Pivot

a living table

Product report : MA4-ID5 : June 2023
Camilla Frederikke Andersen, Martin Vestergaard Schjøtt, Nikoline Sander Jensen

Titel page

Project title

Pivot - a living table

Project theme

Responsible dining table design

Project team

MSc04, team 5
Industrial Design
Institute of Architecture and Design
Aalborg University

Project period

01.02.2023 - 31.05.2023

Supervisor

Christian Tollestrup

Technical supervisor

Erik Lund

Number of pages

24

Abstract

Pivot - a living table, er et afgangsprojekt, som præsenterer et nyt take på et spisebord, hvor brugerens varierende behov gennem livet er brugt som fundament til at designe et bord - et 'living table', som endnu ikke er set på markedet. Projektet skal også ses som en debatstarter på emnet omkring produktlevetid og forhåbentligt være med til, på sigt, at trække møbelindustrien længere væk fra brug-og-smid-væk-kulturen. I denne diskussion er det ikke nok, at det kun er designerne, der tænker langsigtet og er behovsorienterede. Det er også vigtigt at forbrugeren får øjnene op for, hvordan produkter kan bidrage med mere værdi over en længere periode.

Der er tre årsager til at forbrugeren på nuværende tidspunkt skiller sig af med deres spisebord: Størrelse, det er enten for lille eller for stort. Æstetik, de kan ikke længere lide udseendet på deres bord. Form, de vil gerne have og/eller tilbyde en anden setting ved sociale sammenkomster.

Gennem utallige iterationer og et samarbejde med Montana, er Pivot et nyt forslag til ikke bare et spisebord, men et bord der skal leves med og omkring. Det kan tages med gennem hele livet og tilpasse sig de mange forskellige varierende behov, der opstår. Bordet kan udvide sig fra 4 til 10 personer gennem et formskift fra et lille rektangel, til et større, til en kvadrat. For at imødekomme behovet omkring æstetisk fornyelse, er bordpladerne dobbeltsidede, hvilket betyder, at de kan vendes for at give bordet et nyt udtryk i form af et farveskift.

Camilla Frederikke Andersen

Martin Vestergaard Schjøtt

Nikoline Sander Jensen

CONTENTS

SIZE

FORM

AESTHETICS

Tables : a red ocean market

We live in a time where furniture is being produced like never before. Therefore, there is a crucial need to think more circularly, minimize the consumption of raw materials and increase the lifespan of furniture. We want more focus on ethical design, where a piece of furniture is good for people, the environment and business - both now and in a long-term perspective. The consumer **replaces their table** for three main reasons: **size,** because circumstances dictate that they need a bigger/smaller table. **Aesthetics,** because they change their style and do not think the table is aesthetically pleasing anymore. And then to a greater extent, because they want to offer a different atmosphere or setting around the table, thus replacing the table because of its **form.**

We want to extend the useful life of the dining table before it is recycled - and differentiate from the hundreds of thousands of tables on the market. A table that is **designed based on changing needs.**

linoleum : mauve

> **This is an extremely interesting take on tables, which is based on needs and not design**
>
> - Josephine Ring, Montana

OUR RESPONSIBLE CONTRIBUTION

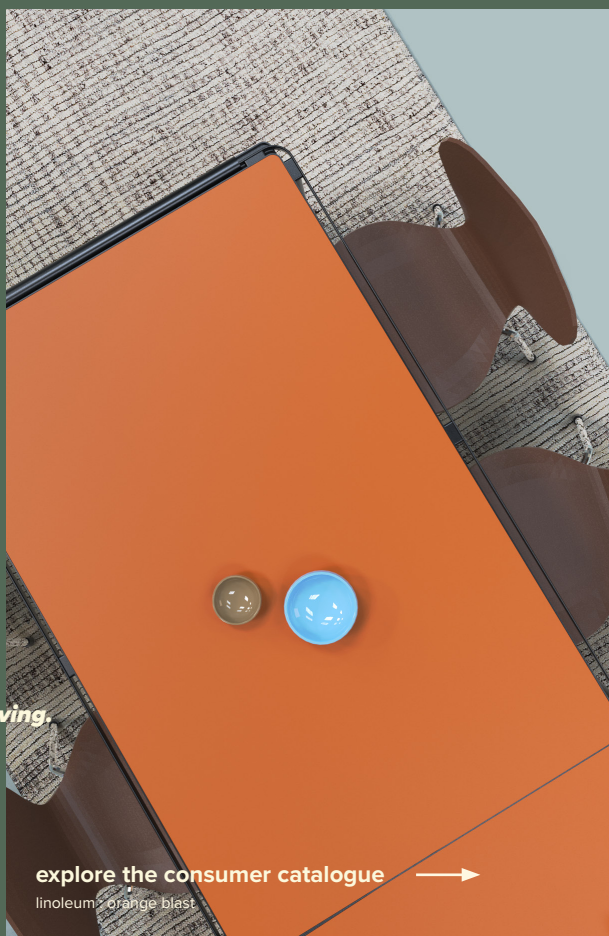
Appealing now : and in the future

New takes on furniture must be presented to the market to **push the limits** towards what furniture is capable of and what the actually needs are - now and in the long perspective. We must walk away from the throwaway society towards a greater extent considering changing needs and conscious furniture purchases that bring **long-term value.** The needs for a dining table changes over time, and the table must be able to meet those changes and hence not just be stationary and rigid. The function of the table shall not change at the concrete level: it is the nature of the table to provide a surface where you can eat, work, do puzzles, collect lego and more.

There are hundreds of thousands of tables on the market that offer the same. But there are no tables on the market that offer what Pivot offers.

What can Pivot offer?
Pivot is a **new take** on a dining table that can change size, both as a temporary solution, but also permanently. Pivot further allows you to keep up with current trends and colors by allowing you to change the reversible table top. And then Pivot can offer a new atmosphere by being able to shape. **Bring Pivot with you.**

It is not only a table for dining - it is a table for living.



explore the consumer catalogue →
linoleum> orange blast

23/24

MONTANA
PIVOT

PIVOT IS A **living table**

A companion for life

- making memories

A dining table is a gathering place - collecting memories throughout life. That is why Pivot is designed to accompany you through life. From the small first home, to the future homes in life. With its different opportunities in sizes and form, the table fits every occasion - in all phases of life - with the people you love the most.

year 1

linoleum : mushroom
4 pers.

year 8

linoleum : mushroom and iron
6 pers.

bring it along in every home of yours!

Flip your tabletop - get at new colour!

The colour of your tabletop can help set the vibe - and you have the option to choose two colors. The Pivot colour palette is selected to provide visual and sensory appeal and will match no matter what color combination you choose. A tabletop with a changeable look.

Linoleum


4178 iron


4185 powder


4172 mauve


4183 pistachio


4132 ash


4186 orange blast

4176 mushroom


4154 burgundy


4155 pewter


4174 conifer


4175 pebble


4003 walnut

Laminate

38 snow


09 nordic


04 anthracite


110 blue pastel


147L shadow


157L cumin

Veneer


300W oak


200W douglas white

Frame


43 aluminium


05 black

38 snow


45P olished aluminium

linoleum : mauve

laminate : snow

Extend in length

- temporary or permanently

With Pivot you can expand from a 4-person table up to 10 people. Pivot can stand permanently extended if life demands it or can be quickly swiveled around the table's unique and elegant rail for life's events and happenings.

laminate : shadow

Extend in width

- and feel the change of atsmosphere around the table

Pivot has the unique and characteristic feature of being able to transform the experience around the table into a very outstanding experience with its square shape. Just roll the plate, attach it and feel the togetherness. Feel the difference. Feel a completely changed atmosphere and mood.

linoleum - ash

Features

- details

Characterism leads to features and details. An elegant meeting between the frame and the rail. Finishing feet. Locking of the secondary plates in square extension. Small details. But important details. This constitutes the whole of the Pivot. A functional, yet elegant table

- a living table.

Find inspiration

Discover, share and be featured

#montanafurniture

@_camillafrederikke

@nikolinesander

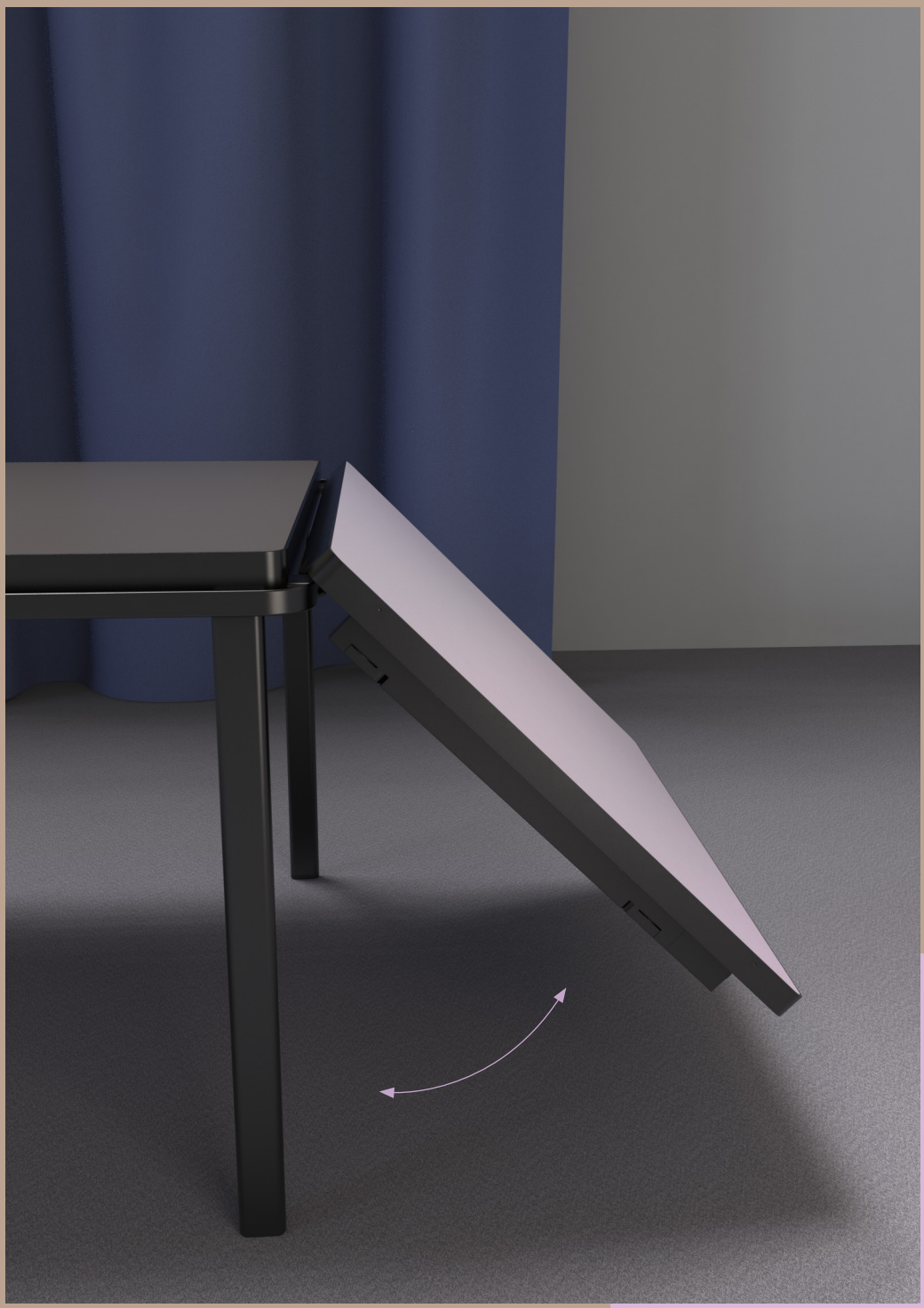
@martinvestergaardh

Individuality

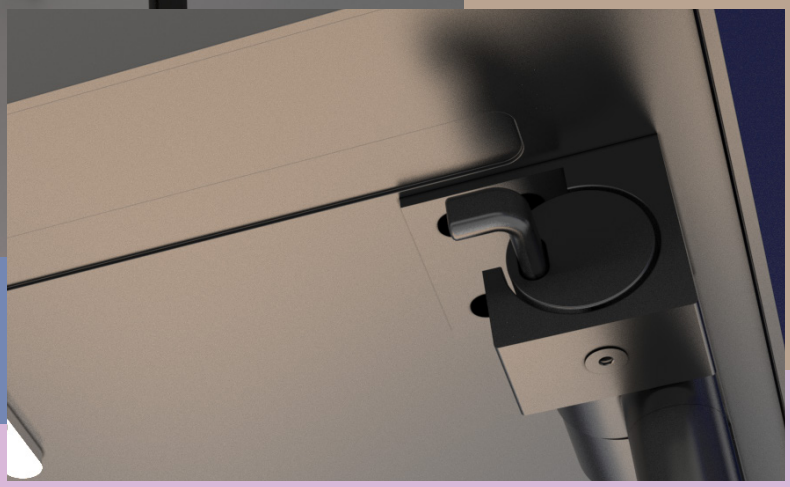
- express your personality

A home reflects your personality and leaves an impression on people's minds. A dining table is lived at. At different paces. Find a color that suits the pace of your everyday life. Then change the pace by finding another color that's perfect for lively events.

linoleum : ash, walnut, iron, burgundy, powder laminate : cumin



laminate : blue pastel



Just swing!

-easy set up

We create playful spaces. We create playful products. Playful in functions. Playful in movements. Swing the plate, fold out the legs with a light tug and expand your experience. Feel the smooth groove and you'll be guided to the hook, which you can gently pull to put the legs back up. Easy, quick and pleasing.

Purchase opportunities

Pivot is offered in different variants and thus price ranges. We offer that the table can be purchased without additional plates, in order to be able to top up later. In addition, it will be possible to renew your table top if you eventually want other colors. With this series, Pivot can accompany you throughout your life no matter what needs change.

PIVOT WITH SECONDARY PLATES

L 140 cm, W 90 cm, H 74 cm

sales price:	34.995 dkk
price retailer:	14.995 dkk

PIVOT WITH NO SECONDARY PLATES

L 140 cm, W 90 cm, H 74 cm

sales price:	22.995 dkk
price retailer:	9.995 dkk

PRIMARY PLATE, TWO COLOURS*

L 140 cm, W 90 cm, H 16 mm

sales price:	8.599 dkk
price retailer:	3.649 dkk

2x SECONDARY PLATES + LOCK

L 70 cm, W 90 cm, H 16 mm

sales price:	15.599 dkk
price retailer:	6.749 dkk

2x SECONDARY PLATES

L 70 cm, W 90 cm, H 16 mm

sales price:	8.995 dkk
price retailer:	3.449 dkk

SECONDARY PLATE

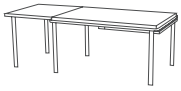
L 70 cm, W 90 cm, H 16 mm

sales price:	4.799 dkk
price retailer:	2.059 dkk

**price for linoleum*

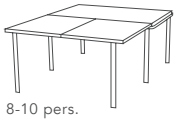
IF YOU PURCHASE THIS, YOU GET THIS

4 pers.



6 pers.

8-10 pers.

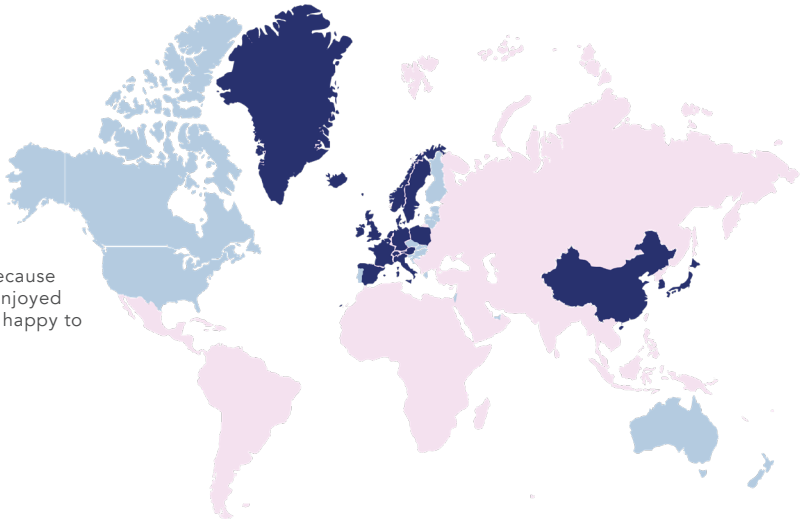


8-10 pers.

Market

- Established
- Developing

We are expanding our markets because we believe that Pivot should be enjoyed by most people possible. We are happy to share Pivot outside Denmark.



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Appendix

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ill. 1 Team

Motivation

As master thesis students, we feel an urge to make a project that we can proudly put in our personal portfolios, and that will help shape us as future industrial designers. All three of us feel that we as designers have a responsibility for the products of the future, including the process and choices behind them. We would like to make our contribution to this by taking an ethical approach, thus producing a project of discussion that can reflect our approach to being responsible designers.

Camilla Frederikke Andersen

Martin Vestergaard Schjøtt

Nikoline Sander Jensen

We as **designers**
have a
responsibility
to contribute to a
sustainable future
through product
design

Abstract

Pivot - a living table, er et afgangsprojekt, som præsenterer et nyt take på et spisebord, hvor brugerens varierende behov gennem livet er brugt som fundament til at designe et bord - et 'living table', som endnu ikke er set på markedet. Projektet skal også ses som en debatstarter på emnet omkring produktlevetid og forhåbentligt være med til, på sigt, at trække møbelindustrien længere væk fra brug-og-smid-væk-kulturen. I denne diskussion er det ikke nok, at det kun er designerne, der tænker langsigtet og er behovsorienterede. Det er også vigtigt at forbrugeren får øjnene op for, hvordan produkter kan bidrage med mere værdi over en længere periode.

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Acknowledgement

A big thanks to our main supervisor Christian Tollestrup, who has challenged us with this type of project, furthermore has pushed, motivated and supported us when things got tough. Also a big thanks to our technical supervisor, Erik Lund, who has kept us optimistic and guided us throughout the process.

A big thanks also goes to Steffan and Kai-Ole from Brdr. Sørensen, who have contributed with important and valuable knowledge that has supported the vision and foundation of the project, and who have taken the time to have us visit from time to time.

Likewise, a big thank you to Michael Dahl from BSM, who took the time to review the production of the table and what complications and opportunities there are for optimization when producing the table.

Finally, a special thanks to Josephine Ring and Nis Kjærgaard from Montana for taking our project seriously from the start and for letting us into the world of Montana. It has been very interesting and educational to get a "real-life" view of a design process, which has brought great value to the project.

Steffan Christensen
Trendy department, Brdr. S

Kai-Ole Christensen
Classic department, Brdr. S

Michael Dahl
Project Officer & IT, BSM

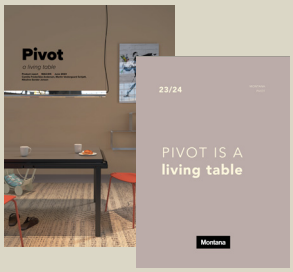
Josephine Ring
Portfolio Manager, Montana

Nis Kjærgaard
Product Developer Montana

ill. 2 Stakeholders

Reading guide

This project consists of four parts : a product report including a small consumer catalog, a process report, technical drawings and an appendix for additional information and reference material. It is important to read the product report first and dive into the consumer catalog when it appears inside, thereupon the process report can be explored.



1 : product report

2 : process report

The process report consists of 10 phases that documents the process of the development of the product proposal. A phase summary can be found at the beginning of each phase. The process has consisted of a lot of “can’t we just...?” wonders, some of which will be answered through the process with a short explanation of why we just can’t. When reading the report, 4 boxes will appear when something has to be noted - read the boxes for further elaboration on the meaning of the icons.

All references are made with The Harvard Method and a complete list of references can be found at the end of the report.

Be aware
The icon is used when a small note to the reader is present

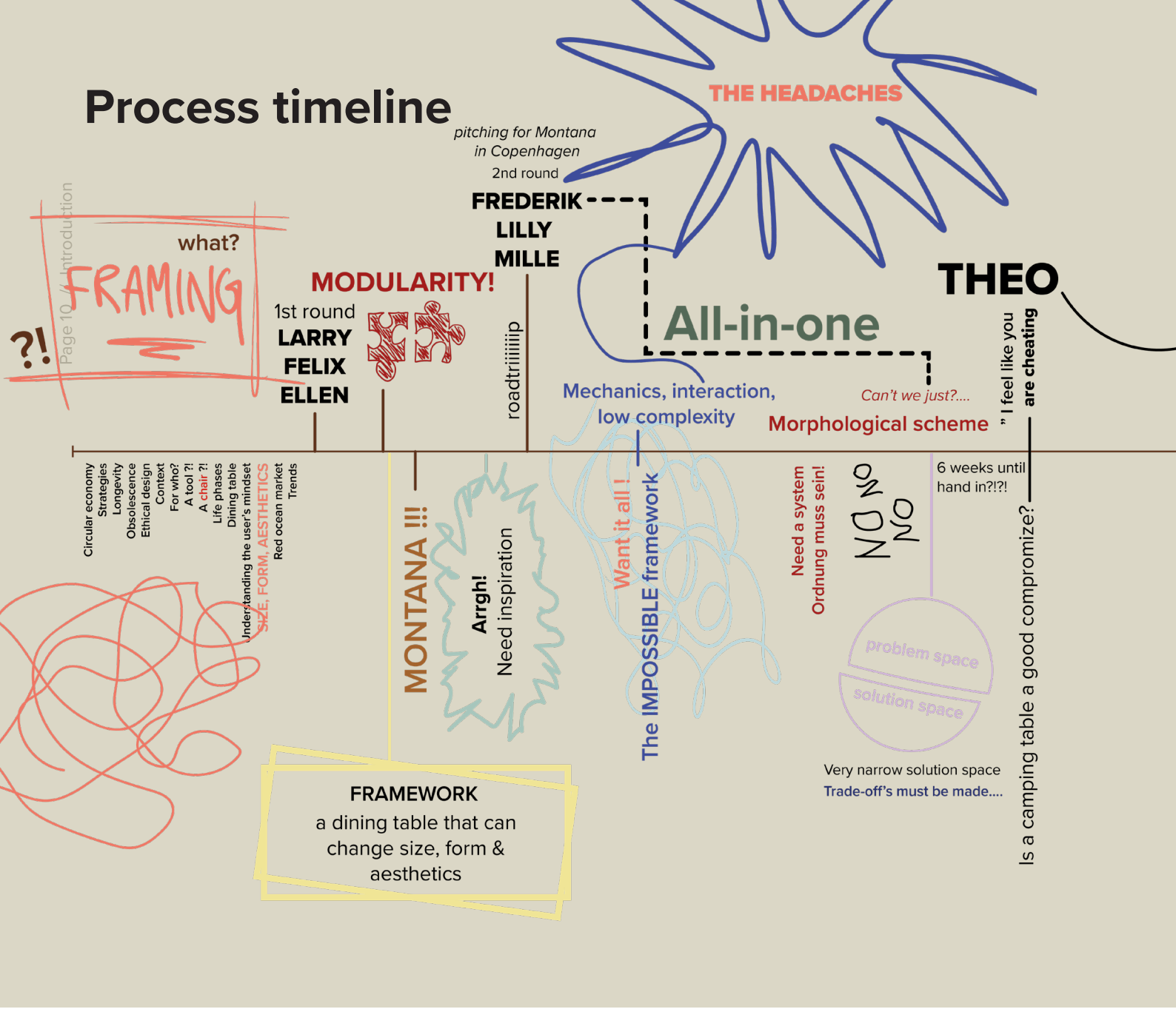
Insight
The icon is used when an investigation has given a relevant, new insight to be aware of moving forward in the process

Requirement
The icon is used when results of an investigation can be translated to a requirement for the product proposal

Reflection in // on action
The icon is used when a relevant reflective note is tied to an investigation - either regarding the results of the investigation or the method.

