 PP Avanti, 610x680,200kg/100L. [online] Available at: <https://www.lomax.dk/lager/vogne-og-transportudstyr/trilleboerer/multihaveboer-bd-1000-pp-avanti-610x680200kg100l-4001660/?pla=1&gclid=Cj0KCQiA1KiBBhCcARIsAPWqoSoydV-

C7YG9PqfkDZZ7exVGzvUYBnpcSOxLpqV7mShbsyuHqMOyfrp8aAneaEALw_wcB> [Accessed 23 November 2021].

Luksusbaby.dk. 2021. Luksusbaby - Shop til børn og teens. [online] Available at: <https://luksusbaby.dk/shop/moby-hip-seat-255570p.htm-l?ab_version=A&gclid=Cj0KCQiA1KiBBhCcARIsAPWqoSqH3dOF31hjqwxf8CD50jnVNLN7QKzkfhaeRbxo2cP7GRAIhcB_CZ0aAt59EALw_wcB&CookieConsentChanged=1> [Accessed 23 November 2021].

Manillo.dk. 2021. InnovaGoods lændestøtte – Støtter og retter op! Hurtig levering!. [online] Available at: <https://manillo.dk/laendesto-tte-til-tunge-loft.html?utm_source=google&utm_medium=cpc&ProductID=3743&gclid=Cj0KCQiA1KiBBhCcARIsAPWqoSop5RhuUHQNG-Nxx3uJYrFqF4S4xm70rvyq91ULohrwaZOt6mHK92r8aApXDEALw_wcB> [Accessed 23 November 2021].

Mediehus, D., 2021. Nyt grej til tunge løft på isfabrikken. [online] Nordjyske.dk. Available at: <https://nordjyske.dk/nyheder/nyt-grej-til-tunge-loeft-paa-isfabrikken/384eda73-19c2-48f1-82bc-55f35eb2769b> [Accessed 23 November 2021].

Metal Supply DK. 2021. Bæreselen, der skåner dig ved tunge byrder. [online] Available at: <https://www.metal-supply.dk/announcement/view/125010/baereselen_der_skaner_dig_ved_tunge_byrder> [Accessed 23 November 2021].

Sengeland. 2021. Vision elevation 80/90x200 - Sengeland. [online] Available at: <https://sengeland.dk/produkt/vision-elevations-seng-8090x200/> [Accessed 23 November 2021].

Teknologisk.dk. 2021. Exoskeletter til tunge løft i produktionen. [online] Available at: <https://www.teknologisk.dk/ydelser/exoskelet-ter-til-tunge-loeft-i-produktionen/40169> [Accessed 23 November 2021].

Appendix 20

aliexpress.com. 2021. 46.79 |Free shippingTop Selling Products Adjusting laptop desk maize black white foldable desk folding small laptop desk|desk piece|desk outletdesk lamp natural light - AliExpress. [online] Available at: <https://www.aliexpress.com/item/466692525.html> [Accessed 23 November 2021].

Bedzzz. 2021. Foldemadras Test 2021 | Her er de 21 bedste foldemadrasser til prisen. [online] Available at: <https://bedzzz.dk/foldemadras/> [Accessed 23 November 2021].

Bolighuset.dk. 2021. Grimstad sovesofa. [online] Available at: <https://www.bolighuset.dk/grimstad-sovesofa/> [Accessed 23 November 2021].

Grey, K., 2021. KAOS Klapp Foldable High Chair - Grey. [online] Elenfhant. Available at: <https://www.elenfhant.com/products/kaos-klapp-folda-ble-high-chair-grey> [Accessed 23 November 2021].

Hexapak.com. 2021. Smart Foldable Box | M-Shape | Z-Shape Collapsible Container | Hexapak. [online] Available at: <https://www.hexapak.com/product/26/folding-type> [Accessed 23 November 2021].

IKEA. 2021. KOMPLEMENT Skuffe, hvid, 50x58 cm - IKEA. [online] Available at: <https://www.ikea.com/dk/da/p/komple-ment-skuffe-hvid-10246308/> [Accessed 23 November 2021].

IKEA. 2021. NORDEN Klapbord, birk, 26/89/152x80 cm - IKEA. [online] Available at: <https://www.ikea.com/dk/da/p/norden-klap-bord-birk-90423887/> [Accessed 23 November 2021].

Jysk Indretning. 2021. Tertio klapsæde. [online] Available at: <https://www.jyskindretning.dk/produkter/tertio-klapsaede> [Accessed 23 Novem-ber 2021].

Kulturnet.dk. 2021. Fodskammel Black Friday 2021 Tilbud. Se hvad du kan spare på fodskammeler her ». [online] Available at: <https://www.kulturnet.dk/fodskammel/> [Accessed 23 November 2021].

Lauridsensmoebler.dk. 2021. Day sovesofa m/bonell fjedre & chaiselong | Prismatch på sovesofaer. [online] Available at: <https://lauridsensmoe-bler.dk/vare/day-sovesofa-m-bonellfjedre-stof/> [Accessed 23 November 2021].

Plusshop.dk. 2021. Hauck Shopper Neo II Klapvogn - Melange Grey & Charcoal. [online] Available at: <https://plusshop.dk/hauck-shopper-neo-ii-klapvogn-melange-charcoal> [Accessed 23 November 2021].

Toxel.com. 2021. Folding Chair. [online] Available at: <http://www.toxel.com/tech/2018/08/04/folding-chair/> [Accessed 23 November 2021].

Appendix 37

Amazon.com. 2021. [online] Available at: <https://www.amazon.com/INCH-Folding-Shelf-Brackets-Collapsible/dp/B07KCKXR34/ref=as_li_ss_tl?keywords=Table+Folding+Bracket&qid=1552343790&s=gateway&sr=8-26&linkCode=sl1&tag=mrbo03-20&linkId=7271fe1c618642677b-30f1e3d6c79cbf&language=en_US> [Accessed 23 November 2021].

Youtube.com. 2021, "Adjustable locking hinge HG-RCT-12-C". [online] Available at: <https://www.youtube.com/watch?v=W_JmA2ayB1g> [Ac-cessed 23 November 2021].

Youtube.com. 2021, "SAVE SPACE WITH THIS MURPHY DESK | COMPLETE TUTORIAL". [online] Available at: <https://www.youtube.com/watch?v=6QTHhMh0C5I> [Accessed 23 November 2021].

Youtube.com. 2021, "[woodworking] One-touch Folding table / mechanism / wall-mounted". [online] Available at: <https://www.youtube.com/watch?v=jynunXBsXcc> [Accessed 23 November 2021].

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