Contents

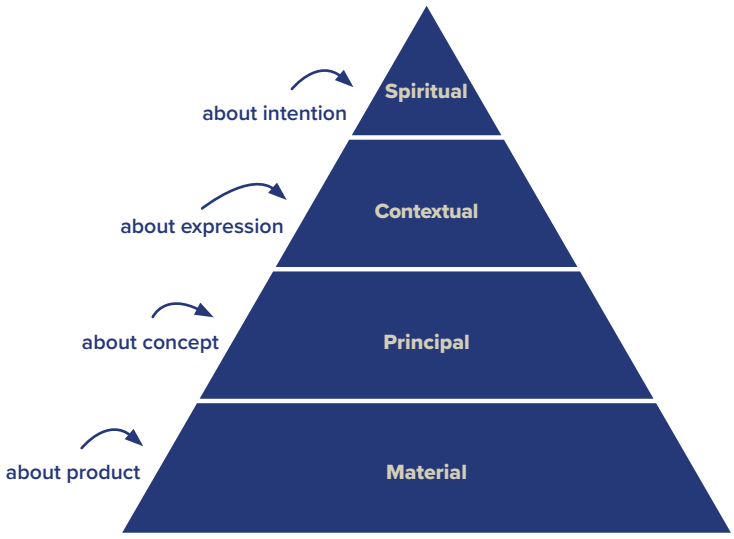
Process timeline



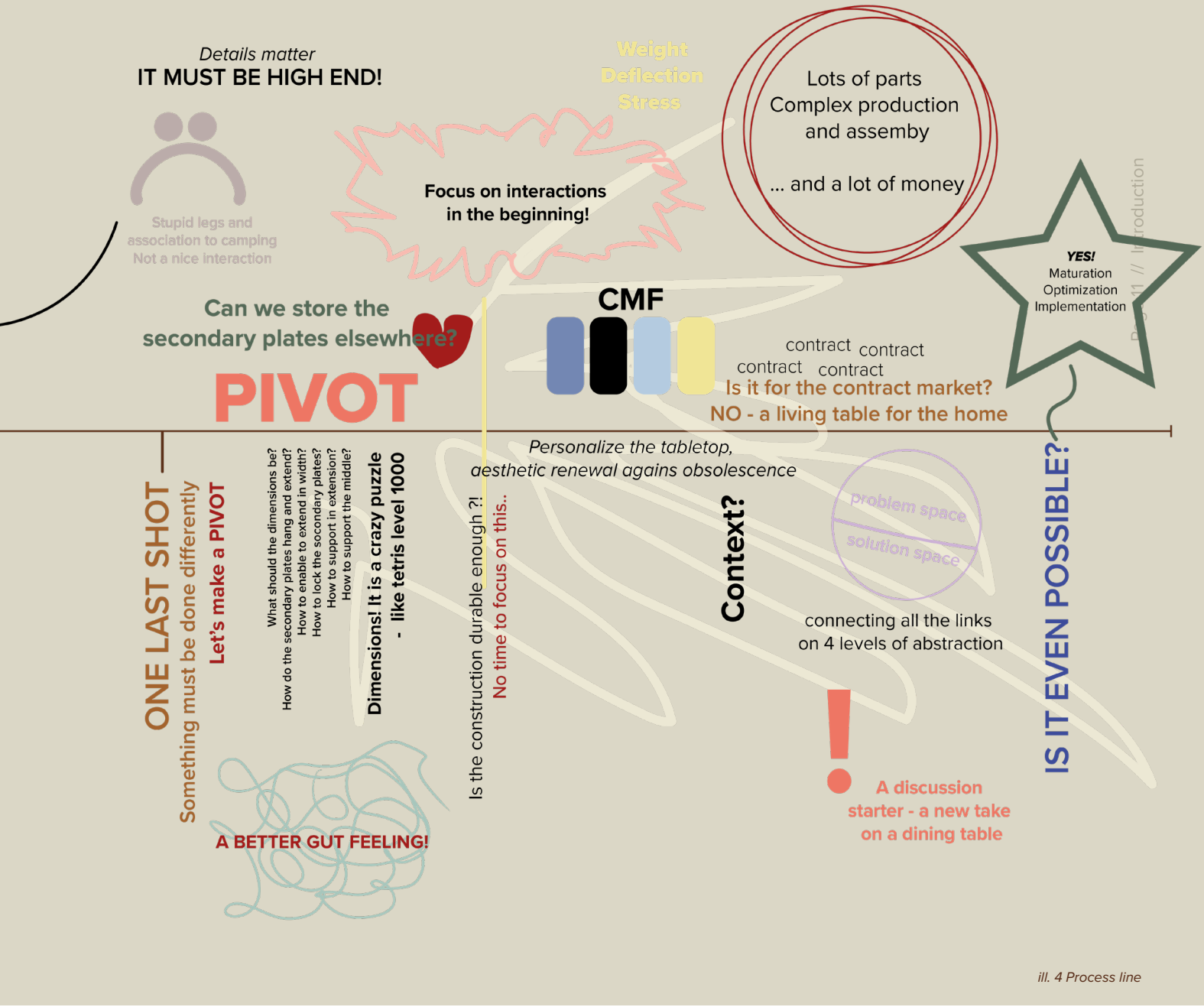
Lerdahl : The vision-based model

The vision-based model by Lerdahl (Lerdahl, 2001) describes four levels of abstraction used for reasoning in decision making and for connecting abstract aims with concrete product principles and details. This model is valuable for navigating in the search for the solution space of the project. The Spiritual level is about intention with the product. The second layer, the Contextual level, relates to the expression and interaction, whereas the third layer, the Principal level relates to the concept. The fourth layer, the Material level relates to the concrete product. (Lerdahl, 2001)

In the phase summaries, a brief description of the visited levels for the particular phase is described.



ill. 3 The vision-based model (Lerdahl, 2001)



ill. 4 Process line

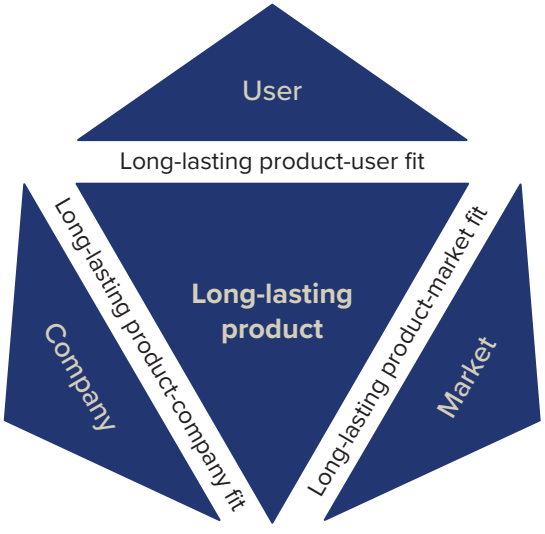
Strategic durability

Haase & Laursen (2023) introduces the strategy; Strategic durability, that is highly relevant to this project. This strategy consist of three long-lasting fits:

Product-user fit: Focus on the long-term problems and needs
Product-market fit: Focus on long-term competitive advantages
Product-company fit: Focus on strengthening the long-term credibility and developing products that are based on a company's strategic strengths, their values and purposes.

The different phases of the process report have had different focal points in terms of which of the three fits drives the development. The project strives to cover the main elements needed to create a strong strategic fit with the user, the market and the company (Haase & Laursen, 2023)

The specific fit that suits the development in each phase will be introduced in the phase summary and is followed by a summary on p. 103.



ill. 5 Strategic durability (Haase & Laursen, 2023)

Introduction

This thesis is a discussion initiator. It is a take on designing for longevity that will create content for a debate on the topic. We believe that new takes on furniture must be presented to the market to push the limits towards what furniture is capable of and what the consumer actually needs - now and in the long perspective. To walk away from the throw-away society and to a greater extent consider changing needs and conscious furniture purchases that bring long-term value. The needs for a dining table changes over time, and the table must be able to meet those changes and hence not just be stationary and rigid.

There are hundreds of thousands of tables on the market that offer the same. But there are no tables on the market that offer what this offers.

> *"I think it is interesting that you operate in a field where you are so much in doubt, because it may mean that you are on to something really exciting. Don't lose your courage just because we are not straight away saying "this is just plug-and-play ish". It is because you bring something new.*
>
> **Josephine Ring**
> Portfolio Manager, Montana

Framing

01 understanding design problem

Theory on actions and strategies towards responsible design and consumption

The real world: context

1st approach: focusing on a tool and the outer scope

2nd approach: focusing on the product and the inner scope

Understanding the user's mindset and needs

Market research

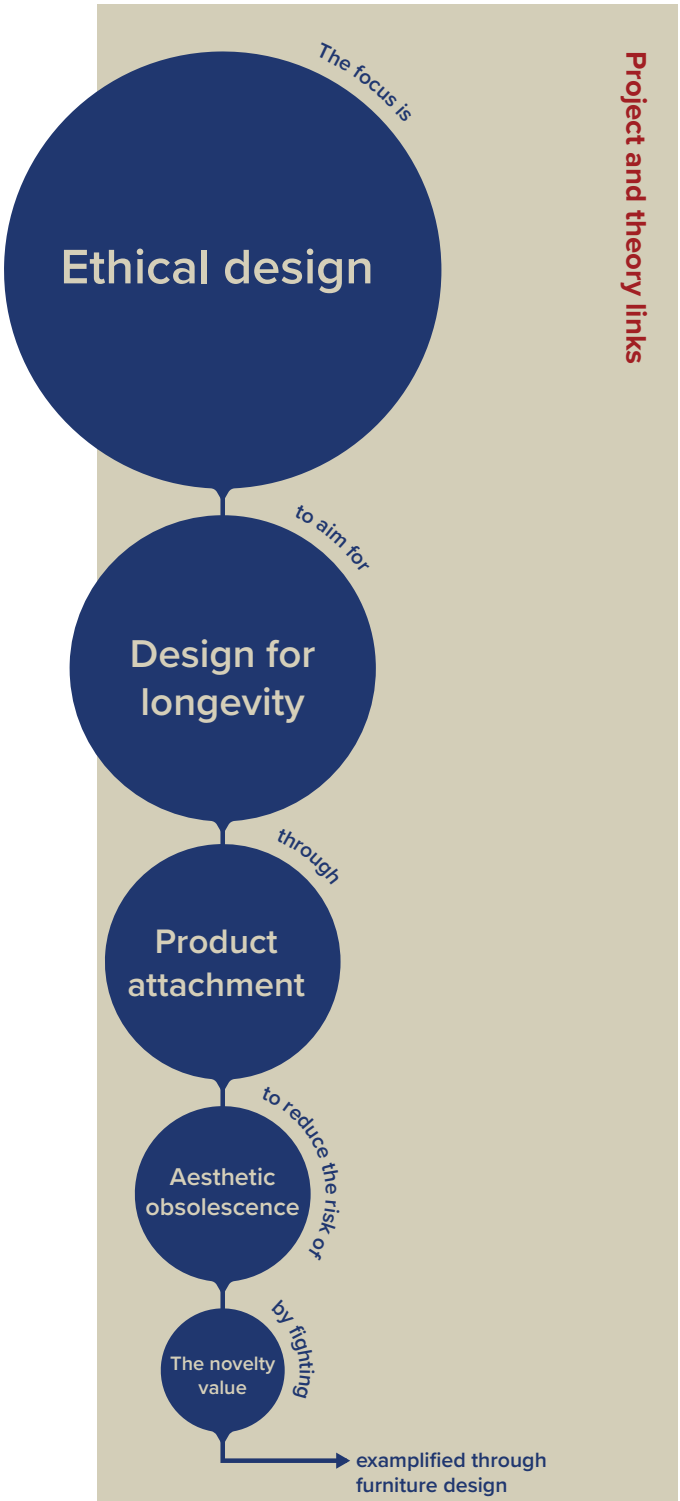
Initial design brief

Summary of the phase

This phase outlines the approach of the project and hence works at the spiritual, contextual and principal level (Lerdahl, 2001) to scope the reasoning at various abstraction levels. The phase examines theory on responsible design, and furthermore the phase forms a common understanding of different strategies and terms within designing for longevity. The theory is followed by a specification of the product category, after which the link between the reasoning and product is verified through interviews with consumers and retailers. This helps to start an understanding of who the consumer is and what their needs are, which provides insights to create a strong product-user fit (Haase & Laursen, 2023). Furthermore, a market analysis is conducted to gain an understanding of the value that other tables can offer. This helps to clarify what it takes to design a table with competitive advantages and differentiation.

The phase concludes in an initial design brief, marking the problem statement, context and initial requirements.

Theory on actions and strategies towards responsible design and consumption



ill. 6 Project links

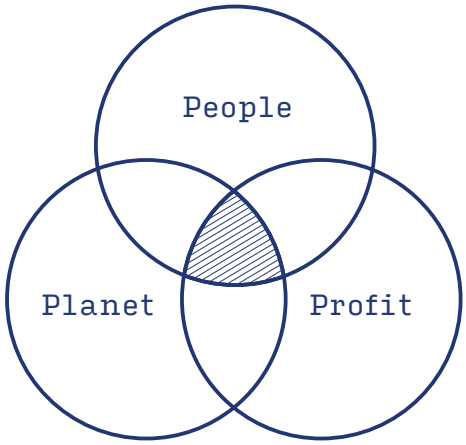
As the entry point of this project is a desire to focus on the **approach** to a design process as the overall “problem to solve” with the intent of making actions towards a less bad product for the planet, it feels natural to investigate current theory and research to build the foundation. Afterwards, it will be necessary to decide on a product in order to concretize actions in the design process. Beforehand, a “sustainability braindump” is performed to internally clarify the meaning of the word "sustainability", including the different terms that can be outlined within this topic. This is done based on existing knowledge in the field (see app. 01). One of the results from the braindump is the use of the term “sustainability”, which should not be referred to anymore as it can have several meanings when quickly browsing the topic. Therefore, from this page, the word 'sustainability' will not be used to generalize, substantiate or explain a product or an approach to it.

The purpose with this theory section is to give an overview and to use it as guidelines and tools through this wicked problem process of designing against obsolescence and for longevity.

Ethical design

Ethical design is the overall approach for this project. A design has to be good for the user, the business and for the society to be ethical. Within theory, ethical design can be described through the Triple Bottom Line (TBL) - the intersection of the three bottom lines to focus on (profit, planet, people) is marked as “sustainability” (although the promise was NOT to use this term anymore..), see ill. 7. (Kenton, 2023)

In here lies a lot of different aspects, strategies and point of views, as for instance circular economy and designing for longevity. Being good for the user and for the society means among others that a product must be long lasting and fulfill long lasting, changing needs.

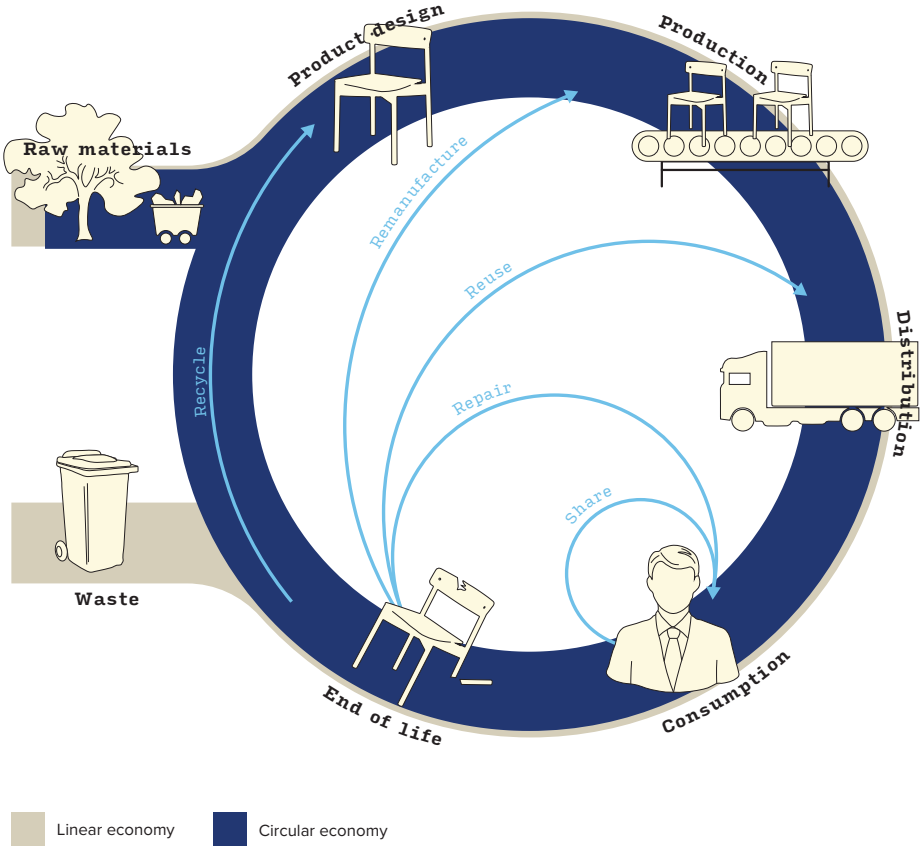


ill. 7 Triple bottom line

Circular economy

Circular economy changes the thinking of a product's life from manufacturing and ending up as waste. It puts an end to the concept of 'end-of-life' by implementing strategies such as maintaining, refurbishing, remanufacturing and recycling (Ellen MacArthur Foundation 2013; European Commission 2020). From Stahel (1982) the concept of a slowed loop is presented where prolonging the lifetime of a product will also contribute to reducing the depletion of raw materials. When the lifetime has been extended to the maximum, the resources from the outworn products should find its way into the circular economy loop once again to be recycled and used for new products, making the circular economy model a closed loop.

Slowing the ressource loop (and not closing ressource loop) will be the focus of the project - to extend the product lifetime.



ill. 8 Circular economy

Longevity

Product longevity is heavily prioritized as a focus for this project to help give the user a responsible consumption pattern while having a product that they love. According to Jensen et al. (2021) four different issues are identified and have to be considered and understood when designing for longevity:

Product lifecycle	Product durability	Product obsolescence	Product lifetime
Describes a product's journey from raw material to end of product life and recycling (closed loop).	Describes a product's physical durability to withstand use and to keep the functions intact.	Describes the emotional attachment the user has with the product. If that bond breaks, it can possibly mean end of product life.	Describes the actual time the product is used.
		focus	

(Jensen et al., 2021)

Another important aspect to be aware of when trying to obtain longevity is product integrity (den Hollander et al. 2017; Bakker et al. 2019). It means that a product should stay as produced as long as possible (Stahel, 2010; den Hollander et al., 2017), because the product has been declared obsolete by the user when it gets to the recycling state (Haase & Laursen, 2023).

Long use strategies

To design for longevity, different strategies can be considered and applied in the concept development. To keep the process focused on the product level, strategies for slowing the resource loop will be the main strategies to look at. Within this direction there are different strategies for addressing design for long-use, design for extended use and design for recovery (Haase & Laursen, 2023).

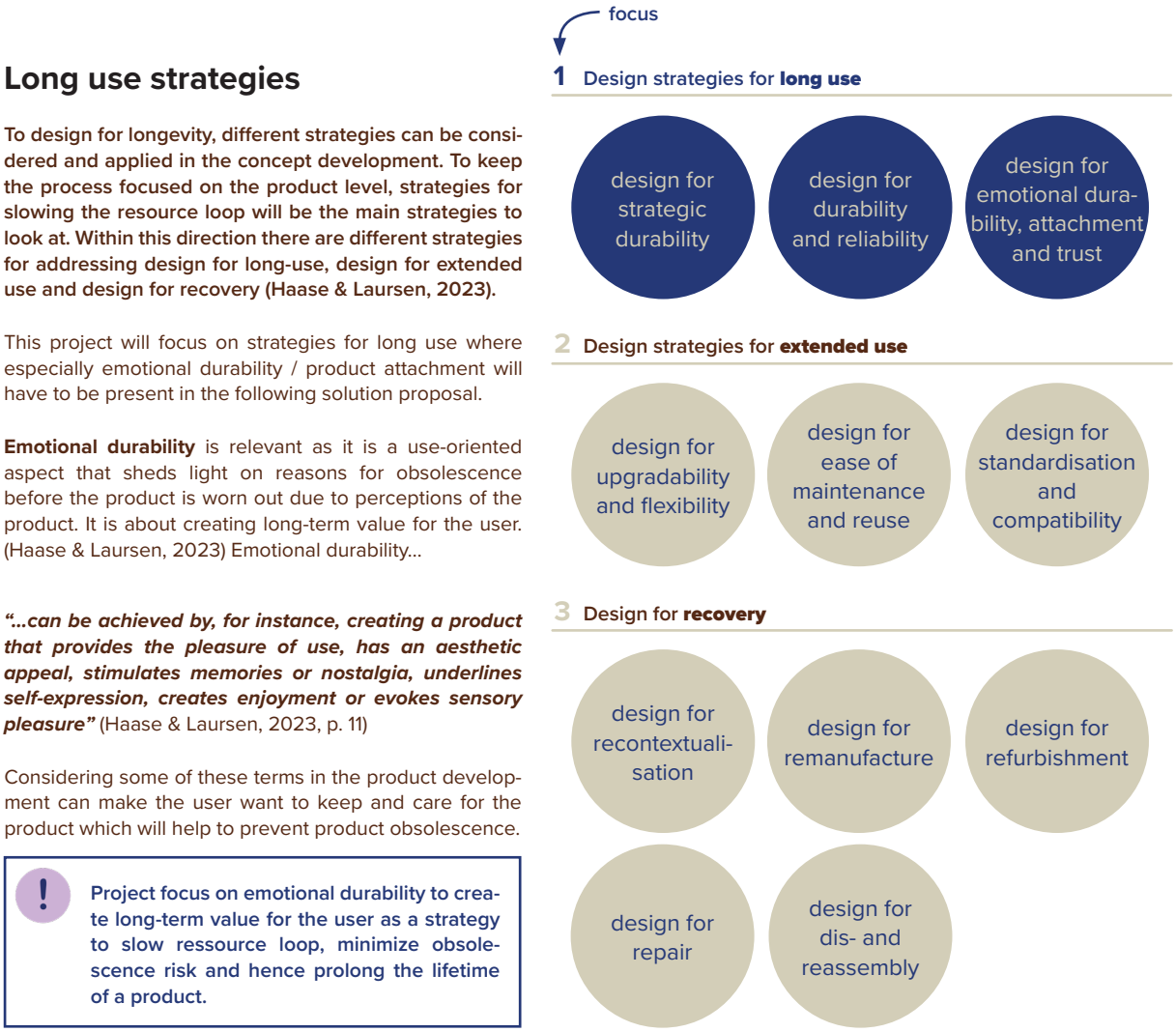
This project will focus on strategies for long use where especially emotional durability / product attachment will have to be present in the following solution proposal.

Emotional durability is relevant as it is a use-oriented aspect that sheds light on reasons for obsolescence before the product is worn out due to perceptions of the product. It is about creating long-term value for the user. (Haase & Laursen, 2023) Emotional durability...

"...can be achieved by, for instance, creating a product that provides the pleasure of use, has an aesthetic appeal, stimulates memories or nostalgia, underlines self-expression, creates enjoyment or evokes sensory pleasure" (Haase & Laursen, 2023, p. 11)

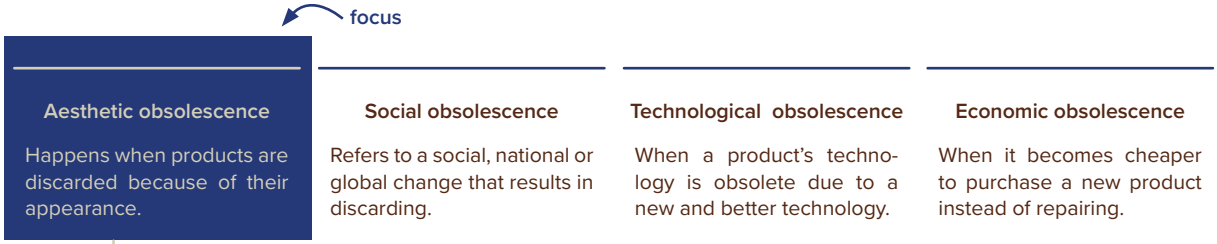
Considering some of these terms in the product development can make the user want to keep and care for the product which will help to prevent product obsolescence.

> **!** **Project focus on emotional durability to create long-term value for the user as a strategy to slow ressource loop, minimize obsolescence risk and hence prolong the lifetime of a product.**



Aesthetic obsolescence

Based on literature (Cooper, 2010), there are four different types of obsolescence: aesthetic-, social-, technological- and economic obsolescence (see app. 02). In this project aesthetic obsolescence is the focal point which will be unfolded at a deeper level.



There are two aspects when talking about aesthetic obsolescence: firstly 'wear and tear' and secondly 'fashion and style'. The first parameter 'wear and tear' relates to a product being faded, dirty and worn out. According to Cooper (2010) it relates to a product that does not look new anymore, instead it looks used. The second parameter 'fashion and style' relates to temporary trends including the appearance and form of a product. The design of a product can change based on year, season and social changes, and these products may be discarded based on aesthetic grounds because one day it is "out of fashion". (Cooper, 2010) Both aspects will be taken into account in the project.

TCO : Total cost of ownership

Prolonging the lifetime is often coherent with the quality of a product - and hence the price. TCO, the total cost of ownership, is the total cost of a product over its useful lifetime. This includes the cost of the product when buying it, furthermore the cost to operate it including maintenance, implementation, upgrades, the required training to be able to use it etc. (bdc, n.d.) As a consumer it can be beneficial to take this parameter into account when purchasing new products. Taking a 10-year perspective, it can be valuable to have considered the value of the product, for instance the quality, in relation to its price. Instead of buying a cheaper product that needs to be replaced for instance 3 times in 10 years, it can be advantageous to invest more from the start and avoid having to replace the product during that period, and then you have only bought one set for 10 years. This will typically be cheaper in the long term; buying higher quality but buying it fewer times. Thus, the total cost of ownership will be lower.

What to use the theory for?

Numerous tools and approaches are theoretically available for prolonging the lifetime of a product and trying to design a “less bad” product. Many of the aspects are overlapping, but the focus of the project will be to focus on prolonging the use of a product by reducing the risk of aesthetic obsolescence through product attachment and emotional durability.

Slowing ressource loop (and not closing ressource loop) will be the focus of the project - to extend the product lifetime.

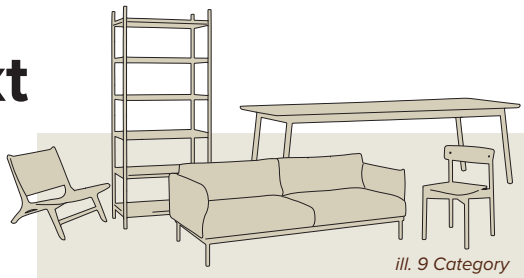
The real world : context

One thing is research and theory on longevity, another is what is happening in the real world. It is a necessity to understand the overall context that the project is designing in and for - what aspects are affecting consumers and businesses today? Additionally, which demography and geography will be in focus? The research is conducted through interviews with Brdr. Sørensen and desktop research.

Brdr. Sørensen : High-end store in Aalborg

Brdr. Sørensen is a high end furniture store located in Aalborg, Denmark. They have two departments; trendy and classic. Contact is established with them as they will be contributing with knowledge and sparring for the project with regard to enlightening about trends, purchasing arguments and market considerations. Additionally giving feedback to business opportunities and immediate considerations regarding whether or not different concepts would fit their store and customers.

Based on the conversation with Brdr. Sørensen, it seems that “sustainability” is a trend for brands but not a trend for consumers (see app. 003). Brdr. Sørensen states that it is an extra argument to the customer when doing sales pitches. They do see a trend in customers being pleased with designer products where it is possible to buy spares if a part of the product has broken or if the customer wants to renew his/her existing product with new details - like Montana’s universe.



ill. 9 Category

Furniture design

Based on the existing research on product longevity, the **furniture category** is well suited for a long lifetime. It is not affected by technical development, and the need for usage is endless. As of now, the exact product type is not determined as the aspects of trends, classics, purchasing arguments, actions towards responsible production and consumption etc. are expected to be common to all categories.

> *“Sustainability is not an argument for our customers. At all. That aspect is not crucial for the customer for buying one product rather than another.*
>
> Kai-Ole, Brdr. Sørensen

ill. 10 Brdr. Sørensen

Demography : Who is the consumer?

The following bullet points are consumer descriptions based on interviews with Brdr. Sørensen (see app. 03). The typical customer description for each of their departments is overlapping and the same buying patterns are spotted.

The typical customer

- In the age of 30+
- Employment can be varying; typically self-employed and CEO's, but also employments with lower salary where the customer has saved up for a longer period of time
- Interested in designer furniture and in creating a personal home - identifies him-/herself through the home
- Buying the furniture is an investment
- Does not buy on impulses

Purchasing arguments

- Behaviors and needs are changing
  - Due to moving (change of context)
  - Age (the psychological setting is changing; e.g. from "lounge sofa" to "conversation sofa")
  - Change in style
- Upgrading or renewing a piece of furniture
- Investing in quality furniture that has value in potential resale
- A piece of furniture that has been a wish for a long time

Purchasing criterias

- It must be of good quality (meant that it can physically last for +20 years)
- It must be aesthetically pleasing and fit with the customer's existing furnishing)
- It must be aesthetically "safe" (neutral colors for instance)
- NOT a criteria: Sustainable arguments, however a nice "consequence" of a chosen piece of furniture

Geography : Where is the consumer?

Aesthetics on furniture vary a lot depending on the geography, for which reason the project must determine a market based on geography. The geography can be split in two parameters according to how it plays a role;

1) relating to aesthetics of the design
2) relating to consumer behavior

Based on both parameters, the focus will be to design for Scandinavian consumers. There is a Scandinavian tradition in paying attention to designer furniture and building an identity upon the furnishing in the home. Hence, there is a willingness towards investing in quality furniture. Additionally, with the aim of designing furniture to be sold at Brdr. Sørensen, they confine themselves to the Nordic style.

As of now, the target user remains to be described in depth. This is a brief overview of some of the aspects of a possible consumer that prioritizes design and quality.

Must blend in with existing Scandinavian interior design

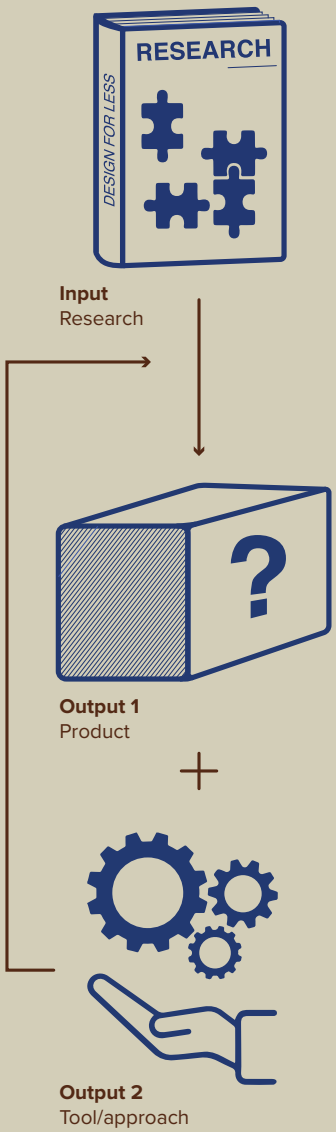
What can this be used for?

Society is moving towards a greater awareness of responsibility for the planet when considering various product purchases. However, the argument for selling the product should not be based on general greenwashed 'sustainable' arguments (e.g. "this is made of recycled materials"), but arguments related to TCO is a good selling point as it can be in the favor of the customer with regard to investment.

This research only lays the foundation of the context, and especially the description of the target user must be more specific - it is necessary to talk to potential consumers. Additionally, due to the lack of depth in the research, no obvious opportunities regarding a new furniture design have been identified.

ill. 11 Market, map

1st approach : focusing on **a tool** and the outer scope



ill. 12 1st approach

Linking the theory and the real world

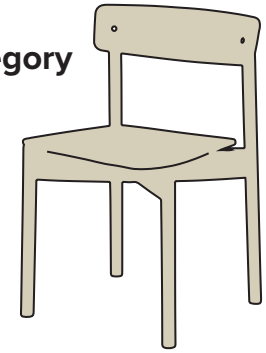
The current aim with the project is to contribute to an increased focus on ethical design in a design process with the long-term objective of making ethical design mindset the norm in furniture design processes. With this mindset, it seems reasonable to approach the project as to have two outputs: one output being a product in the furniture category (output 1) to which long use strategies are applied in the design process, and then an additional output being some sort of tool or approach template for a design process (output 2) that should concretize how research on ethical design can be applied in an actual design process - exemplified in the development of the product (output 1).

For this approach, the product outcome (output 1) will be deprioritized and instead, focus will be put on the ideation of how the tool (output 2) can come along.

Blind-choosing product category

Output 1

In the light of deprioritizing the "product" outcome, a furniture category is "just" chosen. Why not make a chair? It seems clear in size and structure, and it can exemplify different aesthetic directions.



ill. 13 Chair category

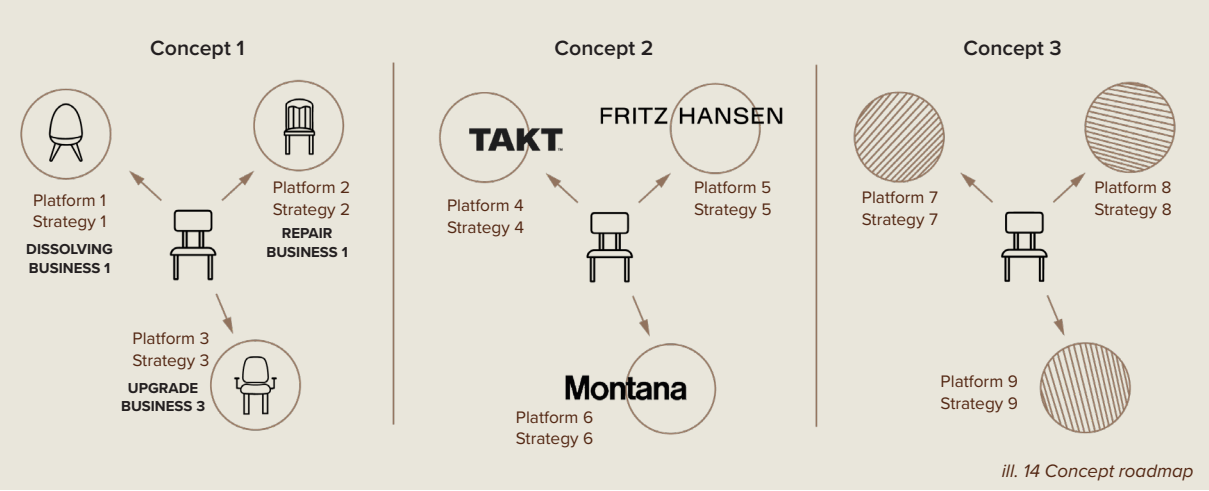
What is the design problem that we are addressing actually? The biggest concern with this furniture category is that it is extremely difficult to apply design strategies for longevity on chair designs when it has not been determined why chair designs as of now may not be designed for long use? Is there even a problem with chairs or are longevity aspects already solved through the chair design classics?

The tool : a concept roadmap

Output 2

The approach is to apply the research (with different design strategies for longevity, see p. 17) to the design process of a furniture product and then exemplify how the design will variate according to the underlying strategies - that is, configuring different combinations of strategies resulting in e.g. three different variations of the same product. This approach is based on the internal idea of the (future) potential of the soon-to-be design process that could be a valuable tool in other design processes, both internal and for other designers.

However, the idea of making some sort of “tool” is still quite fluffy at this point. To align internally regarding how the “tool” is understood, a concept roadmap needs to be illustrated. The objective is to make the approach more tangible, structural, and visual regarding the use of terms as well as how and where to apply different design strategies.



ill. 14 Concept roadmap

The purpose of the concept roadmap is to design a beautiful chair for long use with new standards, but at the same time show three variants of the chair according to different applied strategies; different platforms. By this it should be more concrete to illustrate for others how the weighting of strategies will affect the aesthetic appearance and details.

Even though the roadmap is illustrated, there are still different understandings of how to actually use this in the design process and the internal alignment is still not perfectly calibrated. Nevertheless, it is presented as the framing for the first milestone.

Milestone 1 feedback

> *“Are you in the real world or in research?*
>
> Linda Nhu Larsen,
> main supervisor for other groups

The outer scope regarding the problem of ethical design is important and recognized as a direction for the project, but the wheels fell off with the decision of chair designs to exemplify a fluffy idea of a tool to “solve” ethical design. Why on earth choose the chair as a furniture category? There are so many classics on the market that this project cannot compete with. Additionally, these chairs are already designed for long use as they have built up popularity and an “icon status” and they are not a part of the throwaway society. They have already proven resilience towards aesthetic obsolescence.

With regard to the process-related approach of the concept roadmap, there is a concern that the project will become more research driven rather than “real world” driven. Understood as, what are the challenges of the buyer and which “actual concrete problem” is the project addressing besides the overall goal of a more ethical design?

Reflection : change of focus

The feedback from the milestone is spot on regarding the critical areas of the current scope and approach to the process and framing. Looking back, it was difficult and tending towards stupid to focus on describing a design process of a piece of furniture (a chair) without knowing of the actual product and its requirements, and without actually having been through the process.

It is not possible to start with drawing the process when it has not been accomplished yet. The team became too obsessed with the thought of having a strict plan for the approach for the process, but as of now it turned out to be more of a hindrance than a support in the process. A new approach must be applied to the project, but the thoughts of this approach are still brought along as input for the outer scope.

After the milestone, a wrap-up meeting is held with the supervisor, where the possibilities for changing product categories are discussed. Here, a common vision is seen to design a product that fulfills changing needs throughout a person's life. This kick-states a motivation to find a product category that is affected by changing needs.

2nd approach : focusing on **the product** and the inner scope

Based on the feedback and reflections upon the first milestone and the note from the supervisor, the focus must change from the process tool to the product, and the chair as a product category must be reconsidered. The chair does not align with the thoughts of making furniture that also comply with changing needs during a person's lifetime. A person's lifetime consists of different stages and thus changing needs in life, resulting in frequent replacement of furniture. In order for a piece of furniture to be long lasting, it must address longlasting needs.

Before choosing another furniture category it is necessary to look into potential problems to be solved and which consumer behaviors that can affect the longevity aspect in order to find arguments for the new category. Firstly, this is done by making a mapping of a person's life.

It is necessary to be extremely clear with the scope of the project when designing furniture - there are tons of furniture on the market and it is essential to find the exact spot where the target user, identified unsolved needs, market, and business perspectives contributes with something new. Additionally, to be transparent with what is deselected as a consequence of the scope. That is why the following identification of stages in life, metrics, and contact to users are essential to the scope to find this potential in the market.

Mapping of life

In order for the product to meet different needs, it is first necessary to outline the phases one goes through in life. Rather than defining the target group in terms of age, gender, occupation, etc. it seems more appropriate to frame the user based on human development, which can be defined as a process that can be divided into different life phases.

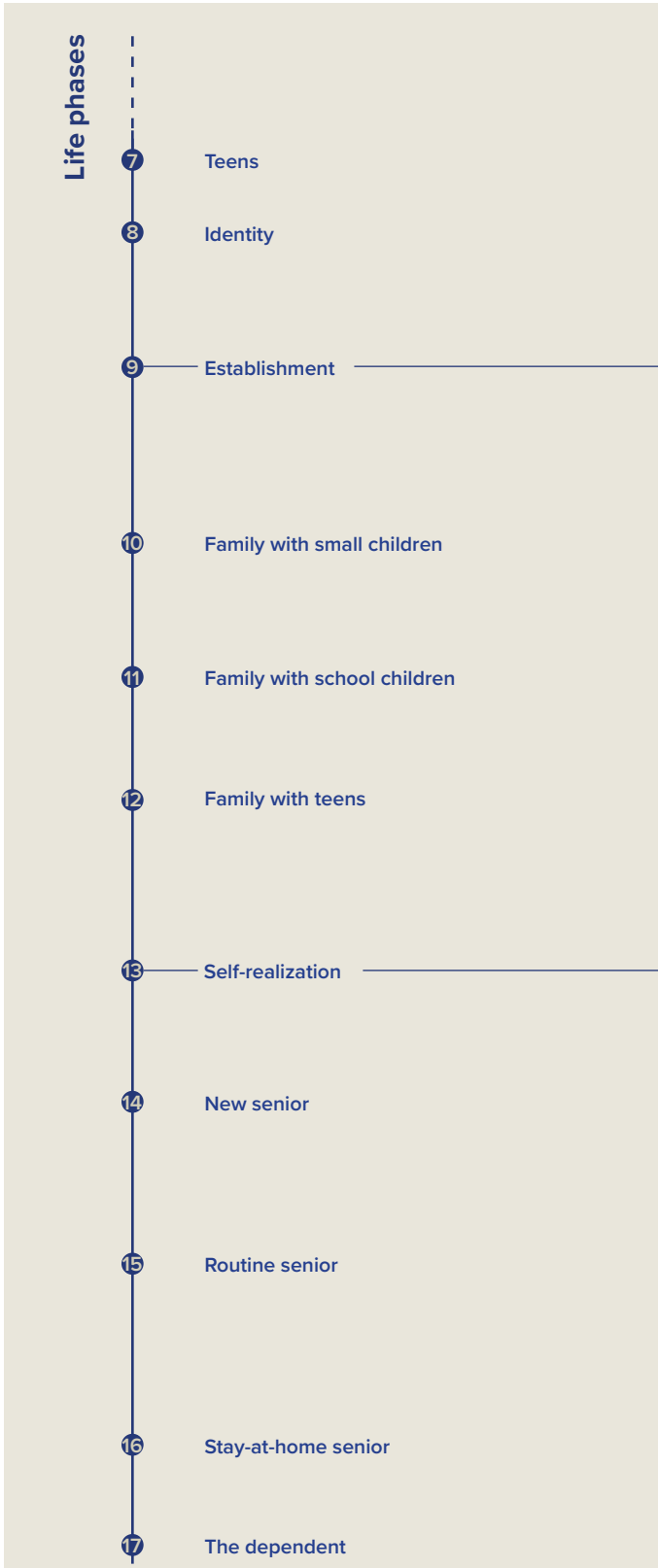
The life phases are defined by biological, psychological, social and cultural milestones as well as family status. The transitions between phases are the trigger for changes in consumption patterns. (Kongsholm, 2020)

According to Anne Glad Wagner, a life phase can come at many different times in life. "In this context, a 48-year-old man may suddenly find he has more to talk about with the 30-year-old dads in the nursery than with his peers in the wine club. Age is less defining today than 50 years ago, when more lives unfolded in a uniform trajectory." (Livsfaser.dk, n.d.)

When designing for a consumer, it is very beneficial to put age aside and instead focus on life phases and hence life activities to reach the insights that describe the challenges and needs.

17 phases in life

The Danish book “Fra vugge til krukke” (translated “From cradle to grave”) describes that a person passes 17 different phases in life (see app. 04). In order to identify which phases have a strong influence on changing needs regarding furniture, relevant phases are mapped and combined with different happenings within the phases.



As of now there is an identified potential in phase 9: The establishment phase. The same goes for phase 13: Self realization. Those phases call for a change of furniture, either due to a new residence, including either more or less space, more or less room for guests, and life changes leading up to a family extension and decrease (when children move away from home). Various product categories can be identified as a subject to these changing needs, e.g. the sofa (and hence the coffee table), the dining table, the bed and the storage furniture.

Investing in a house together

Bachelor party and wedding

Incuring depts

Getting a real job

Considering family increase

Opportunities

- The consumer is establishing a mutual identity with the partner through the home
- 49% have an interest in interior design
- 62% are willing to pay more for quality products
- You are making a home together and this is the time where it would make sense to invest in long lasting furniture
- You have a large social circle
- You are considering children in the new future, so your needs are soon to be changing
- There is a tendency that this type of consumer has a mindset of “wanting the best at first”

Barriers

- The project team can currently be described in this phase of life - this phase is “close to home”
- Many expenses arise in this phase: for instance buying a house, buying a car etc. causing the investment in furniture to be lower on the priority list

Children move away from home

Extra time for hobbies

Better and more expensive food and beverages

Menopause and mid-life crisis

Opportunities

- The consumer has an established economy and therefore have more money to invest - the income is on an average the highest from 45 - 54 years
- The children have moved out and there might be a need of down scaling
- You might consider moving in something smaller (or maybe it comes later in life - now you utilize the space for your hobbies and when children come home on visits)

Barriers

- Instead of investing in the home, you invest in summerhouses, holidays and hobbies
- 56% states: “New experiences are more important for me than buying new things”
- If you are investing in the home, you are making an investment in the house: new kitchen, bathroom, new windows or roof.
- You have already established your identity and style through furniture

To choose a product category and a target group it is necessary to understand what one’s change, when one’s change and why one’s change it. So where can the greatest potential be seen when talking about turnovers? This can be answered by looking into metrics, to know what triggers the various turnovers.

There is an internal desire for choosing the dining table as a category. However, other categories are also held open if they turn out to fit better with the overall frame, the desired target group and a gap in the market.

Metrics : Investigating parameters influencing product longevity

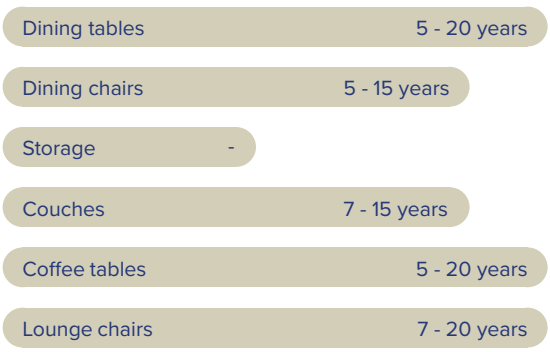
Besides localizing stages in life where consumer needs are changing regarding requirements for furniture, it is also necessary to initiate an understanding of the market potential for different furniture categories and in terms of the amount of consumers that will be affected by these changes. Some of the identified activities in the phases in life will be backed up by metrics.

The metrics are based on the Danish market and assuming that somewhat the same need will be seen in the rest of Scandinavia (see app. 05).

Activity	Amount of the Danish population	Average age
Moving	In 2021: 804.988 in total (from 16-99+) **259.676 (age 25-35)** 67.700 relocations due to couples moving apart	Young adults, 20-29 years
Moving out for the first time	In 2021: 33.117 people in the age of 20-21 years **87.528 people in total in the age of 15-29 years**	20-21 years
Divorces	In 2022: 12.145, divorces, 24.290 people	Can happen for all ages, mostly in the age of 40-54 years
Family increase	In 2022: 11.351 first-borns (mother's age 25-29) 26.306 first-borns in total (mother's age 15-54) 10.425 second-born (mother's age 30-34) 22.621 second-born in total (mother's age 15-54)	First-time mother average age 29,9 years First-time father average age 31,6 years
Household decrease	In 2022: 265.789 families of 2 adults and 2 children	Average parent age when children move out is 50-54 years

Pairing life stages with the metrics above can be a bit strange as the first parameter does not use the age to describe a happening in life whereas the metrics uses the age. However, 260.000 people moved in 2021 in the age span of 25 - 35 years; the age in which can fit with life phase number 9: the establishment phase. In the same age span, in 2022, 20.000 children (first-born or second-born) were born. This indicates that the potential market for a piece of furniture, targeted for this consumer, is rather large.

Average furniture lifetime



It seems difficult to derive anything from the numbers of average product lifetime for various product categories as the spans are really large. They must highly depend on the quality of the furniture and the care (and possibilities of repairing) of it. Additionally, the numbers above do not derive from scientific articles - and with the allocated time for the task, no trustworthy numbers have been found. The same conclusion is found in various research articles who have been searching for the same. (Living spaces, n.d.)

Furniture revenues in Denmark

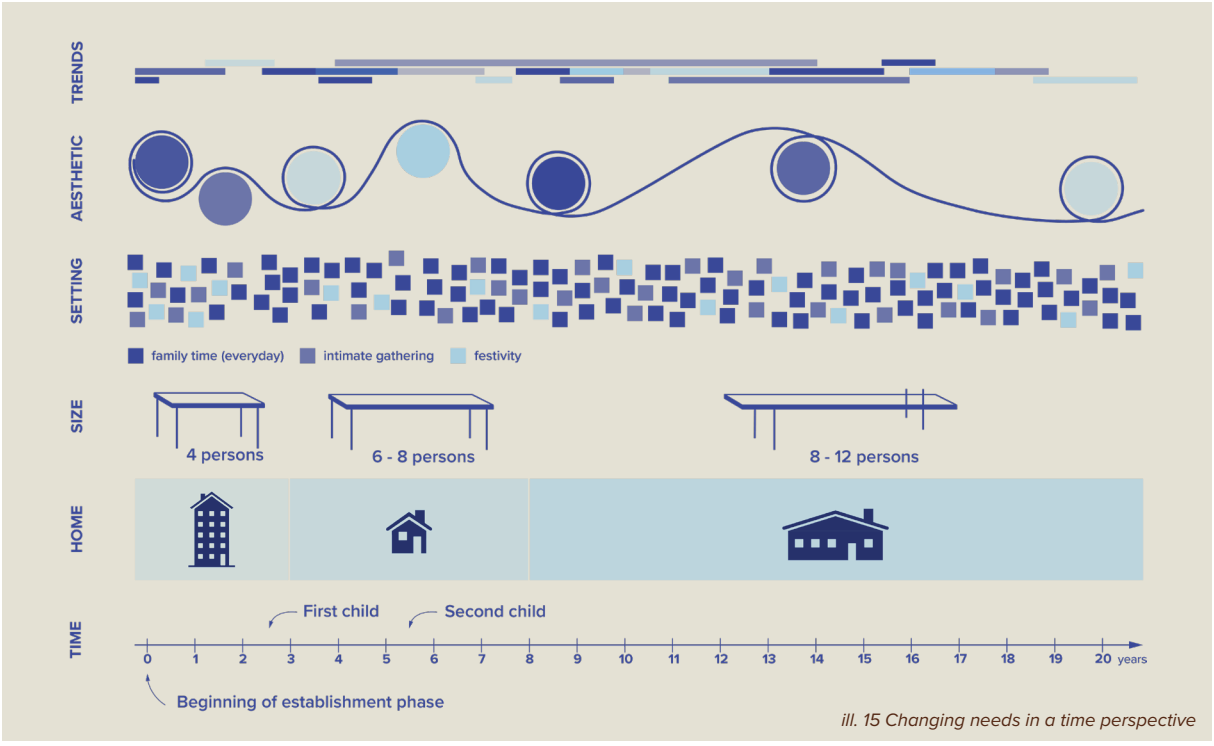
Product category	Market revenue, Denmark (DKK) 2023	2026
Beds (Mattresses excluded)	≈ 465 million	≈ 553 million
Seats & Sofas (Sofa, dining chair, armchair, bar chair etc.)	≈ 3,6 billion	≈ 4,1 billion
Dining tables, Kitchen Islands & Pantries (Dining tables included)	≈ 4,6 billion	≈ 5,5 billion
Cabinets, TV stands & Side tables (Bar table, coffee table, side table etc.)	≈ 1,8 billion	≈ 2,0 billion

To supplement the metrics of activities for the potential target group, the market revenue for different furniture categories is also checked out. Even though the categories are wide, they still give an indication that furniture as a category has a huge (growing) market revenue in Denmark. The product category of tables is larger than for seatings, but the market share of dining tables specifically is unknown.

Summing up : Furniture category and target group

Dining tables for consumers in the **establishment phase** of life

As mentioned earlier, for a product to be designed for longevity, it must fulfill long lasting (changing) needs for the consumer. Many activities are happening in the **establishment phase of life** (phase 9), and many needs for **a dining table** are changing; mostly with regard to the size of it, but the personal style may also be changing, making the dining table at risk of aesthetic obsolescence. The context in which the dining table is positioned may change due to moving home (for instance from a smaller apartment to a house or a larger apartment), and the size of the family may grow. In this phase in life, there is a need for establishing a home and figuring out which furniture to invest in. The income may not be the highest, but a new table is still necessary - together with a lot of other things as well. At this point in life it would be beneficial to invest in a dining table that could fulfill the coming needs and requirements (making a "smart" investment relating to TCO). For the same reason, the table must fit both the smaller apartment and future houses.



ill. 15 Changing needs in a time perspective

Potential needs for the new dining table

Based on the previous research and findings, the following are hypotheses for potential needs for the dining table:

1 Must fit with a small apartment and a house (adapt to a larger room)

2 Must be fairly transportable

3 Basis must fit 2-4 people (and still feel intimate)

4 Must be able to change in size (for hosting guests & family expansion)

5 Must give the opportunity to change the visual appearance

6 Must be affordable for young adults in the establishment phase of life*

** will become more specific later on*

As the design team is highly biased by the project, it is necessary to contact the target group to firstly identify if the target group can verify the above mentioned needs for replacing their dining table as well as benchmarking the needs with the market - are there dining tables on the market to fulfill the needs and/or what are their shortcomings?

Understanding the user's mindset and needs

The dining table market is a huge red ocean. There is competition everywhere, and it is critical to identify how to offer a different value proposition to make a foundation for a business.

What (long term) value must the table propose that is attractive for the user - in the duplicity of being valuable NOW and add value in the FUTURE. Why do people in the establishment phase buy a new dining table, or why do they not buy a new table if they want or need to? To answer these questions and obtain new insights, consumers in the establishment phase of life are interviewed (see app. 06).

The aim with the interviews is additionally to be able to specify the user description - who makes long term decisions under the age of 30 without being caused by an experienced-based behavioral change? And what are their considerations and priorities?

Round 1

Semi-structured interviews with six known people (friends or family over the phone)

Insights in blue // reflections in brown

People in the establishment phase see their current apartment as temporary and does not want to buy a new dining table because they are afraid that it will not fit the new context (size and aesthetics) in future homes // It must be ensured that the table does not become outdated when the table loses its novelty value and a new trend is in fashion.

The personal style changes over time which is a reasoning for wanting to replace the dining table. There is a limit of tables on the market that offer a change in style in a long perspective // The dining table is a large piece of furniture that can be influenced by trends - how is this need addressed with a longevity mindset?

Key insights

Purchasing a dining table is not driven by impulse. Lots of thought lay behind the decision, including considering how it can fit needs in a long perspective - and where to make compromises.

Round 2

Short interviews with 15 people (strangers approached in stores in Aalborg)

Regarding aspects making it attractive to keep a table longer:

> *Then you should be able to change the aesthetics of it. The couch or other furniture become boring qucikly. You think that the color does no longer fit your house.*
>
> Mathias (app. 06)

> *I am considering a round table. It is a conversation table. But the drawback with a round table is, that when you are only 4 in the everyday life with 2 children, you sit far from each other.*
>
> Jane (app. 06)

Key insights

The consumer has replaced or wants to replace their dining table either if it does not fit in size or if the aesthetic appearance of the table is obsolete as to the home and personal style.

To meet longlasting needs and to differentiate on the market, the table must offer the opportunity to change function (size and form) and aesthetics (undetermined).

Summing up : the target user

The importance of this project's target user relates more to the needs of the user (the reasoning behind purchasing new furniture) than to the actual description of the user. However, both aspects are summed up below.

Characteristics

Besides the description of the user on p. 19, the user...

- ...has an establishment mindset → thinking long term on multiple parameters: establishing oneself is equal to considering one's life in a long perspective - both according to family considerations as well as residence- and furniture considerations.
- ...does not buy on impulses but makes "smart" purchases that consider quality and durability with an (unconscious) understandance of TCO

Desired selling points

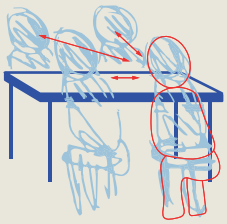
The table must be able to offer a change in...

- ... size
- ... form
- ... aesthetics

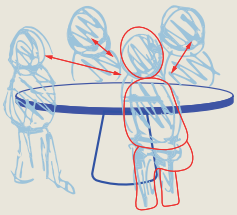
Both temporary, short term and permanent, long term.

After talking with the target group about wishes and dreams for a future dining table, it is obvious and relevant to explore the market. Are there any dining tables that exist today that offer a change in size, form and aesthetics at the same time?

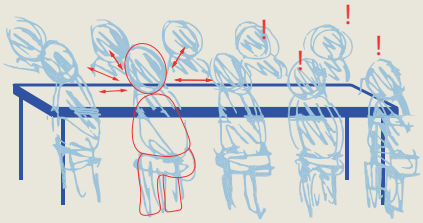
The need for changing the form and size: the need for a new setting



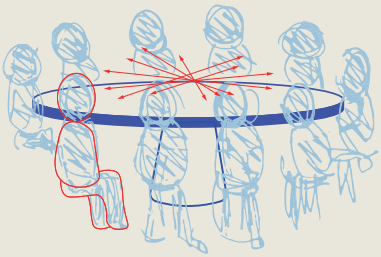
Good for "everyday intimicy" and making a setting suitable for a good interaction with everyone



Not as intimate setting with few people, as you are not fully facing each other



Limited connection to everyone around the table - there is a hierarchy between the seatings

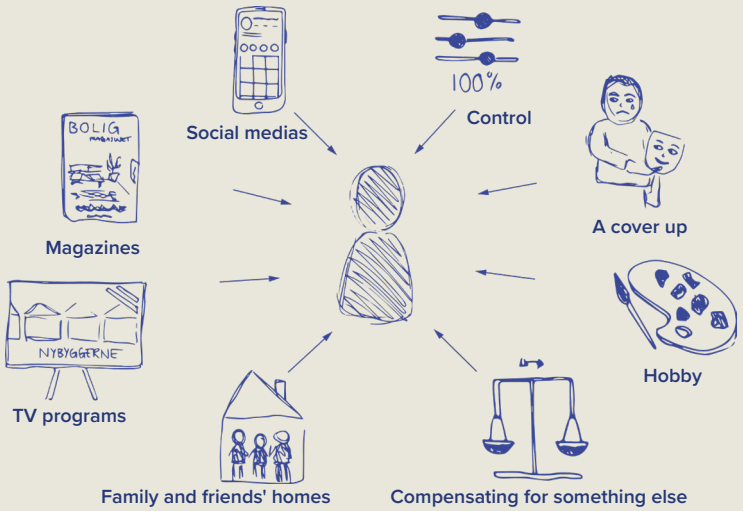


A social table setting with joined connections and interactions with everyone

ill. 16 Need for a new setting

The settings are changing from everyday life and gatherings. For gatherings, the user would like to offer a different setting for different occasions. Social mechanisms and dynamics change according to the seating situation. In a long term perspective, there will be both temporary and permanent needs for changing setting and size. Temporary shifts at gatherings - from everyday to party. And permanent shifts and needs for a change in size when the family is increasing.

The need for changing aesthetics : the need for renewal



ill. 17 Need for renewal

Societal influence that is affecting **what** you change and replace

Renewal as an reaction for something else that is affecting **why** you are changing and replacing

The user is influenced by society. The desire for renewal can come down to the fact that society dictates a fast consumption cycle and demands that we all have to be in movement. The user's desire for renewal in personal style and identity are changing over time and the reason for this can be caused to compensate for other things in life that might not go well. In a long term perspective, the user might go through a lot of different styles, identities and ways of expressing oneself. A table that can change aesthetics over time will offer a strong long term value for the user as a change in style would not require an entire new purchase.

Market research

A market research is conducted to investigate which kind of dining tables are available on the market and if any of them offer a change in both size, form and aesthetics. It will be used to investigate the potential gap in the market combined with the framing of this project (see app. 07).

The market research is divided into three parameters: the expandable table, tables that can change form and tables that can change aesthetics. It is not possible to find a table that offers all three parameters which is why the three parameters are examined individually.

important!

Expandable tables

There are many ways to get a table that can expand in size. Within this category there are different principles:

Dutch extension *ill. 18*

Butterfly extension *ill. 19*

Plates that lift up *ill. 20*

... among A LOT others

There are many different principles for extending tables, which can range from 4-14 or 6-20 people. All tables extend in length or diameter. The tables above are all from Skovby, a Danish brand that are experts in extension tables.

Must store extra leafs at the table
Extension must be a one-man job

Tables that can change form

Tables that change shape are not as common on the market as extendable tables. The concept is moving towards a different category and is considered more as modular tables for the contract market.

Campo d'Oro *ill. 21*

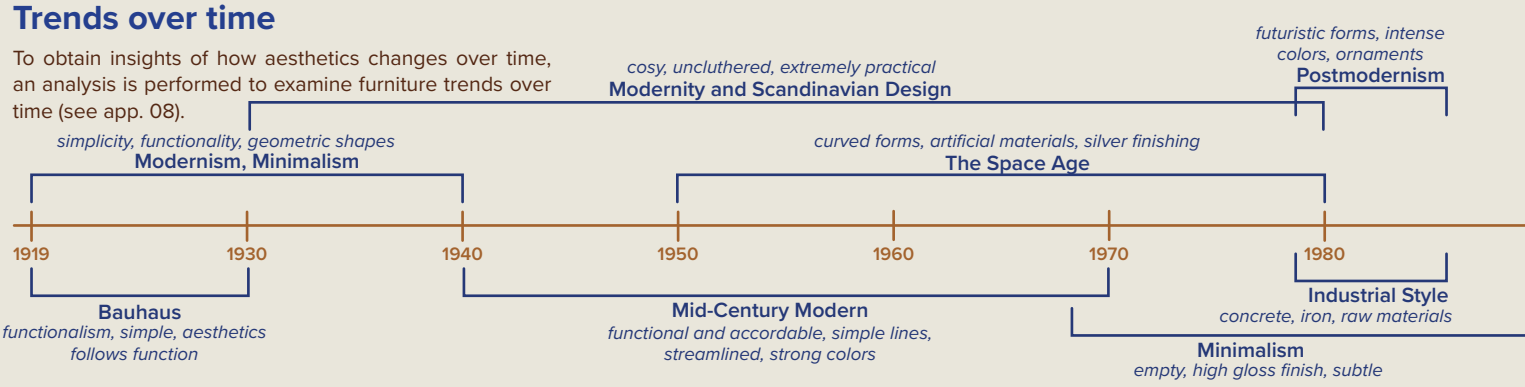
Da Fanzhuo *ill. 22*

Hive Modular Table *ill. 23*

... among others

Trends over time

To obtain insights of how aesthetics changes over time, an analysis is performed to examine furniture trends over time (see app. 08).



ill. 24

ill. 25

ill. 26

ill. 27

ill. 28

ill. 29

Tables that can change aesthetics

There are several tables where the consumer can personalize aesthetics in the purchase situation, or where the consumer e.g. can replace the legs with different ones if they wish to renew themselves. A few tables offer a reversible top, but this is not a common feature in the table category.

Shanghai frame / legs *ill. 30*

Spider frame / legs *ill. 31*

Y frame / legs *ill. 32*

... among others

The analysis shows a tiny sample of the large red ocean market for dining tables. Based on this, there are no tables that offer a take on overcoming aesthetic obsolescence by being able to change aesthetics after purchase. This raises an opportunity in bringing a new principle into the market.

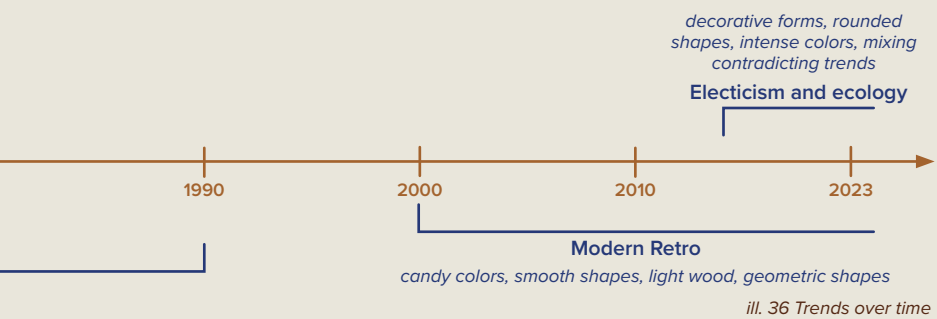
A table that can change in size, form and aesthetics : market position?

It is impossible to investigate the entire market and hence create a full market research. However, it is estimated as sufficient to perform desktop research and select tables that represent a category. The market research has been based on FUNCTIONS and not price point or aesthetics.

The framing of this project reveals a little gap in the market: **a table that can change in size, form and aesthetics does not exist.** The table will be in a small field between all the many different dining tables and will therefore be a completely new take on a dining table - being a firstmover on the market. This also means that the consumer potentially has to get used to this innovation, which involves risk taking, but it is exciting to investigate what it takes to get people to accept and understand the value it can possibly bring.

From a business perspective, if a table can be designed to fit into the consumer's current home and into their future home, a consumer who had not thought of investing in a table at this stage can be approached. Many other expenses are incurred when buying a house, so it would make sense to invest in the table upfront if it is possible to convince the consumer that the table will fit into any context of a future home.

Analysis based on "History of furniture and interior design trends" (FonduDesign, 2021)



ill. 36 Trends over time

Trends have changed based on colors, materials, shapes, details, and expressions in relation to heaviness. Trends are based on an inexplicable urge to innovate. Designs that are tied to trends are tied to a time - and can be interesting for a while, unlike classics, which are not tied to times or trends. Classics are judged to be timeless, so the consumer does not feel pressure to change it over time.

The aim is not necessary to develop a classic table. Not because it is not desired, but because it cannot be said in advance. The starting point will be to give a take on how to accommodate changing trends and thus not fight against, but work with the novelty value.

ill. 33

ill. 34

ill. 35

Initial design brief

Introduction

This project looks into designing the dining table of tomorrow. A dining table to fit current needs as well as coming needs and eliminating the desire for replacing it within a few years. The focus is to prolong the use-time for the same user of a dining table.

Aim

To turn away from the throwaway society where new purchases are made when needs are shifting. Instead, consumers must feel confident in purchasing this table despite uncertain plans for the future as the risk of obsolescence of the table is lowered.

Problem statement

How to design a long lasting dining table that offers a change in both size, form and aesthetics to adapt to the consumer's changing needs over time?

Target group

Consumers in the establishment phase of life, prioritizing quality, durability and design. Identifies her-/himself through the home and does not buy on impulse but makes "smart" purchases.

Unique selling points

- Offers a change in size
- Offers a change in form
- Offers a change in aesthetics

Context

- Consumer retail market, private homes
- Market: Medium to high end furniture design stores
- Geography: Scandinavia

Functionality

- Must be able to change in size (Mapping of life p. 25 + Understanding the user, p. 26)
- Must be able to extend in length and width - hence change form (Understanding the user, p. 26)
- Must be able to change aesthetics that does not require additional purchase (Understanding the user, p. 26)
- Must be transportable (Mapping of life p. 25)
- Basis must fit 2-4 people and expand from here (Mapping of life p. 25)
  Must store extra leafs at the table (Market research p.28)
  Extension must be a one-man job (Market research p.28)

Aesthetics

- Must blend in with existing Scandinavian interior design (The real world: context p. 19)

The take on dining tables

02 initial concept development

1st round of concept development

Choosing modularity

Value proposition

Who is Montana?

2nd round of concept development

Montana feedback & own evaluation

The design brief

Summary of the phase

This phase mostly works at the principal and spiritual level (Lerdahl, 2001) as the scope and visions is channeled and concretized in initial concept ideas to iterate on functions and features. The ideation is executed through hand sketches and considerably 3D modeling and quick renderings for presentable material. Additionally, a value proposition is stated to communicate the value the table conveys to the consumer in a matter that is easier to understand. As the project develops, Montana Furniture gets involved, which results in updates towards the design brief and business aspect.

Montana also provides an exciting approach to designing and developing the table to their values and DNA, which will help strengthen the product-company fit (Haase & Laursen, 2023). It starts with an understanding of who they are as a company, then leveraging their strengths in the product.

1st round of concept development

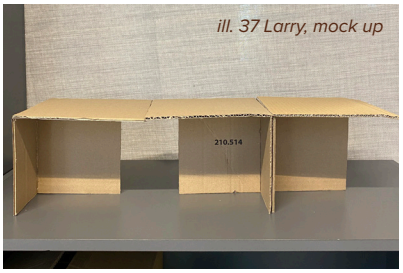
Focusing on size and change of visual expression

The concept development is problem sliced to ease the ability to find a solution space - the first focus is change of size and aesthetics. The approach is brainpool sketching and sketching together (Tollestrup, 2004) supplemented with 3D modeling and small scale cardboard mock-ups.

The different ideas are printed out and spread over a large area to make it easy to see them all (see app. 09). From here, the pros and cons of the different ideas can be loudly discussed, opening up opportunities to mix and match different elements to create new concepts.

The outcome of the session is three concepts, each of which forms its own direction for the design of the table which are being visualized in both 3D models and mock ups: Larry, Felix and Ellen (see app. 10).

Larry


ill. 37 Larry, mock up

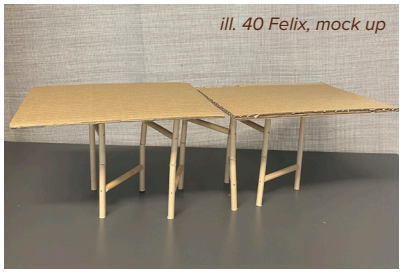

ill. 38 Larry, one module


ill. 39 Larry, three modules

Opportunities: **1)** Modular based - One module can be used in the apartment phase and then it is possible to "build on" in future homes **2)** The visual expression can be changed by turning the tables **3)** The consumer split the investment over time

More opportunities and considerations in app. 10 for all concepts

Felix


ill. 40 Felix, mock up


ill. 41 Felix, small


ill. 42 Felix, large

Opportunities: **1)** All in one principle **2)** The legs can be moved and placed in the holes ➝ change of visual expression **3)** Can be compact for the apartment setting and large for a bigger context

Ellen


ill. 43 Ellen, mock up


ill. 44 Ellen, small


ill. 45 Ellen, large

Opportunities: **1)** All-in-one principe **2)** Can be compact for the apartment setting and large for a bigger context **3)** The conumer can play with different visual expressions by moving the plates back or forward

Evaluating the concepts

The modularity of Larry is an interesting strategy for further development. The principle of modular tables leads to the idea of system design - can the tables be used in other settings as a table system that covers not only dining tables but several categories such as desks, children's room tables, etc.? Furthermore, with modular tables and with a system design in mind there is potential in terms of business and scaling. However, it is discussable whether or not the table in itself offers a change in size, form and aesthetics? The all-in-one principles are more “safe” in that regard as they offer value NOW and not only in the future with supplemental purchases.

Choosing modularity

Modularity is chosen as the overall strategy to follow in the concept development because of the opportunities of adding value for the consumer by splitting investment, changing in size and changing in form according to the composition.

Modularity is not just modularity. There are different views on the strategy, for which reason “all-in-one” concepts can also be labeled as modular: they consist of moveable parts/modules to position in relation to each other.

Opportunities and barriers for a modular table

From research (field research, user research and market research) it is possible to map opportunities and barriers for modularity, some of which are more related than others:

- Splitting investment
- Consumer can decide price level him/herself
- Renewal of aesthetics (rearranging / additional purchases)
- Wear and tear (replace worn out parts)
- Personalize the table from the beginning - like Montana
- Offer options
- Flexibility in different use situations - one module could be used for a desktop in the everyday life
- Aesthetically pleasing in proportions in both small and large configurations

- Long term supply - if consumer makes a long term commitment, so must the company
- Functionality - small splits between modules where dirt can get stuck
- Difference in color/material of old and new modules
- Wobbly connections and less rigid structure
- Higher risk of weak spots due to connections etc.
- Higher complexity in business model
- Do people want to be a part of the design process by choosing and connecting the different modules?

Commercial opportunities?

The idea of a modular table must be tested with regard to an immediate evaluation of its commercial opportunities with Brdr. Sørensen (see app. 03). The objective is to verify or dismiss the modular table strategy as the business perspective and hence the commercial potential is crucial to the project.

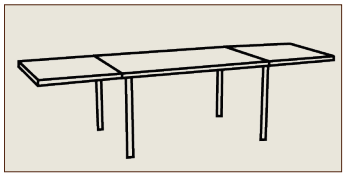
> *I like the case and the thought behind it; that it is a system where you can add modules. Of course, there are also a lot of questions that must be examined*
>
> Steffan, Brdr. Sørensen

Summing up, there is great support of the vision and some of the potential benefits of a modular table system is verified. However, there are also concerns, which are similar to the problems spotted within the team with regard to wear and tear, differences in colors, mismatch of the levels of the table modules, amount of supportive legs etc. These will be brought up later on.

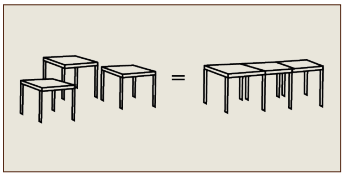
Modular table strategies

With the above mentioned opportunities and entry points for a modular dining table, different concrete strategies for the configuration of a modular table can be mapped. The strategies are mapped based on ideating and on a benchmark search for modular tables (see app. 11):

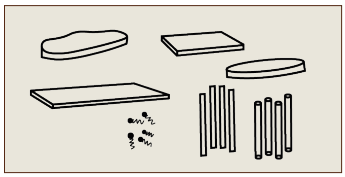
All-in-one, expandable



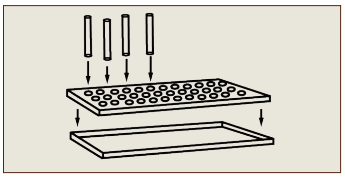
Puzzle, many small tables make one



Full on modular, build yourself



Platform, base modules



ill. 46 Modular table strategies

This will be used in the further concept development.

Thinking of

Montana

It is recognized that there are some similarities in the values and DNA that is found in the Danish brand Montana and especially when looking at the ’Montana System’. It would be valuable for the project to initiate contact with them. An introduction email is written to Josephine Ring, Portfolio Manager for Montana, if they could be interested in collaborating on this project (see app. 12). Now the waiting game begins.

Value proposition

The entry point of the project is a vision based approach to the design of the table. Apart from internal, abstract aims, it is necessary to align a more concrete (yet still rather undefinable) value proposition for the consumer that is more acceptable and understandable to communicate. What value is offered to the consumer with this table - and what enables the table to offer this value?

What value?

Express your personality with a table that fits every occasion - in all phases of life - with the people you love the most. Transform it and when needs are changing and as time goes by.

For whom?

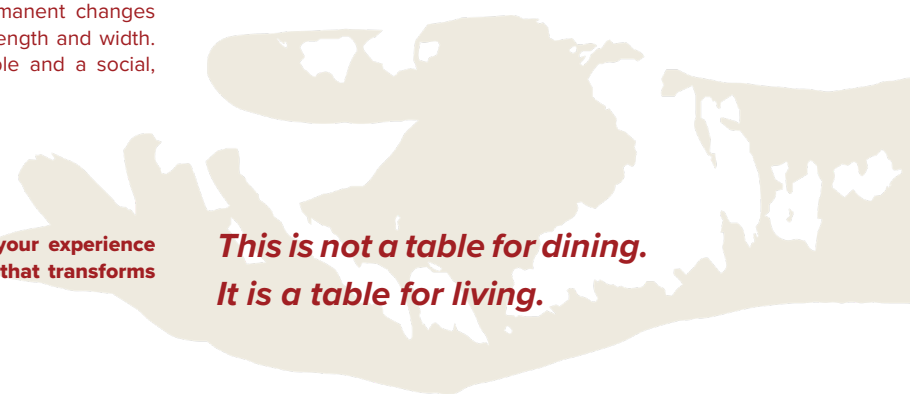
Quality-conscious couples and families who love to bring something new to the table - an ability to transform the setting in the dining room.

How?

High quality dining table with temporary and permanent changes of size, form and aesthetics through expansion in length and width. To offer a practical, space-optimized everyday table and a social, exclusive, voluminous gathering table.

Summarized

Bring something new to the table and expand your experience with the first long lasting high-end dining table that transforms atmospheres by changing form and aesthetics.



This is not a table for dining.
It is a table for living.

Montana wants to meet

After 6 days of waiting, Montana agrees to a collaboration and would like to meet at their office for a pitch of the project. This provides a huge motivational drive and, at the same time, an enormous pressure. The meeting with Montana is only a week away, and knowing full well that the last few weeks have been complex during the development of concepts, there is a need to concretize what exactly is desired to be achieved with the table.

Who is Montana?

A company analysis is conducted (see app. 13) through desktop research and interviews with Brdr. Sørensen and Montana, which is supplemented with information from a received company presentation (Montana, 2023).

Let's create playful spaces

Company

A Danish family owned high-end furniture brand, founded in 1982 by Peter Lassen.

Particularly known for the modular "Montana System" - a shelving storage system of 36 modules, 4 depths and 42 colors (Montana, n.d.). The company is now in the transition towards a furniture brand more than a storage brand (see app. 14).

> ***A few years ago, the three white colors constituted 55% of the sales. 8% of the sales came from the colors [gray colors excluded] and they make up for 75% of their color assortment***
>
> Kai-Ole, Brdr. Sørensen

The Montana Modules are designed, developed, and produced in Denmark. Other furniture is produced elsewhere in Europe, though assembled in Denmark.

Mission

> *Our mission is to inspire the creation of playful spaces, where people can grow, thrive and feel at home*
>
> Montana

Unique selling points

Making room for personality - Always giving the consumer the opportunity to play and be creative with colors and materials.

Supply in the long run: 10 years guarantee of the product (and color availability)

Making the opportunity to follow trends through their classic design and system: change colors, materials, shelves/closet, sideboard/bookshelf, etc.

Quality that lasts for generations

Values

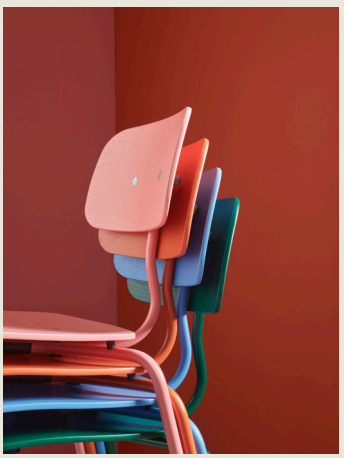
Portfolio

ill. 47

Wall units

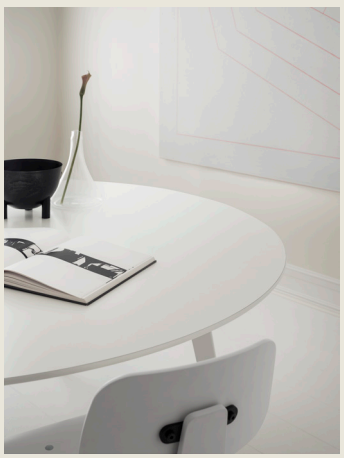
ill. 48

Cabinets and storage



ill. 49

Chairs



ill. 50

Tables

Brand strategy

The strategy consists of four cornerstones

Making Room for Colours & Creativity	A Brand by and for People
The Odd-One-Out in Danish Design	**Striving for Foreverness**

Brand ambition

> *We want to challenge the norm and be known as the ones that surprises and are thinking "out of the box"*
>
> Montana

The vision and communication is based on being creative and playful, but they seem a bit conservative internally when designing and deciding on what to have in their portfolio, which have to be taken into consideration to make a table that fits the company and has to be commercial.

- Quality, craftsmanship, longevity
- Timeless design
- Adaptable and flexible

Aesthetics must fit Montana's universe

Analysed value proposition

Creating playful and personal spaces through an endless amount of opportunities of modules in different sizes and colors. The trust, quality, and transparency Montana provides the customer with, contribute to a piece of long-living furniture that can be passed on for generations.

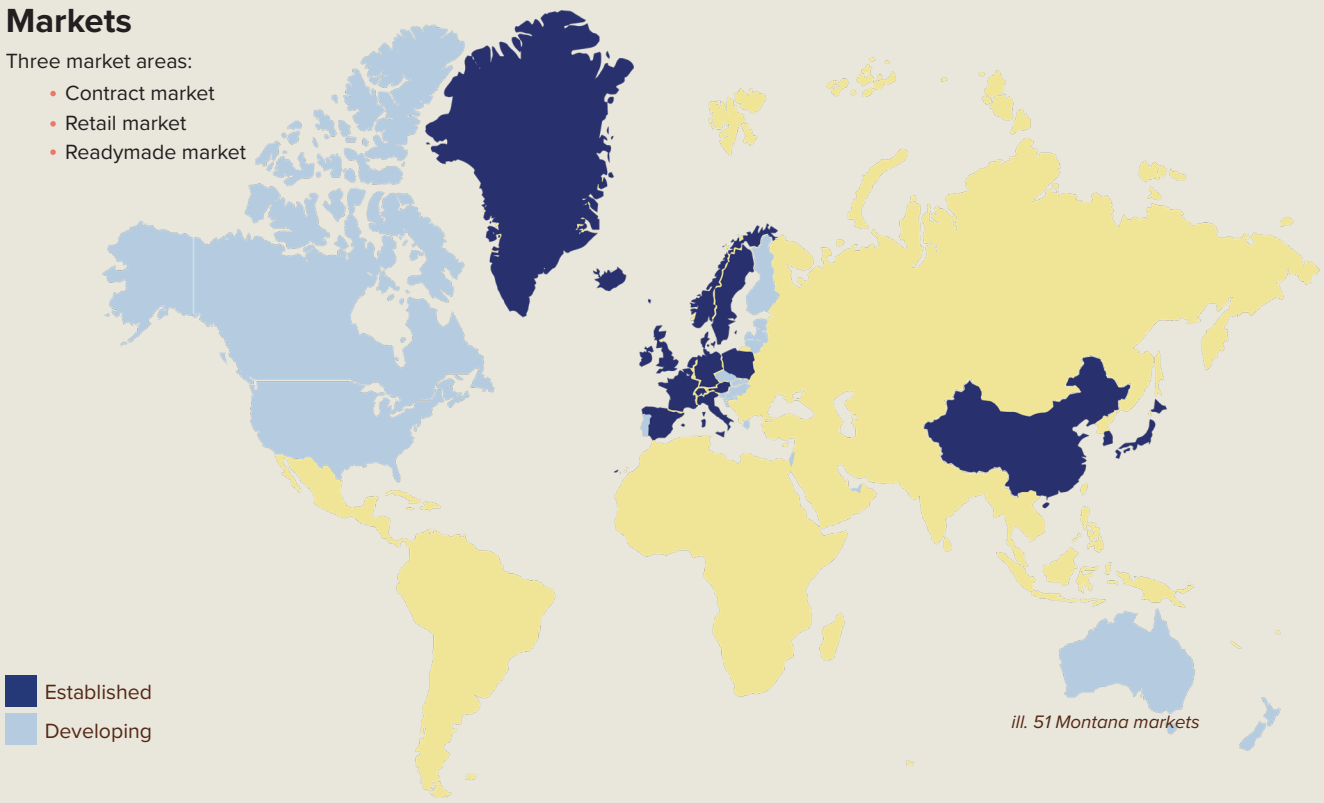
Longlasting - how?

Minimalistic design that is marked as timeless - enabling possibility to pass on to generations with pleasure and to personalize with supplemented add-ons to express one's own personality and thereby give it new life. Due to the status of a high-end brand, the furniture has a high resale price, making it a good investment for consumers.

Markets

Three market areas:

- Contract market
- Retail market
- Readymade market



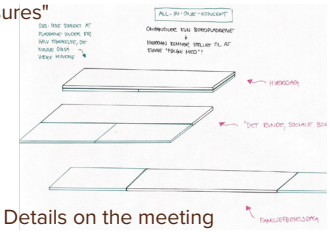
ill. 51 Montana markets

2nd round of concept development

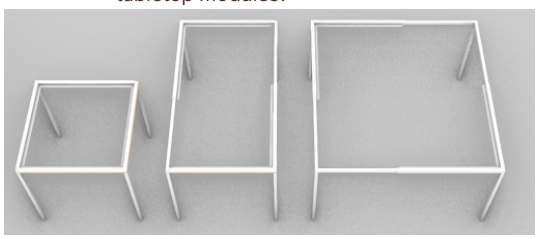
Focusing on modularity

The second round of concept development takes a starting point in the opportunities and strategies of modularity. Method wise, the team makes use of hand drawings and 3D-modeling in individual sessions of 20 minutes after which sketches are discussed and elaborated jointly (see app. 15).

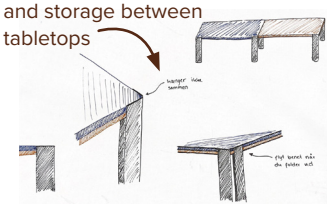
Testing and calculating on dimensions to find the "golden measures"



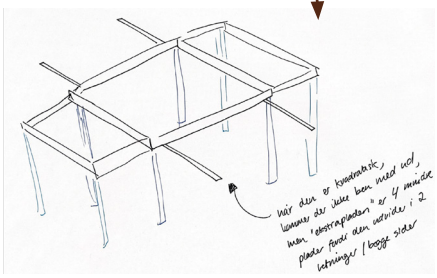
Could the entire frame expand and hence make room for more tabletop modules?



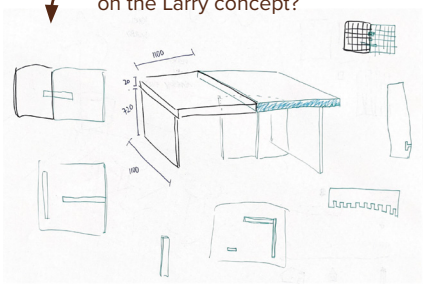
Details on the meeting and storage between tabletops



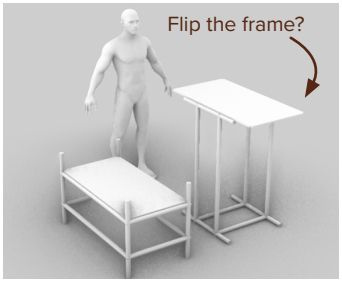
Extra support in the standard frame to pull out when extending?



How to play with the leg positioning on the Larry concept?



Flip the frame?



ill. 52 2nd round concepts

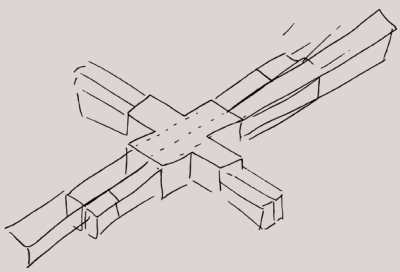
Three takes on modular tables

So far, the project has consisted of a lot of parallel and individual work due to the best allocation of resources, which may have increased the feeling of the complexity in the concept development. Therefore, a new strategy for concept development is planned: interactions and development will take place together so that different competences and strengths can be utilized.

Based on previous development of concepts and value proposition, three directions are selected, each forming a principle for the realization of the three focus elements (Change in size, form and aesthetics):

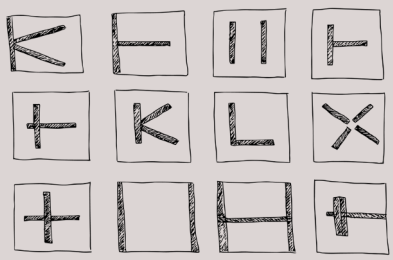
1

All-in-one



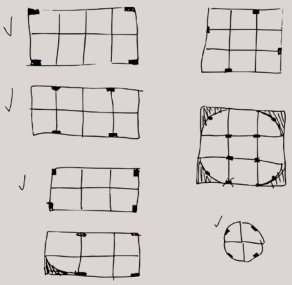
2

Puzzle



3

Platform



ill. 53 Initial sketches for Frederik, Lilly and Mille

Due to the short time before the meeting with Montana, there is a time limit on the development of each concept, with one concept to be developed in one day. This is manageable due to previous work on the framework with a clear story-telling.

NB! These come as requirements if "Frederik" is the concept to move forward with...

It is necessary to address the ideation differently and shift mindset to being more open-minded and trusting that developing and detailing on the ideas will open up for possibilities of adding more of the opportunities within modular design.

- Secondary plates must be in level with primary plate in all extension options
- Primary plate and extension plates must be connected in length and width extension
- Minimum 3 support points for primary plate
- Minimum 3 support points for secondary plates at extension
- Fixed support for primary plate
- Fixed support for secondary plates at extension

All of the opportunities in modular tables are restraining the process more than it is pushing it forward as it brings down the explorative, creative process because there is a sudden mindset of wanting to incorporate ALL opportunities in each of the concepts from the beginning. The team has a critical eye to the sketches and are currently evaluating them negatively “on the go” - if a sketch does not have opportunities of incorporating all of the opportunities, it is marked as not having potential. However, this is not consistent with the process of having an explorative, open concept development and it is unfair to evaluate opportunities based on quick sketches - it is not even possible.

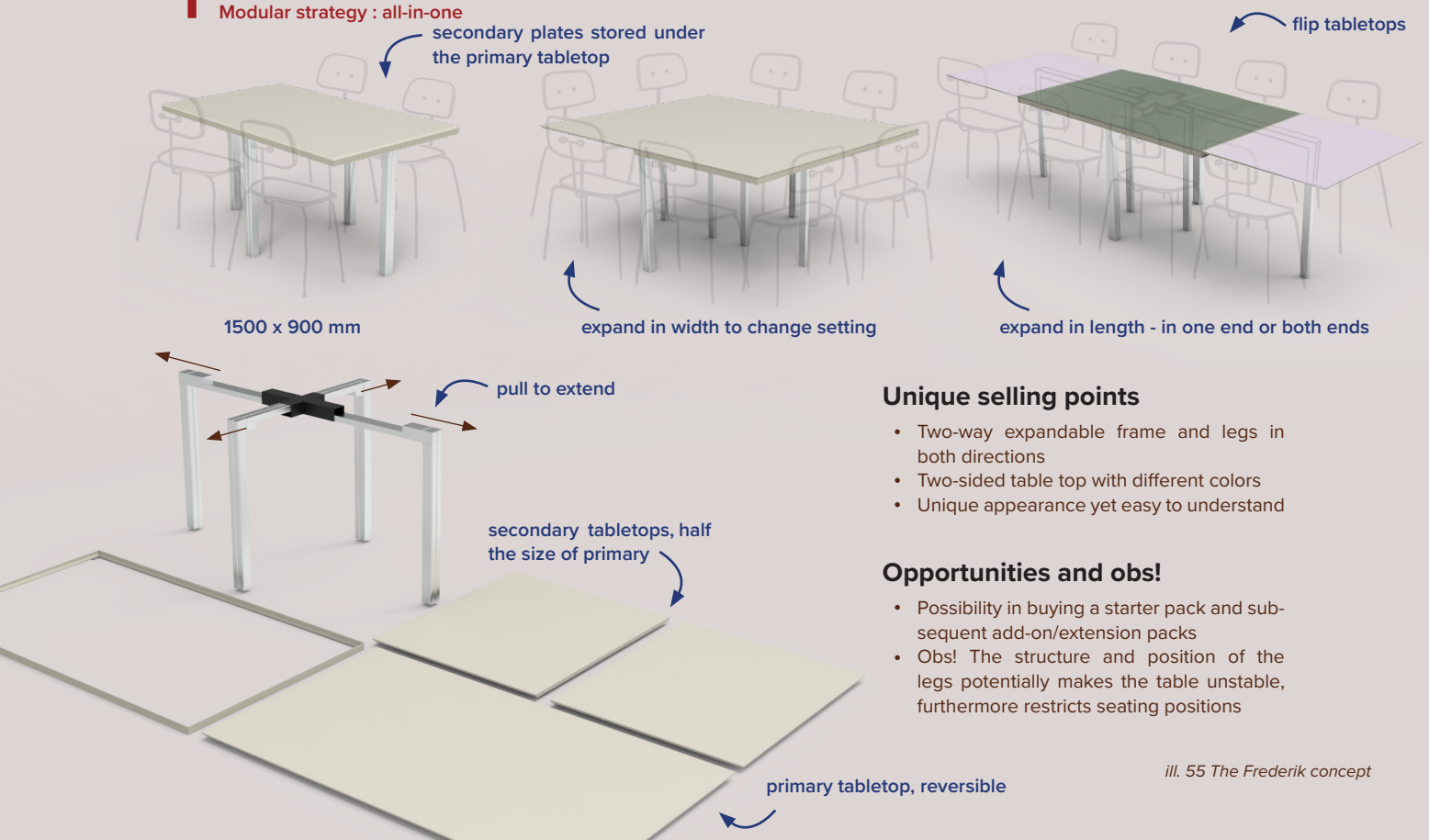
Searching for inspiration in stores

To open up for the shift in mindset, different furniture stores are visited with the objective of exposing the group to inputs and inspiration from current, accessible tables on the market.

ill. 54 Inspiration trip

1 Frederik

Modular strategy : all-in-one



Unique selling points

- Two-way expandable frame and legs in both directions
- Two-sided table top with different colors
- Unique appearance yet easy to understand

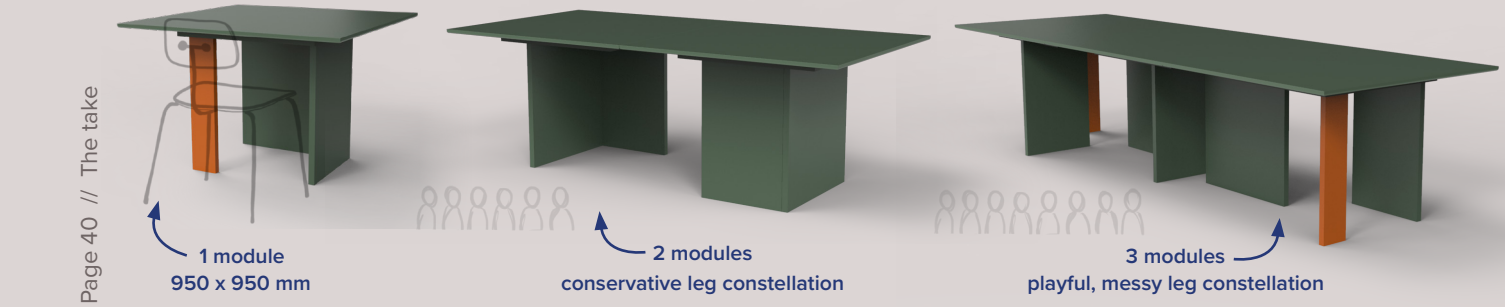
Opportunities and obs!

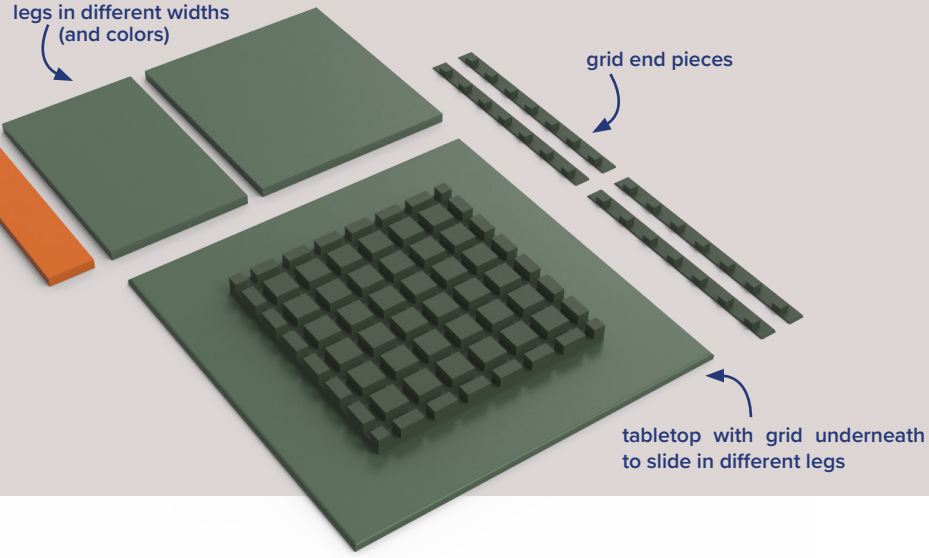
- Possibility in buying a starter pack and subsequent add-on/extension packs
- Obs! The structure and position of the legs potentially makes the table unstable, furthermore restricts seating positions

ill. 55 The Frederik concept

2 Lilly

Modular strategy : puzzle — — → further development of Larry (p. 33)





Unique selling points

- Split investment
- Simple scaling opportunities
- Multiple options for aesthetic renewal regarding "heaviness" with the legs and colors

Opportunities and obs!

- Possibility to develop a system for the home, e.g. a desk that could be attached as a temporary extension
- Obs! The table must nudge the user or limit the user in the placement of the legs in order to ensure stability
- Obs! How to join the modules?

ill. 56 The Lilly concept

Montana feedback

The three takes on a modular table are presented to Montana's Portfolio Manager, Josephine Ring. She is very positive about the approach to the project and the research that is made and believes that it brings a new take on the dining table and sees it as something innovative, which she believes fits well with Montana:

> *I think it is an extremely interesting take on tables (...) based on a need and not design. And that's also one of the things we work a lot with at Montana, that we shouldn't develop from nothing.*
>
> Josephine Ring, Montana

Key insights

Insights in blue // reflections in brown

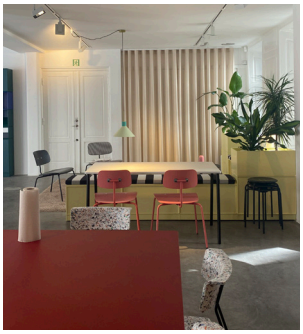
The most commercial tables : Firstly Frederik, secondarily Mille // Lilly was presented in crazy colors causing it to be the one that definetly stood out in her "commercial eyes". It shows the importance of how concepts are presented.

A product must not be difficult to decode : Frederik is very simple to understand // this is a very important insight for further development - both for interactions and branding when trying to "sell" the concept to consumers.

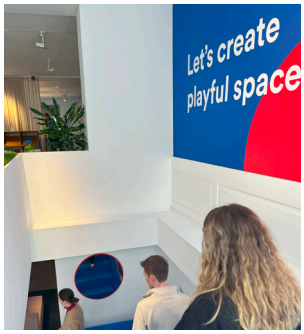
Scaling to the contract market : a business opportunity that could be considered // the thought is relevant, but it puts different requirements for the table. This idea is parked.

ill. 57

ill. 58



ill. 59



ill. 60

3 Mille
Modular strategy : platform

ill. 61 The Mille concept

Unique selling points

- Endless opportunities with extension
- Playfullness with aesthetics
- The consumer decides pricepoint herself/ himself

Opportunities and obs!

- Possibility in developing different sizes of top plates as Montana also do to put on top of two modules in order to hide joints
- Obs! A lot of joints will appear in the table top - how will it look and work in real life?

Summing up

- Verified framing
- Exciting project
- Most fond of Frederik, the all-in-one concept as it is easy to decode and understand and it is the most commercial table of the three.

What about aesthetics?
There is no “design” included in the concepts but the appearances are highly impacted by the function. Moving on from here,it must be taken into consideration that the design of the table is not based on B2B aesthetics. One note though, is that Montana really likes the idea of a reversible tabletop.

ill. 62

ill. 63

Own evaluation

On the basis of the given feedback and gut feeling, **future development will be based on the principles of Frederik, an all-in-one concept.** It must be a simple design that can change its size and transform in form allowing to change the setting around the table. Furthermore, the user must be able to renew the aesthetics over time after the purchasing situation in order to reduce the risk of aesthetic obsolescence. The development must deal with the position of the legs which at the moment makes the table unstable, furthermore restricts seating positions. Is it necessary to design a new expandable frame to solve the requirements?

This is a crucial point of impact, looking in retrospect! Designing an all-in-one table is the key to the (almost) impossible requirements to the construction of the table, which will be clarified in the following phases. The feedback of Montana was assigned of high importance as they bring a “real world perspective”, but the team must still pay attention to making own decisions as Montana does not have the same hidden agenda.

Design brief 2.0

A new take on a dining table for Montana

Introduction

This project looks into designing the dining table of tomorrow. A dining table to fit current needs as well as coming needs and eliminating the desire for replacing it within a few years. The focus is to prolong the use-time for the same user of a dining table.

Aim

To turn away from the throwaway society where new purchases are made when needs are shifting. Instead, consumers must feel confident in purchasing this table despite uncertain plans for the future as the risk of obsolescence of the table is lowered.

Problem statement

How to design a long lasting dining table that offers a change in both size, form and aesthetics to adapt to the consumer's changing needs over time?

Target group

Consumers in the establishment phase of life, prioritizing quality, durability and design. Identifies her-/himself through the home and does not buy on impulse but makes "smart" purchases.

Value proposition

Bring something new to the table and expand your experience with the first long lasting high-end dining table that transforms atmospheres by changing form and aesthetics.

Context

- Consumer retail market, private homes
- Market: Medium to high end furniture design stores
- Geography: Scandinavia

Functionality

- Must be able to extend in length and width - hence change size and form (Mapping of life p. 25 + Understanding the user p. 26)
- Must be able to change aesthetics that does not require additional purchase (Understanding the user p. 26)
- Must be transportable (Mapping of life p. 25)
- Basis must fit 2-4 people and expand from here (Mapping of life p. 25)
  - Extension to 6 pers. in length (2nd round of concept development p. 38)
  - Extension to 8 - 10 pers. in length (2nd round of concept development p. 38)
  - Extension to 8 - 10 pers. in width (2nd round of concept development p. 38)
- Must store extra leafs at the table (Market research p. 28)
- Extension must be a one-man job (Market research p. 28)
- Secondary plates must be in level with primary plate in all extension options (Three takes on modular tables p. 38)
- Primary plate and extension plates must be connected in length and width extension (Three takes on modular tables p. 38)
- Minimum 3 support points for primary plate (Three takes on modular tables p. 38)
- Minimum 3 support points for secondary plates at extension (Three takes on modular tables p. 38)
- Fixed support for primary plate (must touch ground) (Three takes on modular tables p. 38)
- Fixed support for secondary plates at extension (must touch ground) (Three takes on modular tables p.38)

Aesthetics

- Must blend in with existing Scandinavian interior design (The real world: context p. 19)
- Must fit Montana's universe (Who is Montana? p. 37)
- Must offer a reversible tabletop with different colors (Montana feedback p. 40)

Finding the solution field

03 product development

Making the simple all-in-one table work

An expandable frame

The 5 headaches

A morphological scheme

Can't we just...

The small available field for development

Three tables in one : Theo

Updated design brief

Summary of the phase

This phase builds on the iterations and insights of the previous phases and it dives deeper into the principal level of the value pyramid (Lerdahl, 2001), which is supplemented with exercises on both the contextual and material level as the phase culminates in a more in-depth development and presentation of a table (which turns out not to be the final table).

The phase covers the work of 1 month of structured concept development based on functional solution principles to enable the table to extend in two dimensions - an aim that feels impossible to meet if it must be consistent with all four levels of abstraction, but also an aim that will strengthen the product-market fit (Haase & Laursen, 2023) due to its uniqueness and principle that is not seen before in dining tables.

Making the simple all-in-one table work

The Frederik-concept might look simple and easy to interact with in 3D and in a 1:8 3D-printed model, but it contains MANY concerns. Therefore, the focus is now to iterate on different solution principles towards other stable expandable frames in two dimensions.

The overall goal of the development is to aim for a table that is low in complexity regarding mechanics AND interaction - for the sake of business and the decoding for the consumer.

Dimensions guidelines

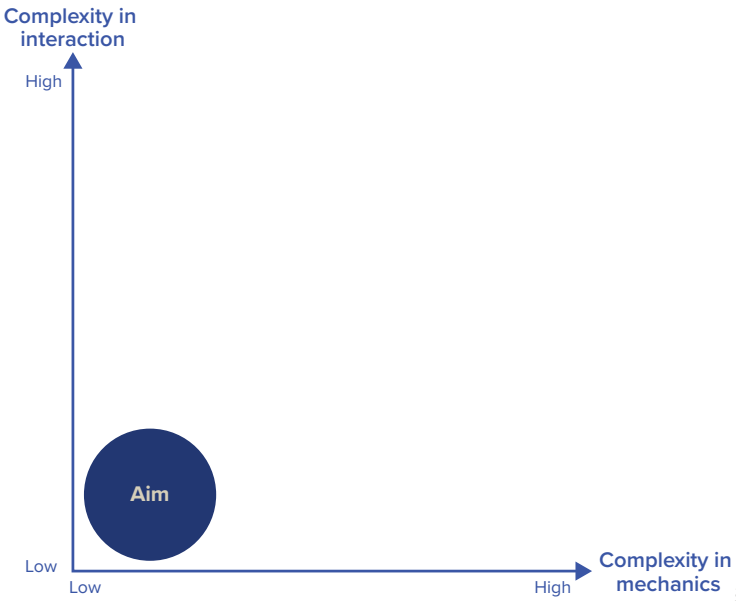
Length
4 pers.: min. 130 cm
6 pers.: min. 195 cm
8 pers.: min. 260 cm

Height
72 - 74 cm

From fieldtrip most 6 pers. tables are 220 cm in length

Width
80 - 90 cm
(100 cm for very long tables)

(Boboonline, 2019)

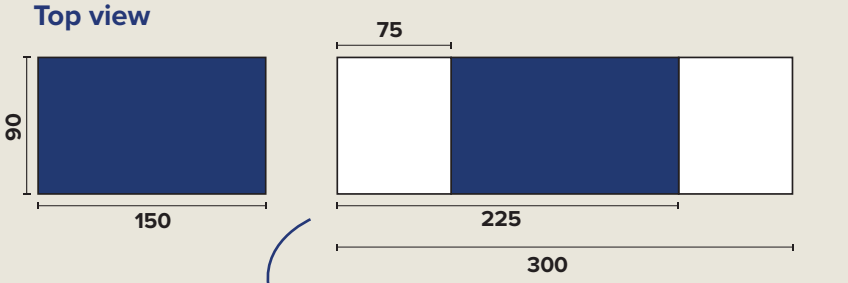


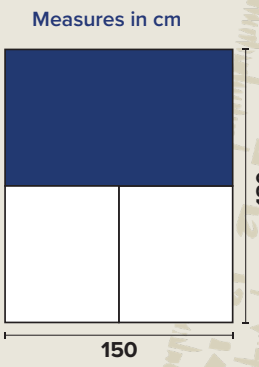
ill. 64 Aim with development

Dimensions

As the main innovation of the table is to extend in both length and width, the dimensions of the table is critical. The width of the primary and secondary plates must be the same (to extend in length) and the length of the secondary plates must be exactly half the size of the primary plate (to extend in width).

The standard dimensions of the table are determined to be 150 x 90 which complies with the guidelines.





ill. 65 Measures

ill. 66 Length extension

ill. 67 Width extension

Dimensions primary: 150 x 90 cm
Dimensions secondary: 75 x 90 cm
Table height: 72-74 cm

An expandable frame

There is an internal awareness that the development of this table contains a lot of linked variables that affect each other. However, problem slicing is necessary to ease the development as it is too chaotic to include all aspects simultaneously (as concluded in previous concept development iterations).

The following are solution principles on expandable frames in two dimensions. In the process the team makes use of stick-models, 3D modeling and quick hand drawings to iterate and communicate ideas. Each principle has some immediate concerns (possibly a lot more unanswered questions) to take into account if they are carried on.

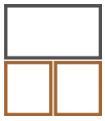
Frederik
(funky)

Principle

The "cross" consists of 2x2 legs that travel in a path that holds them together, but enables then to move parallel to each other.

Length extension

Width extension



Opportunities
- Innovative
- Atypical look
- Simple to understand

Concerns
- Tilting?
- How to extend in the real size?
- How to move tabletops? With the primary frame?

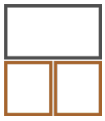
Esra
(extra legs)

Principle

A double frame where the outer frame is divided in 8 parts that can move in one direction.

Length extension

Width extension

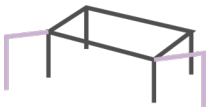


Opportunities
- Stable
- Few interactions

Concerns
- A lot of legs in the corners (3)
- A lot of legs when extended
- Wear and tear after 20 years?

Sus
(swinging legs)

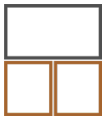
Principle



A frame with a rotational hinge to enable 2 extra leg configurations to swing out. 45° to length extension, 180° to width extension.

Length extension

Width extension



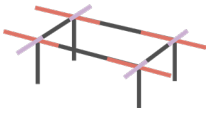
Opportunities
- Minimum legs
- Unique look

Concerns
- The motion takes up a lot of space
- Support in the middle when extended in width

The swivel radius in the movement is too big

Noelle
(no extra legs)

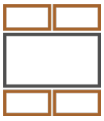
Principle



Like Esra but cut in more pieces and without legs as the plates will be smaller.

Length extension

Width extension



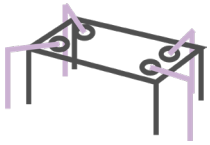
Opportunities
- No extra legs at all
- Stable

Concerns
- (Too) many secondary plates
- Many interactions

It is a no-go to split the secondary plates in two

Rolf
(rotating legs)

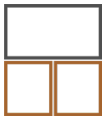
Principle



The legs are attached with a rotational hinge to enable width extension. Additionally the legs can be pulled out to extend.

Length extension

Width extension



Opportunities
- No extra legs
- Lightweight look with legs under the table

Concerns
- Asymmetrical frame in width extension
- The rotation hinge
- Can the legs be long enough to only extend in width in one direction?

ill. 68 An expandable frame

With different principles of solving a 2-dimension extension frame, it is "just" needed to implement the table tops with the movements of the frames...

... but (?#</!*) no, it is extremely difficult!

2 extra plates (not 4) - now called "secondary plates"
Width extension on the same side of the primary table
Symmetrical length extension from the primary table

The 5 headaches

There are five big pains in the development that influence each other - when one pain is solved it results in a bigger pain for one of the others. These are the source to a very difficult (and protracted) development - these are also the reason why earlier table ideas are discarded.

It is highly necessary to structure the development very strictly to keep an overview of potential principal solutions to each of the requirements for the table - or else there is a risk that the team misses out on simple solutions towards the five headaches.

1 Level

The table tops are stored under each other in the standard position but must be in level in the extended positions (including only extending to 6 persons)

2 Support primary plate

The support of the primary plate is tricky as the secondary plates are exactly half the size. If the secondary plates are stored exactly underneath the primary plate, it must be supported "outside" the size of the primary plate.

3 Support secondary plate

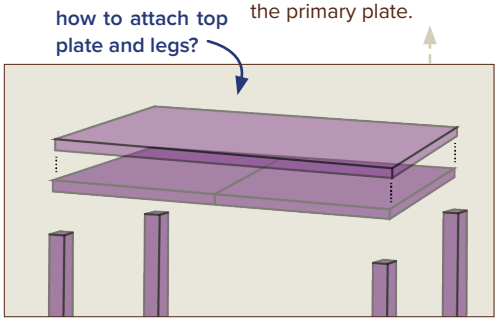
In continuation of no. 2, the secondary plates are longer than most standard extra leafs (length 45-50 cm) which requires more support - potentially fixed support (touching ground)

4 Comfort

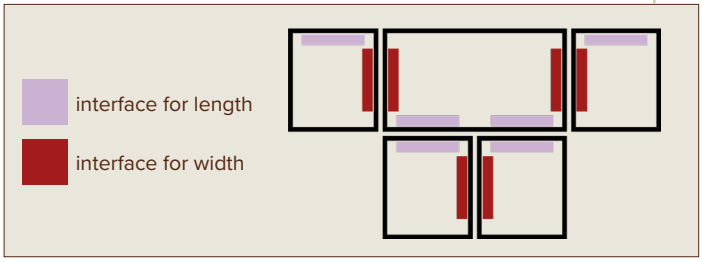
Due to comfort when sitting at the table, there is limited space underneath the primary plate for the secondary plates and the extension mechanisms

5 Joining tabletops + frames

How are the table tops locked to each other in the extended positions - have in mind that the interfaces/contact edges of the secondary plates are not the same in the length extension as in the width extension (see ill. 70)



ill. 69 Tabletops over each other



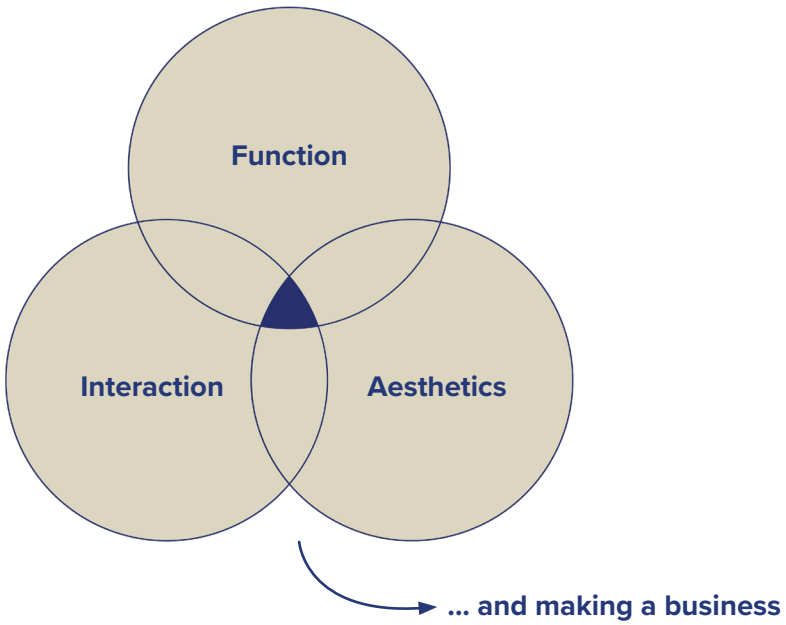
ill. 70 Interfaces between tabletops

The dilemma of function - interaction - aesthetics (and business)

The above mentioned headaches only relate to the functional aspect of the table. The aesthetic and the interaction dimension is also of high importance - in addition, it must have business potential. If the table functions but looks ugly, no one will buy it. Conversely, if the table looks beautiful but does not function, no one will buy it. If the functions work but it is very troublesome, no one will buy it - and so on.

This tension field causes many dilemmas, but the driver and innovative part of the table is the function of extending in two dimensions, for which reason the team focuses on the function. However, aesthetics and interaction are (as illustrated) overlapping and hence are considered in parallel when briefly evaluating the different ideas for the table. These must be further investigated when the function is further developed.

The aspects of function - interaction - aesthetics - business is referred to in the subsequent phases (phase 04, 05, 06 and 09).



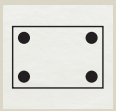
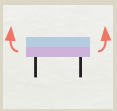
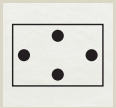
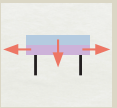
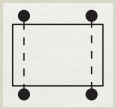
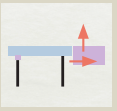
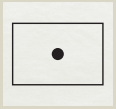
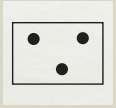
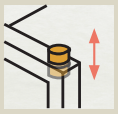
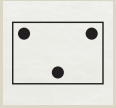
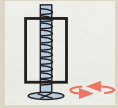
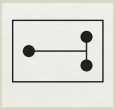
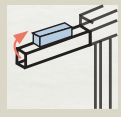
ill. 71 The 3 (4) aspects

A morphological scheme

Each of the requirements are put in a scheme. From each requirement, existing principles (from the furniture category (inside domain) and elsewhere (outside domain)) as well as general principles are found. Own sketches and ideas are also included. Some principles can quickly be ruled out whereas others have potential, but needs to be "tested" to its fullest in combination with principles for the other requirements to make a complete table.

Be aware that there are more requirements present in the updated program on page 42 but those are not requirements where it would make sense to explore different principle solutions (for instance "primary table must fit 4 persons").

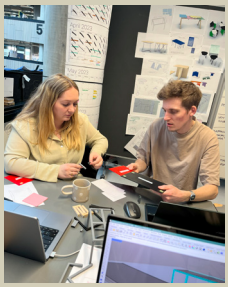
Requirements to be investigated

	A	B	C	D	
	Minimum 3 support points for primary plate + Fixed support for primary plate (must touch ground)	**Minimum 3 support points for secondary plates at extension**	**Fixed support for secondary plates at extension (must touch ground)**	**Secondary plates must be in level with primary plate in all extension options**	
1	 "Standard" support in 4 corners	Pull out support from the primary frame - in 2 directions	 Foldable legs ON the secondary plate	 Secondary plates comes UP in level	
2	 4 support points on the middle edge of the sides (like Frederik concept)	Support on the secondary plates	 Foldable legs on an extending frame/support	 Primary plate comes DOWN in level with secondary plates	
3	 4 support points outside primary plate	Half supported from primary frame, half supported from the support on secondary plate	 Fixed legs extending from the primary frame (like Esra)	 A combination - something comes UP and something comes DOWN	
4	 Support in the middle		 Separate legs stored underneath	 Dutch extension principle, a wedge	
5	 3 support points randomly positioned in a large triangle			 A "chunk", e.g. push-and-pop-up-button	
6	 3 support points positioned in the middle			 A "chunk", e.g. push-and-pop-up-button	
7	 3 support points in two corners and one middle			 Screwing extension legs	
8	 3 support points, two in one end and one in the other end			 Secondary support moves in a rail	
9				 Telescopic legs	
10				 Extension block positioned in the hole	

Time to find your magnifier!

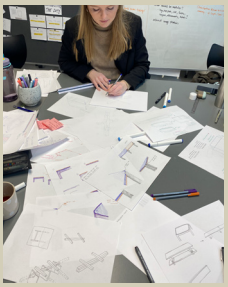
Methods

Shared problem solving with high use of various visual communication tools (see ill. 73-76), as well as desktop research and comparison to existing products (Pinterest, Youtube, furniture stores etc.).



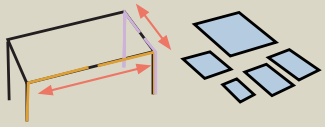
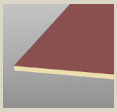
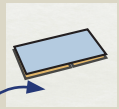
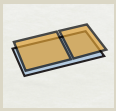
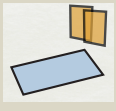
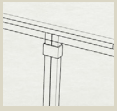
ill. 73 3D print

ill. 74 rapid prototyping



ill. 75 sketches

ill. 76 3D modeling

E	F	G	H	I
Extension to 6 pers. in length + Extension to 8 - 10 pers. in length	**Extension to 8 - 10 pers. in width**	**Primary plate and extension plates must be connected in length extension and width extension**	**Must offer a change in aesthetics**	**Secondary plates must be stored**
 The entire frame can extend (the legs will follow)		 Box closing fitting	 Reversible tabletops	 Stored crosswise under the primary plate
 The dutch extension (FDB table)		 Coupling fitting	 Buying smaller detail parts of the table, feets, edgebands, etc. (Montana ref.)	
 Extra plates are installed subsequently (holes for the extension is ready, FDB table)		 Rotating retainer	 Changing legs, square, rectangular, circular, plate, etc.	 Stored under the primary plate
 Foldable plate - like a board game		 Dowels and holes	**Huge wish to make this possible!**	 Stored over the primary plate
 Foldable plate in one dimension (Bolia table)		 A “max” of the extension, the plates are firmly fixed		 Stored elsewhere
 Rotational legs (like Sus)		 A connection that grabs in the leg/frame on the frames/legs that have to be fixated		 Stored vertically at the end of the table
				
 Extension sliders				
 Telescopic frame				
  Three legs in each corner 1 stationary 1 for each direction (like Esra)				

The headaches (p. 47) have evolved through the countless iterations on functional principles for a 2-dimension expandable table where different combinations from the morphological scheme are found and tested.

ill. 72 Morphological scheme

Can't we just...

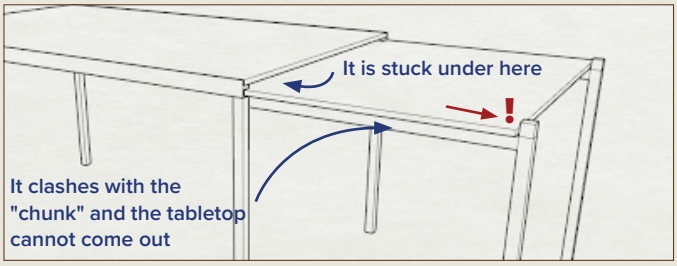
Countless times in the development process, the sentence “can’t we just... do this” is stated. It seems so simple to “just” extend in two dimensions, but reality is something different. It is an incredible puzzle to figure out how to solve different motions in a limited space available (due to comfort and available space for frame, legs and tabletops) whilst having opportunities of offering an acceptable interaction and aesthetic without looking like an institutional, ugly table.

The processes described on this page may be difficult to understand. Understanding the complexity almost requires sitting next to a 3D-model to get an overview of how different modules and components are positioned and move according to each other.

... pull out extra legs and then add a “chunk” to get it at level?

This idea connects the thought of “Esra” (p. 46), where the combination is A1, B2, C3, D1, D5, EF9, G5, and I2 (see morphological scheme).

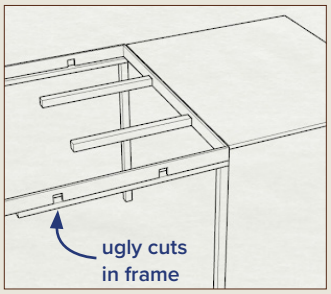
But, if the support of the extra plates extends from the primary frame and the plates are underneath, the user cannot pull out the frame, add a “chunk” and then pull out the secondary frame - the chunk will be in the way.



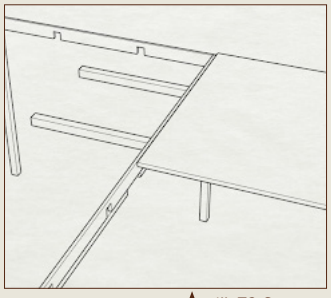
ill. 77 Table with chunk

... add the supporting structure to the secondary plates?

No, because of headache nr. 4: the interfaces between the primary and secondary plates are not the same in the two extensions. Due to this, the supporting structure of the secondary plates should come from the primary structure or it must be possible to somehow turn around a supporting (and connection) structure on the secondary plates. The “connection” to the primary frame is furthermore troublesome as it would need a “cut” in the long side of the primary frame.



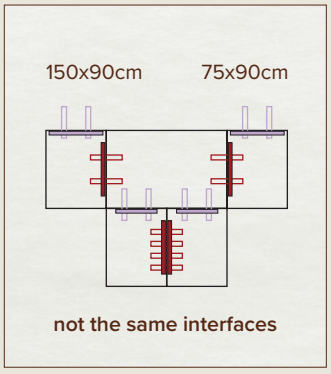
ill. 78 Cuts



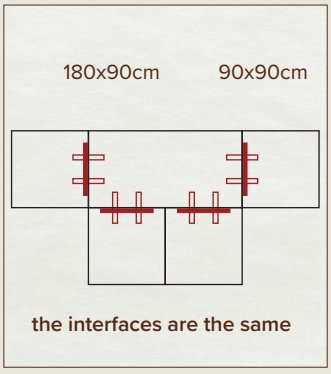
ill. 79 Support

... would it work if we change the dimensions?

If the dimensions are changed to a 1:2 ratio (being 180 x 90 cm in standard dimensions), the size of the secondary plates will be 90 x 90 cm. In this way it will be possible to use the same interface edge. However, the secondary plates will become even larger and the extension sizes of the table are off in terms of guidelines for dining table sizes. Additionally, there will be some of the same headaches in terms of fixed support for the secondary plates as well as the interaction motions with the large plates. Due to this, the tradeoff is put on hold in the hope for a breakthrough in the “original” dimensions.



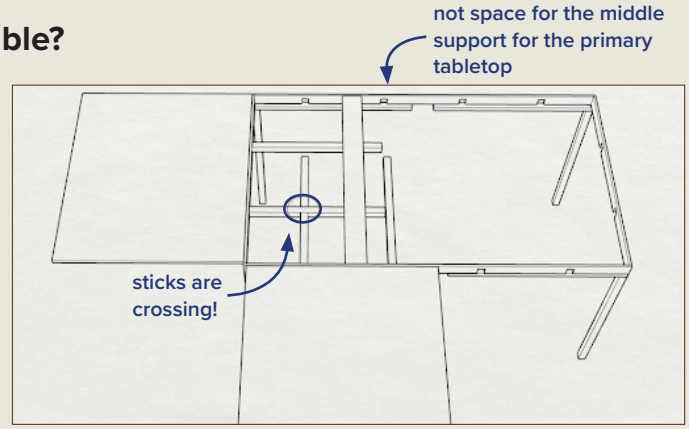
ill. 80 Interfaces original size



ill. 81 Interfaces new dimensions

... do like a dutch extension table?

The dutch extension principle is a very simple principle of extending a table AND fixing the storage and leveling of the table tops through the form of the fixed support on the extra leaf. However, it is reliant on a “middle piece plate” to support the primary plate which leads to smaller extra leafs. For this reason, it cannot be transferred to an extension in width as the “middle part” would be missing. Also the sticks from the extension plates will cross and when the table is unfolded the plates can’t be under the main tabletop and go out and be in level with it in both directions.

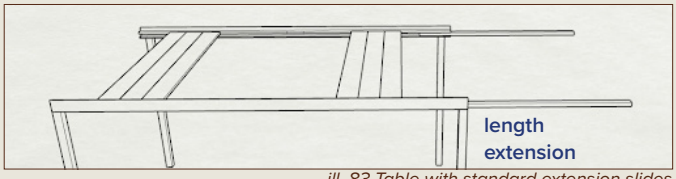


ill. 82 Dutch extension

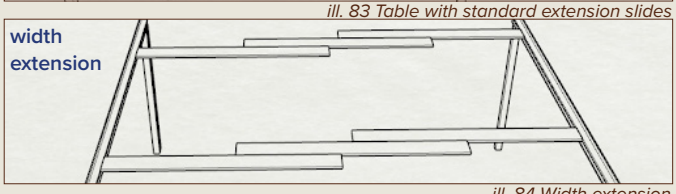
... use standard extension slides?

There is a reason that extension tables on the market only extend in one dimension. They are rigid in one direction and the mechanism takes up space. It would require two mechanisms, one for each dimension, which takes up space. I can potentially crash with the requirement of the maximum thickness of the tabletops. However, this direction is continued with.

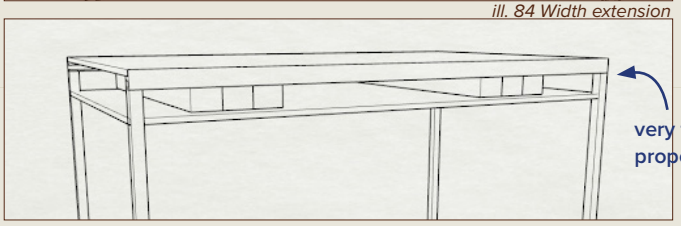
An investigation of the extension system necessary for this concept shows that the mechanism will have a square profile of at least 55 mm which makes the thickness too big when adding the tabletops and the construction to the equation. (HT-BENDIX, 2023)



ill. 83 Table with standard extension slides



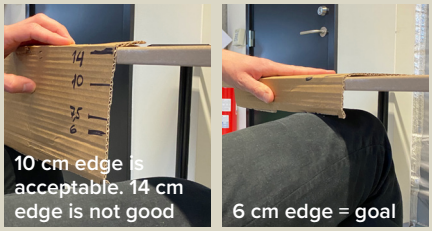
ill. 84 Width extension



ill. 85 Thickness of the table

Comfort - dimension update

The comfort of a dining table (air under the table) is a high priority, as this is a key selling point. Therefore, it is important to set an early requirement on how much space there should be for the consumer's legs. Different heights are tested which are based on tables on the market:



ill. 86 Testing thickness

64 cm air between floor and bottom surface of the table

The development of this table is the most frustrating ever experienced in terms of ideas that never came to fruition (due to the headaches) although there plenty of times where a feeling of being on the point of a breakthrough. How far to continue the development (and spend critical time) in a direction when there is obviously no “plug and play” solution and when it is constantly a balancing act between function and aesthetics? A lot of the ideas would probably work if it was upscaled and cut-outs in the frame were made here and there, but it would look like a mess. That is just as bad as if it did not work functionally and the idea could just as well be discarded. So, when do the steady nerves come to an end to realize that it is time to make a pivot because this is an impossible task? The final functional principle was found one month before hand-in, on the edge of being “too late”.

The small available field for development

The conclusion of the numerous tests of different principle configurations so far is that the solution field for a dining table that can extend in two dimensions is very narrow. It is definitely impossible to strike the "aim" area of the coordinate system.

As of now, there are two table tradeoffs that would work with the requirements:

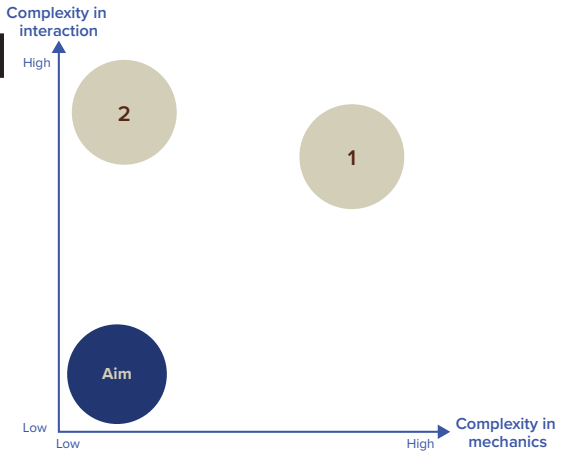
1. Extension slides and foldable legs (but with A LOT of tradeoffs) - in general, merging two principles to extend differently from length to width with the tradeoff of horrible interaction and comfort

2. 3 tables in one - storing two smaller tables under the primary table

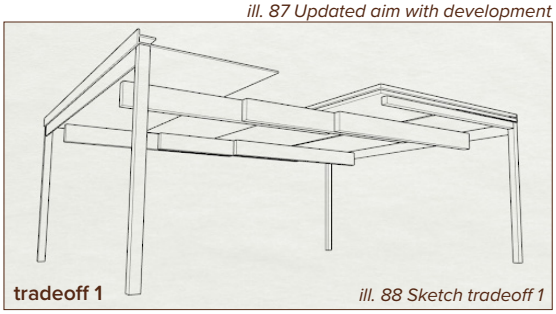
Tradeoff number 1 still requires that an "okay" solution to the length extension is developed and there are already huge concerns regarding interaction and comfort - as well as structural concerns when pulling apart the frame.

At this point in the process (6 weeks before hand-in) the team has hit the wall enough times to take a step back and realize to enter into a compromise - it is not possible to be able to finish the project in time with an all-in-one table. For this reason, tradeoff number 2 is determined as this idea is realizable. This puts the projekt far up in "interaction complexity" but it remains low in "mechanics interaction".

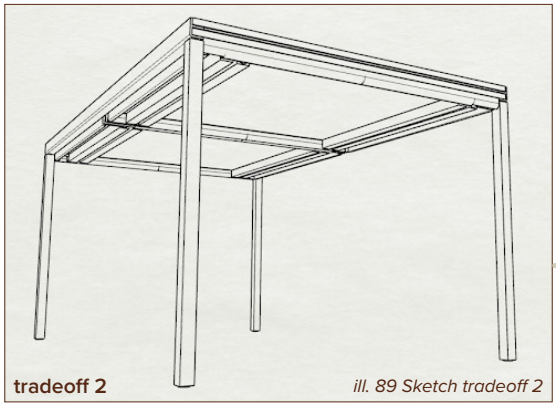
The aim was to achieve the ultimate table with all functions integrated with supreme interactions, but no table on the market has achieved this, so why is the aim placed in utopia? Looking in retrospect it should have been realized before to find the good compromise that could have been developed for a longer time.



ill. 87 Updated aim with development



tradeoff 1 *ill. 88 Sketch tradeoff 1*



tradeoff 2 *ill. 89 Sketch tradeoff 2*

Making a temporary stop : reflecting on the legacy of the project

Whilst working on the development of the table (the morphological scheme and the different combinations), the legacy of the project is temporarily put aside. There are no restraints for the concepts in terms of "an affordable price point" for people in the establishment phase of life other than the desire of designing a smaller table that can extend in size in two dimensions. The minute Montana became a part of the project, the price point and market shifted permanently to "high-end". Regarding the size, one could argue that it would be fair to change the "standard" size of the table to a 6 pers. table, but it would probably not ease the development. On the other hand it would cause the secondary plates to become even bigger which complicates the interactions. For that reason, the legacy still holds water.

Is it still a "modular dining table"?

As stated earlier, there are many takes on the definition of modularity. Montana was, apart from overlapping overall visions and values of future furniture design, contacted because of the modular thought - to transfer their modular storage units to the dining table category. However, when Montana pointed the project in a direction towards all-in-one (which we agreed on being the path to follow), we compromised on the initial thought of modularity and splitting the investment. When designing an all-in-one table, the complexity of both interactions and mechanics rises - which is mirrored in the graph above (ill. 87).

Yes, it is still a modular dining table - there are a lot of interaction surfaces between the "modules" of the primary table and the secondary tabletops. This modularity is the source of all the headaches.

Three tables in one : Theo

While in the process of developing a table that can extend in both directions, the following questions arise:

Can't we just... have three tables in one?

And for the first time, the answer is: **yes!**

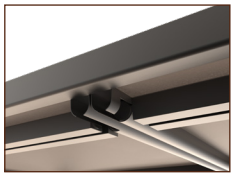
A frame just “outside” the primary tabletop is formed, which enables secondary tabletops to be stored underneath - and pulled out from the ends. With a continued desire to be able to flip the tabletop, the frame allows both the primary and secondary tabletops to be supported without being screwed in place.

ill. 90 Frame of Theo

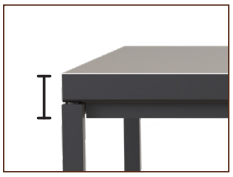
Fold-out legs are positioned on the secondary plates, which “solves” the headaches of:

Level: secondary legs are a bit longer than the primary

Support of primary plate: from the side



Support of secondary plates: fold-out legs ON the secondary plate



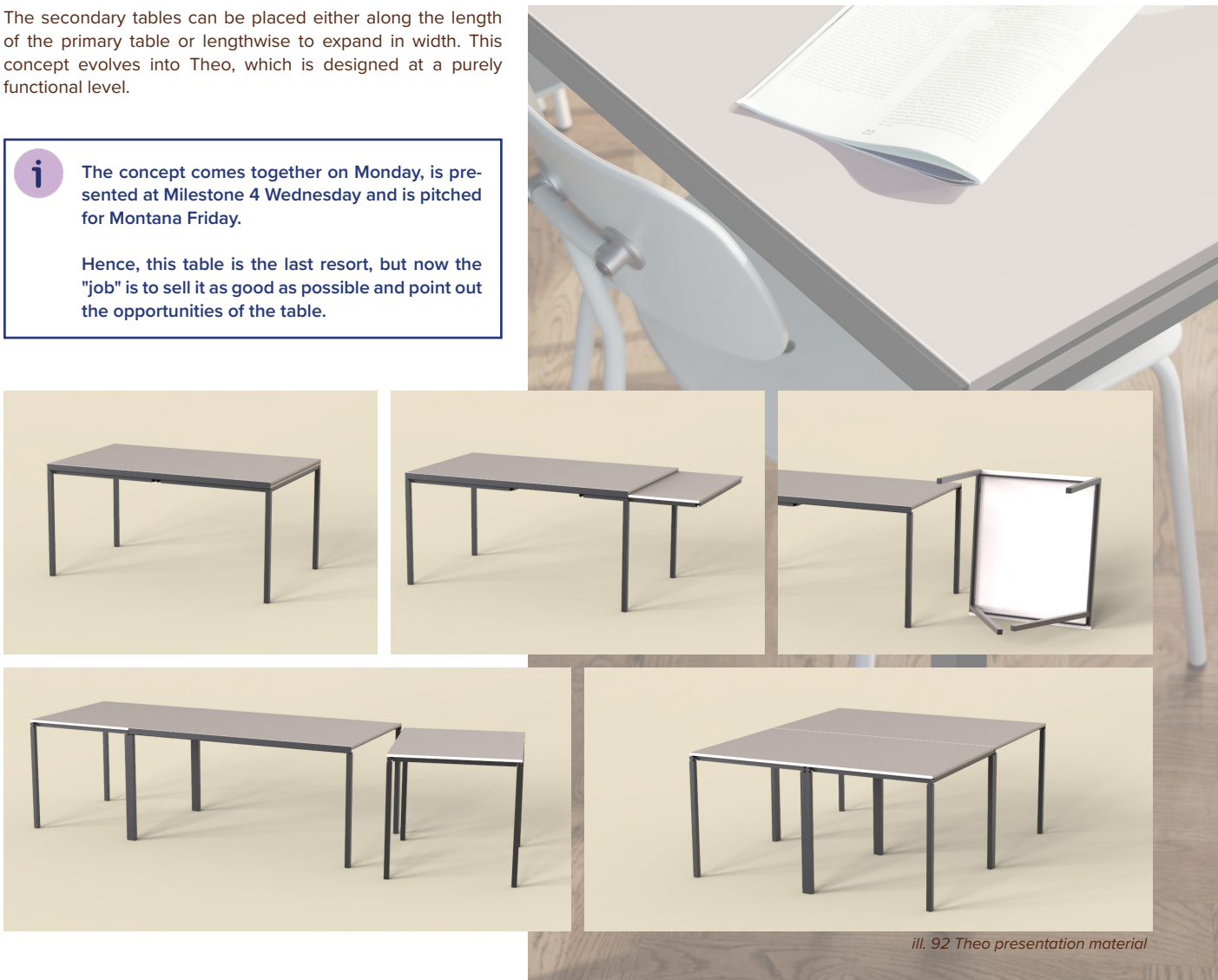
Comfort: the mechanics of expanding the table is manual

Joining tabletops + frame: not figured out yet

ill. 91 Theo solving headaches

The secondary tables can be placed either along the length of the primary table or lengthwise to expand in width. This concept evolves into Theo, which is designed at a purely functional level.

> **The concept comes together on Monday, is presented at Milestone 4 Wednesday and is pitched for Montana Friday.**
>
> **Hence, this table is the last resort, but now the "job" is to sell it as good as possible and point out the opportunities of the table.**



ill. 92 Theo presentation material

Business perspective : the modularity

The small tables can be utilized to scale the concept which brings benefits business wise. There are possibilities in designing a system: the small tables can be used as small desks, can work in the children's room, in the tiny studio apartment or in other situations.

ill. 93
small office desk

ill. 94
in the children's room

ill. 95
studio table

Furthermore, there is a potential for splitting the investment - the table can offer different purchase options.

ill. 96
all-in-one purchase

ill. 97
only primary table

ill. 98
purchase of secondary tables later

ill. 99
purchasing an extra primary tabletop

ill. 100
purchasing small tables

Theo is introduced first to Milestone 4 and then to Montana, knowing that Theo comes with new major headaches:

The function

How to transform from camping table functionality and into a "high end" expression and interaction - without scratching the furniture and the floor? How are the tables fixed when they are put together?

The expression

How to give Theo an identity? An understated, conservative and therefore long-lasting aesthetic that can withstand wear & tear? How to deal with the many legs when the tables are put together?

The construction

Details are everything. How about joints, stability, tolerances, joints and edges that wear out and how will it be after 10 years?

Are we cheating? : Feedback from Montana and milestone 4

> *I feel like you are cheating*
>
> Christian Tollestrup, main supervisor

The table Theo takes reference back to the very first concepts, e.g. Larry (p. 33), which is based on modular design. The thought and idea of a system design has always been there - but it feels like a shortcut compared to the direction the project was moving in before the development of Theo. Does it fit with the framing of making the table extend in both dimensions? Or are Theo based on actually just putting tables together?

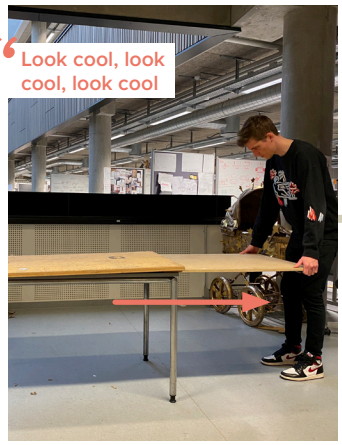
Montana agrees with the headaches Theo brings with him, but also highlights good elements and other things to consider (see app. 16 for all feedback):

- Finds it an exciting take on a table
- Sees an opportunity in producing different table sizes to offer in the system
- Wants the principle of being able to flip the table top to be a fixed element
- States that it can be expensive with 3 tables in one
- States that it can be heavy and suggests to consider lightweight materials

Theo's potential is seen from a business perspective. It is possible to expand into a fairly large collection. With Theo, Montana can enter the entire table category in the home and create uniformity in the home, as they already do in the storage category.

Further development of Theo: big headache with the interaction and association issue

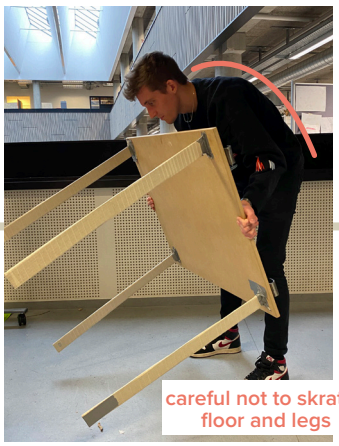
The interaction, when the consumer needs to expand either in length or width, is the biggest hurdle - it must be acted out to identify how to make it “less bad”. As Theo is designed now, the consumer will get the feeling of "looking stupid" by setting up this "camping table".



Pull out the secondary plate 75 cm before it is "released"

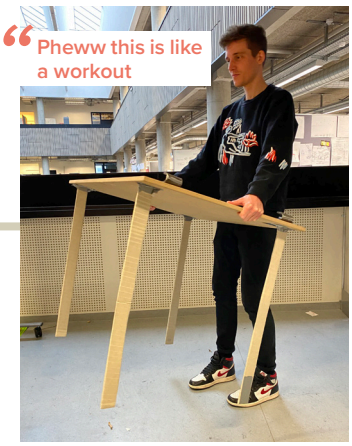
Put the table on the floor, fold out 4 legs while balancing the table

Get a nice grip on the table before lifting it from the floor



Get the table up on all the legs - careful not to skratch primary table

Carry the table over to the extensi-on position - length or width



Put down the table on the floor "nice and easy"

ill. 101 Interaction acting out with Theo

When testing interactions, the gut feeling hits harder: **this is not a nice table at all**. The first “dance move” with the table (pulling out the secondary table before it is “released”) is caused by the support of the primary frame and that it also supports the secondary tables. In pure frustration, the team questions the storage position of the secondary tabletops - that is to say, now 5 weeks until hand-in, the team is looking back at the morphological scheme at the eleventh hour.

Can we store the secondary plates ON the table but elsewhere?

One of the major headaches is that the secondary plates are exactly half the size of the primary plate and are stored under the table. This headache leads back to the question of whether these cannot be placed elsewhere, so the thought turns to storing the plates hanging down at the end of the table like a Finn Juhl Nyhavn table. What can then be done?

ill. 102 Finn Juhl Nyhavn

Design brief 3.0

A new take on a dining table for Montana

Introduction

This project looks into designing the dining table of tomorrow. A dining table to fit current needs as well as coming needs and eliminating the desire for replacing it within a few years. The focus is to prolong the use-time for the same user of a dining table.

Aim

To turn away from the throwaway society where new purchases are made when needs are shifting. Instead, consumers must feel confident in purchasing this table despite uncertain plans for the future as the risk of obsolescence of the table is lowered.

Problem statement

How to design a long lasting dining table that offers a change in both size, form and aesthetics to adapt to the consumer's changing needs over time?

Target group

Consumers in the establishment phase of life, prioritizing quality, durability and design. Identifies her-/himself through the home and does not buy on impulse but makes "smart" purchases.

Value proposition

Bring something new to the table and expand your experience with the first long lasting high-end dining table that transforms atmospheres by changing form and aesthetics.

Context

- Consumer retail market, private homes
- Market: Medium to high end furniture design stores
- Geography: Scandinavia

Functionality

- Must be able to extend in length and width - hence change size and form (Mapping of life p. 25 + Understanding the user p. 26)
- Must be able to change aesthetics that does not require additional purchase (Understanding the user p. 26)
- Must be transportable (Mapping of life p. 25)
- Basis must fit 2-4 people and expand from here (Mapping of life p. 25)
  - Extension to 6 pers. in length (2nd round of concept development p. 38)
  - Extension to 8 - 10 pers. in length, symmetrical from primary table (2nd round of concept dev. p. 38 + An expandable frame p. 46)
  - Extension to 8 - 10 pers. in width on the same side (2nd round of concept dev. p. 38 + An expandable frame p. 46)
- Must store 2 secondary plates at the table (Market research p. 28)
- Extension must be a one-man job (Market research p. 28)
- Secondary plates must be in level with primary plate in all extension options (Three takes on modular tables p. 38)
- Primary plate and extension plates must be connected in length and width extension (Three takes on modular tables p. 38)
- Minimum 3 support points for primary plate (Three takes on modular tables p. 38)
- Minimum 3 support points for secondary plates at extension (Three takes on modular tables p. 38)
- Fixed support for primary plate (must touch ground) (Three takes on modular tables p. 38)
- Fixed support for secondary plates at extension (must touch ground) (Three takes on modular tables p.38)
- Dimensions: primary table 150x90 cm, secondary table 75x90 cm (Dimensions s p. 45)
- Table height: 72-74 cm (Dimensions p. 45)
- 64 cm air between floor and bottom surface of the table (Can't we just p. 51)

Aesthetics

- Must blend in with existing Scandinavian interior design (The real world: context p. 19)
- Must fit Montana's universe (Who is Montana? p. 37)
- Must offer a reversible tabletop with different colors (Montana feedback p. 40)

A new table

04 functional detailing

The Pivot table

What should the dimensions be to enable the secondary plates to hang?

How do the secondary plates hang and extend?

We need a 1:1 interaction model and a test

How to enable to extend in width?

How to lock the secondary plates under the table?

How to support the secondary plates in extensions?

How to support the middle part of the table in width extension?

Summary of the phase

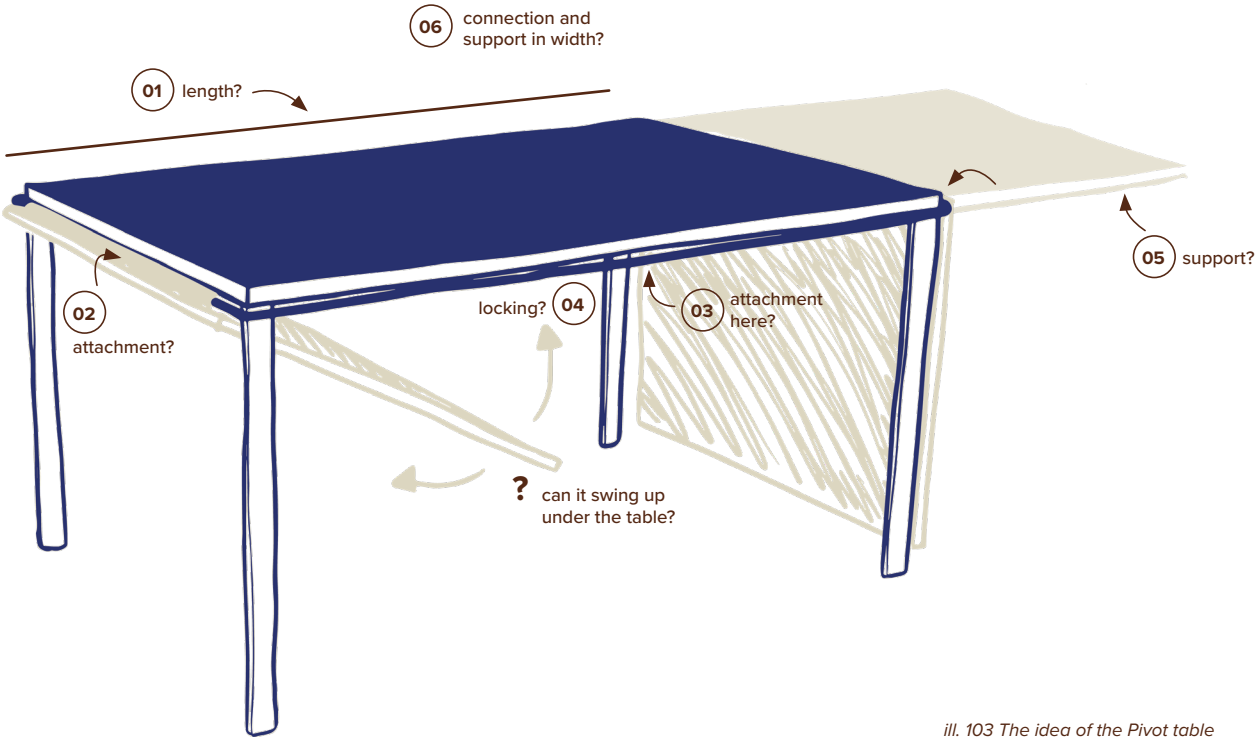
This phase introduces a new table in the eleventh hour that to a greater extent shows opportunities for being the liaison between the four abstraction levels and hence solving the design brief and value proposition satisfactorily. The phase works mostly at the principal level to understand the working principles of the table, secondly the material levels for detailing of the construction (Lerdahl, 2001).

The table's features must be adapted to the user's needs and desires to maintain a strong product-user fit (Haase & Laursen, 2023). The need for this kind of table is clear, which is why it is now important to design a table that the consumer buys into.

The development and detailing of the table is problem sliced - solving and detailing one aspect at a time, starting with the functional aspect, which is presented in this phase. With the aim to design a homogeneous product, all aspects are considered and balanced in parallel as they overlap and affect each other. Those will be elaborated in following phases.

The Pivot table

Due to the major headache of previous concepts regarding getting the extension function to work, this is (again) the first to develop. Having the secondary plates at the end opens new potentials, while at the same time leads to a lot of critical questions to be answered:



ill. 103 The idea of the Pivot table

Having the secondary plates hanging down the side is both a new opening where potential can be quickly seen, while at the same time it leads to a lot of critical questions to be answered:

extra tricky to figure out

01
What should the dimensions be to enable the secondary plates to hang?

02
How do the secondary plates hang and extend?

03
How to enable to extend in width?

04
How to lock the secondary plates under the table?

05
How to support the secondary plates in extension?

06
How to support the middle part of the table in width extension?

The development of the table is not done by answering the questions in a chronological order. Several elements of the table have been developed in parallel and with several iterations and loops over a period of time. To understand the development in its best possible way, the questions are answered and presented as a linear process although all aspects correlate.

"Solving" this table and its headaches within a few weeks is only possible due to the extensive iterations on previous concepts - a lot of insights and principles can be reused (but with a twist).

However, due to the late occurrence of this pivot, the development seems to be influenced by "damage control" as fixing the headaches is happening while detailing. At this point the focus is to prove the concept while at the same time stating clearly that a project like this needs extensive product maturing.

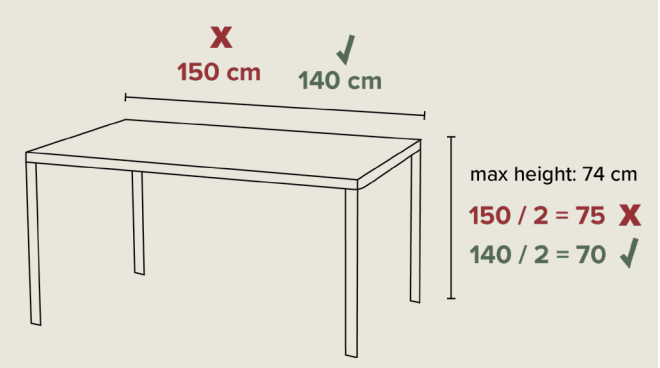
01 What should the dimensions be to enable the secondary plates to hang?

The length of the secondary plates must not be longer than the height of the table as it must hang from the end of the table. Consequently, the dimensions must be updated.

> When the length decreases and the width does not, the dimensions of the "square extension" become less square. However, 10 cm does not change available seatings around the table.

Update

Dimensions primary: 140 x 90 cm
Dimensions secondary: 70 x 90 cm

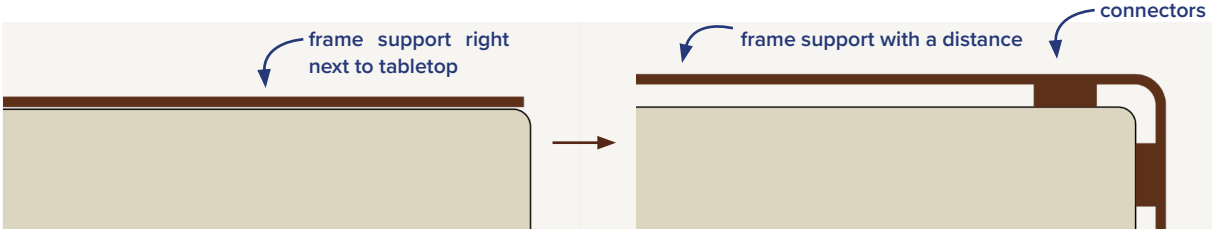


ill. 104 Dimension update

02 How do the secondary plates hang and extend?

The leading principle of the table

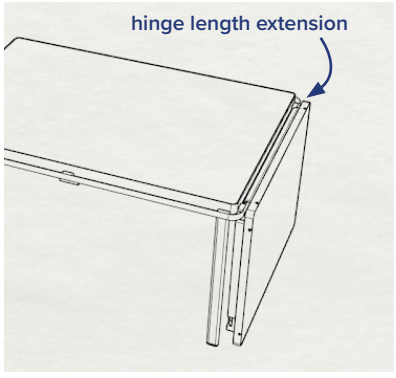
The principle of the concept is to move the frame support - this is possible due to the fact that the secondary plates are not stored directly under the table but are hanging on the side (see ill. 106).



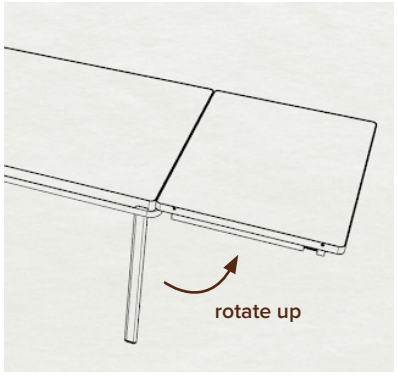
ill. 105 Moving the frame support

The plates hang at the end and swing up to extend, meaning they need to rotate around an object - hence the idea of having a rail as the “inner” of a rotational hinge. From a functional perspective, the rail is a cylinder and is led around the entire table. In order for the rail to be fixed to the frame, small connectors are placed in each corner and at the sides of the table.

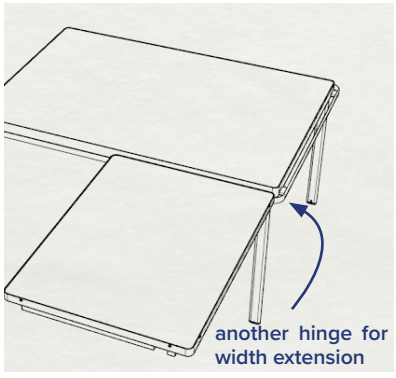
The secondary plates can either be folded up as an extension of the table in length - or the user can lift and move the secondary plates to the long side of the table and thus extend in width - with the use of another hinge (see iill. 108).



ill. 106 Secondary plate hanging



ill. 107 Secondary plate in length extension

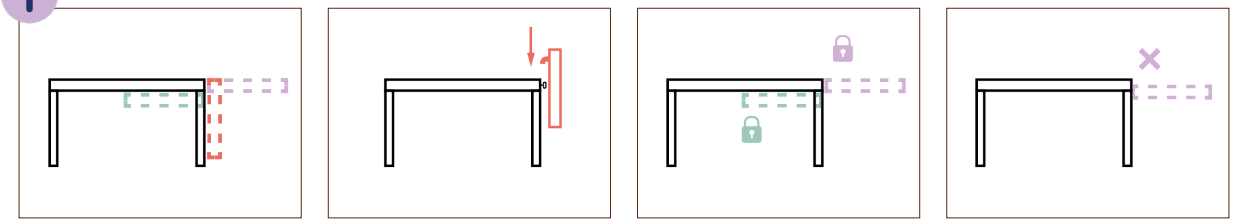


ill. 108 Secondary plate in width extension

How to enable the plates to swing up under the table?

Designing a rotational hinge opens an opportunity to make a 180° motion to enable the secondary plates to swing up under the primary plate from the end of the table. This puts demands on the hinge for the extension in the length, which has the following requirements to enable the rotation:

Requirements for the hinge for length extension



Must be able to rotate the secondary plates 180 degrees

Must allow the user to place the plates in a vertical position at the end of the table

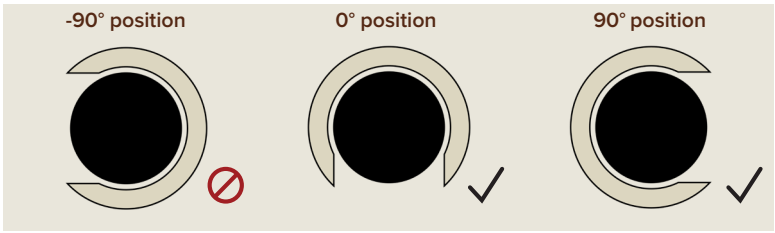
Must ensure that the plates are locked at 0° and 180° and cannot be pushed out

Must ensure that the plates are at the same level as the primary plate in extensions

ill. 109 Requirements hinge 1

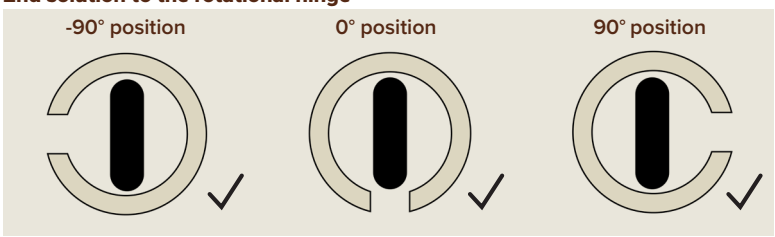
To ensure that the hinge cannot be pushed off the rail in the position under the table, the opening must be as small as possible but also large enough to ensure that the interaction to put the plate on the rail does not become cumbersome and an annoying interaction for the consumer. This requires another iteration on the rail in conjunction with the hinge.

1st solution to the rotational hinge



ill. 110 Rotational hinge 1

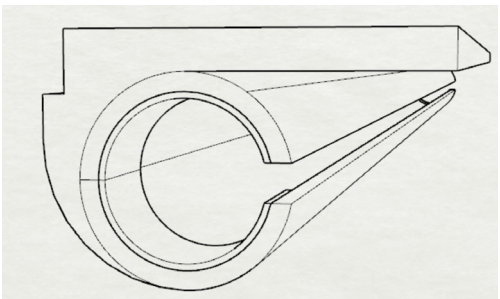
2nd solution to the rotational hinge



ill. 111 Rotational hinge 2

A 3D model of the design of the hook is printed and tested. It is quickly apparent that regardless of the material of the rail and hook, these will rub tightly against each other every time the plates rotate for extension. The feeling of rotating the plate must not be loose, hence must the tolerances between rail and hook be small. To avoid wear and scratches on the rail, this requires a nylon bushing to be inserted in the hook.

ill. 112 3d printed rotation hinge

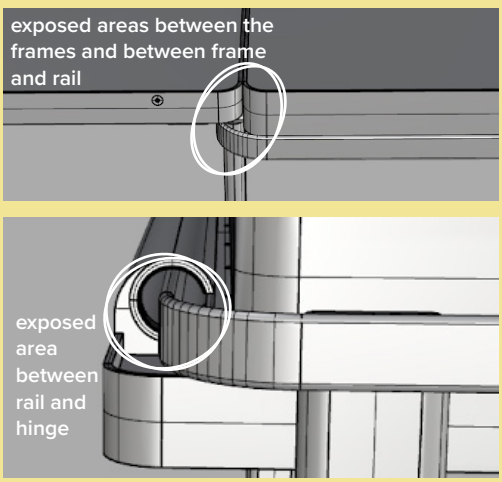


ill. 113 Final rotation hinge

Durability input

Scratches on the frame : the complexity of low tolerances and no wear

There are two categories of wear and tear of the table: one relates to scratches on the tabletop from everyday use and if the vacuum cleaner is smashed into the frame; marks that the user is accountable for. The other category relates to scratches on the table that originate from repeated movements of the table; marks that the table is accountable for. The second category is more critical as it is not expected that the functions of a high-end table cause wear. At the same time, the motions of the rotation of the secondary plates must be snug. The surfaces and materials on the exposed areas between the rail and hinges are critical. Therefore, it would for instance make sense to anodize rather than lacquer the frame.



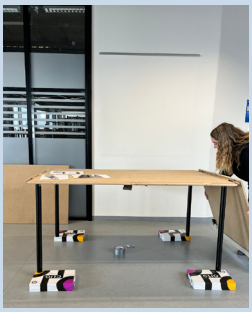
ill. 114 Exposed areas for skratches

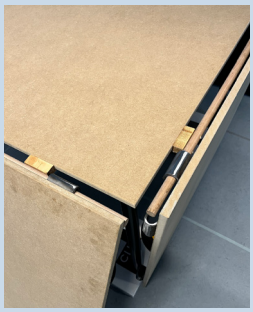
We must stop for a moment : we need a 1 : 1 interaction model and a test

A 1:1 model is needed to test the "dance" with the table with the objective of understanding the interaction weaknesses of Pivot. This page highlights insights - see app. 17 for a full description and analysis of the tests.

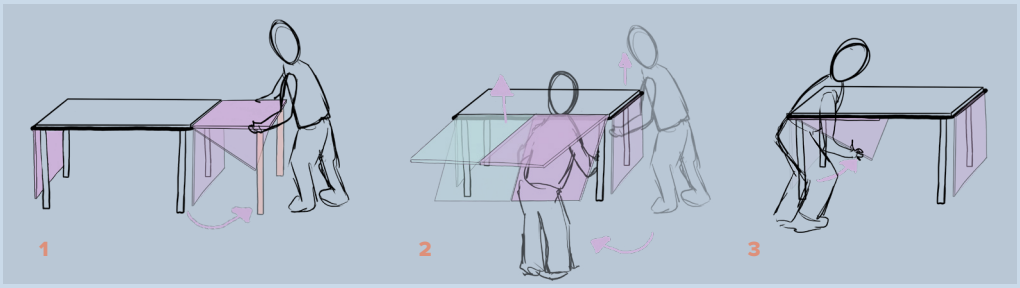
The aim with the tests is to identify the extension procedure and its interaction areas:

1. The interactions when extending in length
2. The interactions when extending in width
3. The interactions, when flipping the secondary plates up under the table





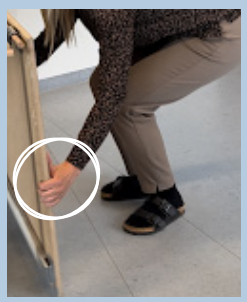
Overall scenario



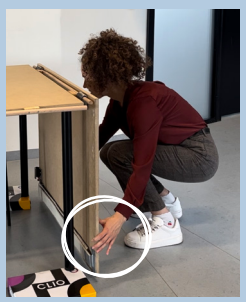
ill. 115 Test setup

1 Extend in length

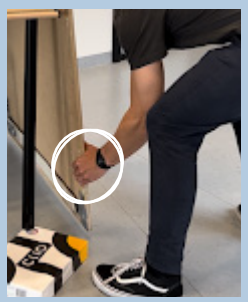
Swinging up the plate



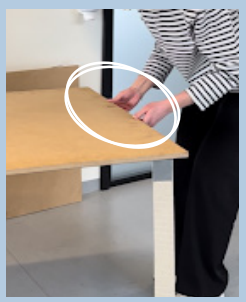
Grabs in the middle



Grabs very low



Only uses 1 hand

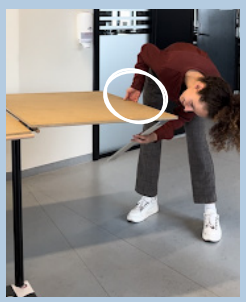


All hands end here

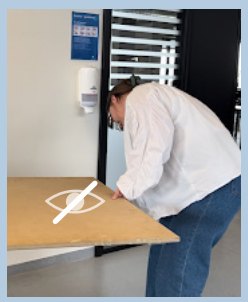
> **!** Test persons grab differently around the edges (according to their strengths). They all grab in the middle of the end when the motion is completed.

Folding down the legs

Ouch knees and back



One hand supporting the plate in the middle



Tries to use only tactile senses

Must look to figure out how to release legs

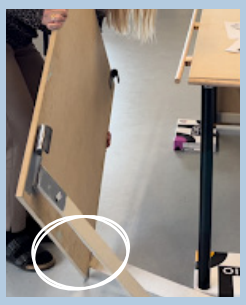
> **!** It would be good if the tactile senses could be supported when folding down the legs

ill. 116 Test, extension in length

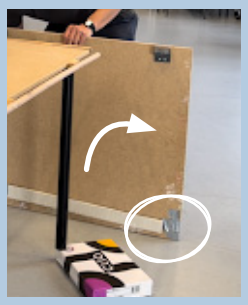
2 Extend in width

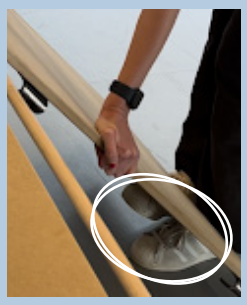
Turning the plate from length extension to width extension

Leans on the side edge



Uses the corner to "roll" - very important!





Uses feets for protection

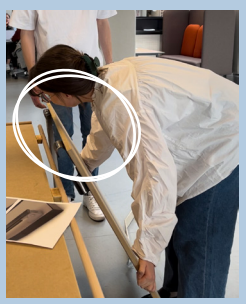
!

The corner of the plate is exposed!

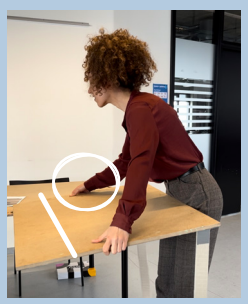
Test persons use their feet for a protection layer between table and floor.

Attaching the plate to the rail

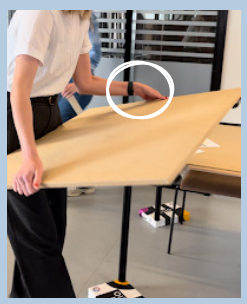
Attaches it at an angle



Difficult to see interface between rail and hinge



Attaches it horizontally - be aware of fingers!



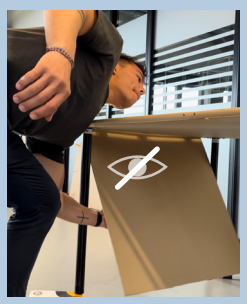
!

Different approaches for attachment: either holding plate horizontal or at an angle.

Difficult to see the hinge and the rail in the performance

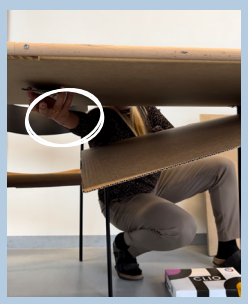
ill. 117 Test, extension in width

3 Locking the plates under the table

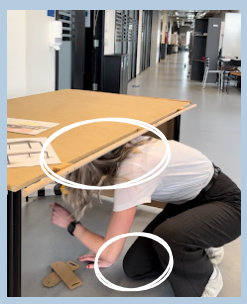


Performing blind - uses his tactile senses

Must bend down to see locking mechanism



Weird position of wrist



Unsafe position under the table

!

Uncomfortable (wrists, back and knees) and unsafe position to lock secondary plates at the center

Locking from both sides of the table

ill. 118 Test, storing and locking plates

+

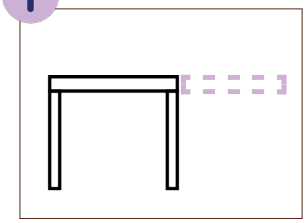
1: Guide under the secondary tabletops for the positioning of the fingers in extension
1: The foldable legs must be locked to each other and the inner leg must be locked to the tabletop
1: The foldable legs must be released blindly
1: The foldable legs must be placed further in to leave room for the fingers
2: Rounded tabletop corners
2: The secondary plate must be able to be attached with an horizontal angle (and at an angle)
3: Locking position must be positioned at the edge of the table
3: Locking must be possible from both sides

In general: the interaction is a learning process. The test persons already had an easier approach to the extension at the opposite end of the table after they had just performed the action once.

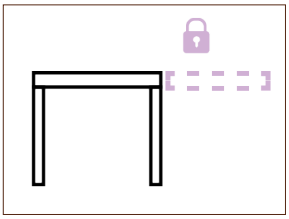
03 How to enable to extend in width?

From the insights from the interaction test, there are requirements to the hinge for the width extension to function as intended:

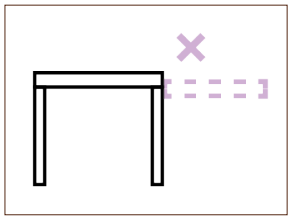
Requirements for the hinge for width extension



Must be able to rotate the secondary plates to a position at 90 degrees



Must ensure that the plates are locked at 90 degree and cannot be pushed out



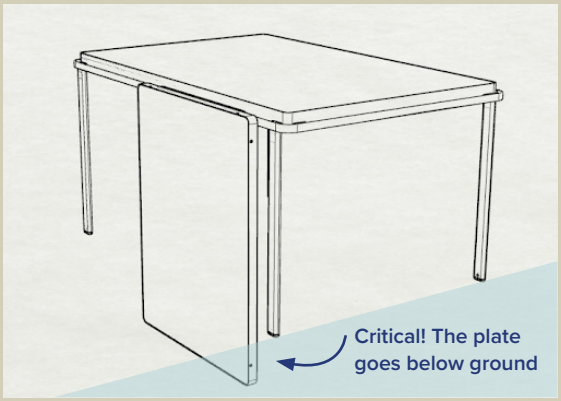
Must ensure that the plates are at the same level as the primary plate when they are folded up

ill. 119 Requirements hinge

Different principles are developed through iterations of 3D-modeling with insights along the way.

...Can't we just use the same rotation hinge as for the length extension?

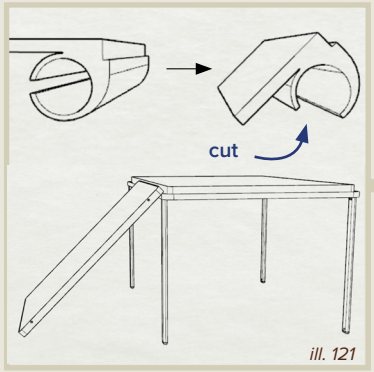
No. From the functional model it became clear that the secondary tabletop "of course" cannot hang down freely on the long rail, as the width of the top is 90 cm and the height of the table is 74 cm. This means that the rotation hinge for length extension cannot be used for this extension and a new one has to be developed.



ill. 120 Dimensions of secondary plate

... Can't we just make it square?

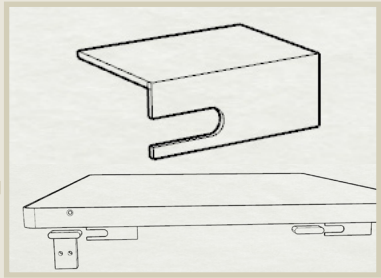
If the secondary plates must be able to hang both at the end and on the long side, the length must not exceed 65-70 cm. This would mean that the primary table would have a maximum dimension of 140 x 70, which is not an acceptable width for a dining table.



ill. 121

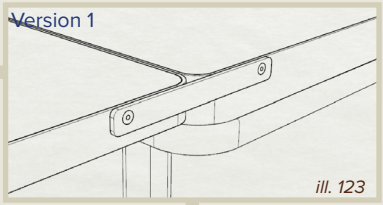
Rotational hinge from length extension - the opening is made larger

Does not allow inclined position and a horizontal position (requirement) + the hinge bumps into the primary frame when stored under the table

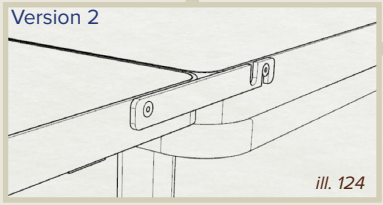


Design of angle brackets with a locking hole. This will require the plate to be put on first and then slide it to the side for the hole to meet the leg connectors.

Not aesthetically pleasing when the plate is extended in length. Here it is realized that the hinge becomes visible → The design must be visually acceptable



ill. 123



ill. 124

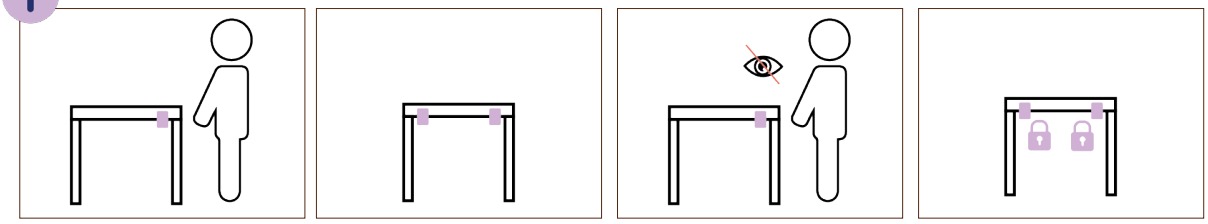
The idea of clamping the frame of the secondary plate to the primary frame.

The principle goes against the already integrated function principles in the table

04 How to lock the secondary plates under the table?

Once the secondary plates are folded up under the table, they must be held in this position. For the interaction test, a simple locking mechanism is tested, where only one plate needs to be swung out to hold the secondary plates up. These are placed in the center under the table to support the plates in the best possible way. However, these do not have an acceptable interaction, and a new solution must be developed.

Requirements for the locking mechanism



Must be accessible in a standing position

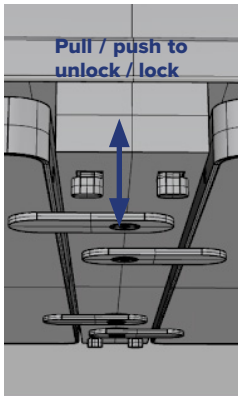
Must be accessible from both sides of the table

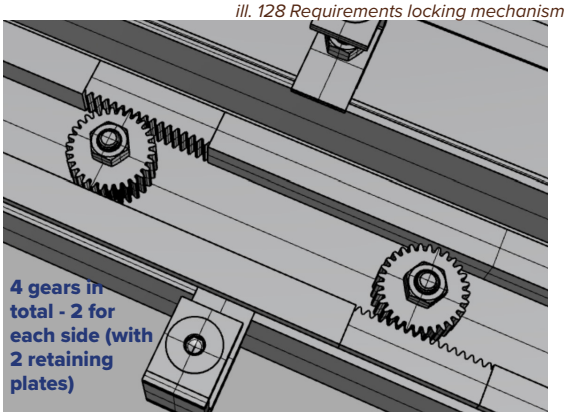
Must be performed blind

Must allow each plate to be locked separate

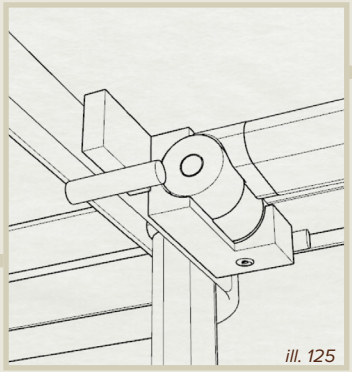
ill. 128 Requirements locking mechanism

The locking mechanism is designed so that the user's fingers can reach a small 'trigger' that can be moved back and forth. This trigger is composed of a rack that grips two gears (see app. 18 for calculations on gears). This mechanism rotates the two gears, which rotate two plates out from under the tabletop. Two triggers will be placed on either side, symbolizing that the right trigger reacts to the plates turning to the right, and the opposite with the left trigger. In addition, the triggers will be placed on opposite sides of the table, so that the user can perform the action from both sides - but with opposite trigger movement.



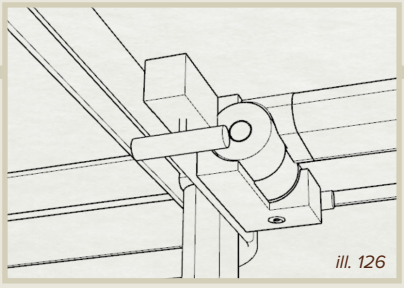


ill. 129 Locking mechanism



ill. 125

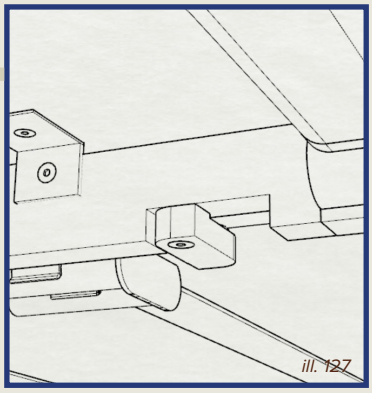
The idea of rotating a part of the bracket 90 degrees after fixing the secondary plate to the rail.



ill. 126

When the rotation part is rotated 90°, it must grip the rail. Therefore, a spring is added to enable a movement that can bring the rotation part down, rotate it and release it again, where it then grips the rail.

The spring allows the secondary tabletop to flex the extra distance that the rotation part has to move. This is not acceptable as the table needs rigidity.



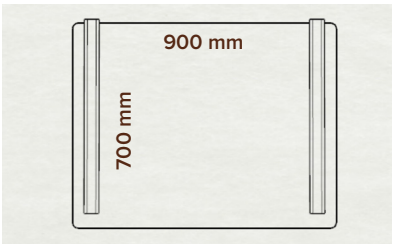
ill. 127

From a deflection test (p. 90), it is seen that when applying weight to the joint of the two secondary tabletops, the outer corners lift, which is why this locking mechanism is placed as far out as possible. This also allows the user to reach and operate it blindly without having to crawl under the table.

05 How to support the secondary plates in extensions?

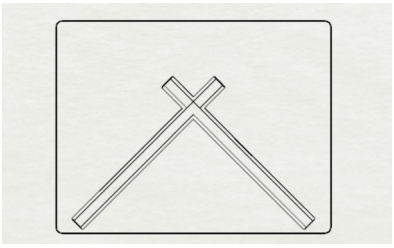
The size (and weight) of the secondary plates requires fixed support in terms of foldable legs. The back of the secondary plates will be visible when hanging at the end in the standard position; therefore, aesthetics must be taken into consideration (additionally considering that it must look high-end).

Different principles for fixing legs to a plate are investigated. Due to the fact that this action must be done blindly, there is a need for as few interactions as possible.



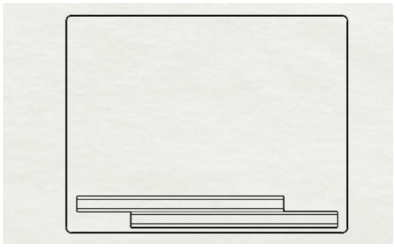
ill. 130 Leg 1

The legs cannot lie along the length of the plate, as the length of the plate is less than the length of the legs (unless the legs are either telescopic rods, or that there is an extension piece at the end of the legs, which must extend a long distance (about 5 cm), which is not preferable). The user should be able to easily extend the legs as they carry the plate's weight during the interaction.



ill. 131 Leg 2

Can the legs be crossed? This requires offhand cut-outs in the legs where they intercross which will be noticeable when folded out as well as create a weak spot durability wise. Additionally, the interaction may be difficult as the user must grab the leg exactly at the hinge.

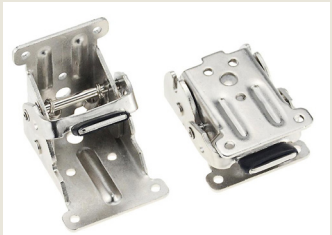


ill. 132 Leg 3

Positioning the legs along the width of the plate requires a staggered position or to be placed on top of each other. For aesthetic reasons, it is desired to design them to lay on top of each other.

The leg folding mechanism

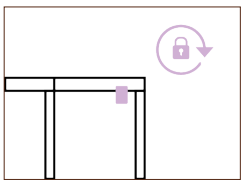
The hinge is an important element of the table as it will be visible. Therefore these cannot be ugly standard components - these are designed based on function and not with an aesthetic approach. The standard components can be used for reference.



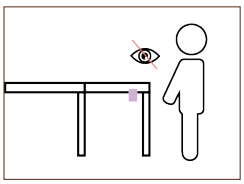
ill. 133 Selflocking leg folding hinge

This hinge is one of the more expensive parts of the table. Under the development, function was the main focus: to have the legs locked in the right position and to be able to figure it out without looking. This took all the time and energy located for this part. This leaves production methods and materials behind. Further development would focus on making all 4 hinges the same and cheaper materials, as steel sheets combined with cheaper and more accessible production methods than CNC-milling (laser cutting and edge pressing).

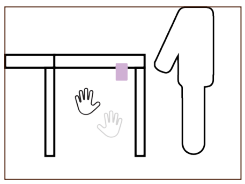
Requirements for the legs and hinge



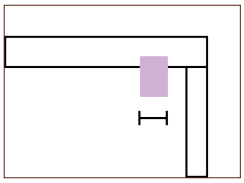
Must be self-locking at 90° (folded out)



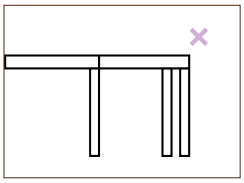
Must ensure that the user can perform the task without looking



Interactions must be possible one-handed (also holding tabletop)



Hinge must not exceed 50 mm when folded

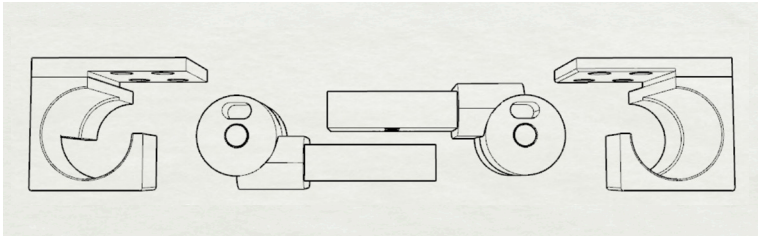


Must allow the legs to be aligned with each other when folded out

ill. 134 Requirements legs and hinge

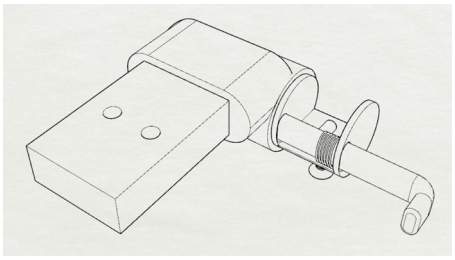
A slim folding leg hinge

The hinges are shaped differently depending on their placement under the secondary tabletop due to functional reasons derived from the requirements above. Two different hinges are needed for one secondary plate and to allow the legs to be aligned they must lay on top of each other when folded up. For that reason the hinges are formed as illustrated on ill. 135.

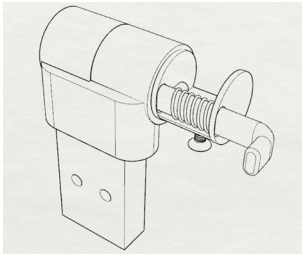


ill. 135 Leg hinge parts

The hole for the lock is placed towards the top of the circular part so when turning the leg 90 degrees the spring loaded trigger will automatically pop into the hole and thereby lock the leg in its position. This means that the user can fold out the leg without more interactions.



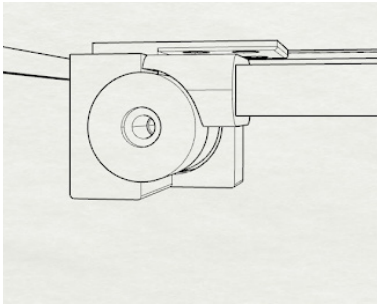
ill. 136 Split is pulled out and the leg is unlocked



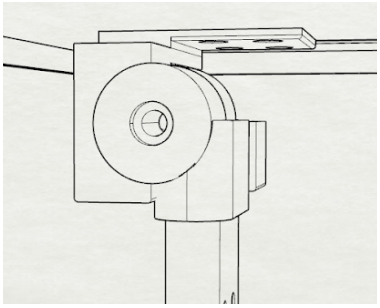
ill. 137 The split locks the leg

The leg shaped part of the hinges is used to assist the 90 degree movement space and increases the stability of the leg when folded down together with the spring lock.

The lowest leg connector that is folded down first (ill. 135, second part on the left) have to be on the outer side when extending in the width and the trigger have to be on the end, none of the hinges can be the same, which means four different hinges are needed for are complete table with 2 secondary plates. With further development it will possibly be an opportunity to improve the hinges and end up with only 2 different hinges.



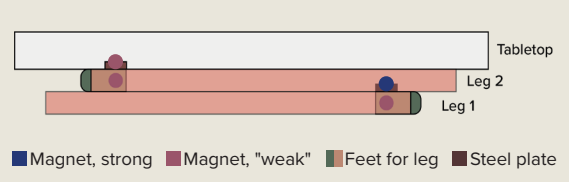
ill. 138 Motion of the leg hinge, locked with magnet



ill. 139 Motion of leg, folded out and locked with spring

Locking legs with magnets

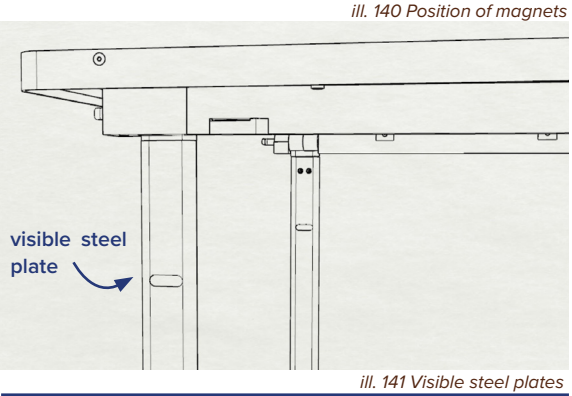
The foldable leg hinge secures locking when folded out - not in collapsed mode. Therefore, a possibility is seen in integrating magnets that will keep the legs locked under the tabletop, which at the same time will make it easy for the user to simply pull them down. The legs are produced in aluminum, which is not magnetic, thus a small steel plate is integrated into the legs.



ill. 140 Position of magnets

In the folded state, the magnet of the upper leg should act on a steel plate mounted on the underside of the table top. The magnet on the lower leg should then act on the upper leg's integrated steel plate (see ill. 140). In this way, the legs will lock together.

The magnet placed in leg 2 must be strong in order to stay positioned when leg 1 is pulled down. The magnet used for leg 2 is a neodymium, N42, Ø20 mm, height 10 mm and holds approx. 11 kg (SuperMagnete, n.d.).



ill. 141 Visible steel plates

As the magnet is positioned inside the leg, there will be a distance of 2 mm between the magnet and the surface it has to grab onto. This reduces the bearing capacity from 11 kg to about 4 kg.

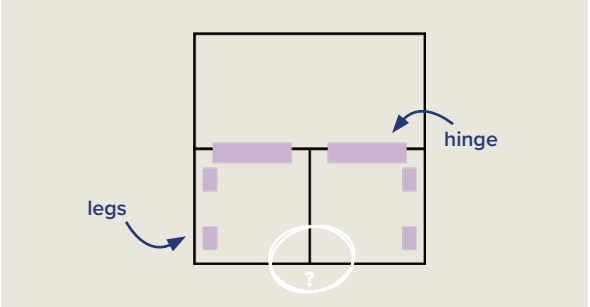
The magnet used for leg 1 is a neodymium, N42, Ø20 mm, height 5 mm and holds approx. 6,4 kg (SuperMagnete, n.d.). The bearing capacity for this leg will be reduced to around 1,75 kg. With a leg weight of approximately 700 g the strength of these two magnets is estimated to be fine.

This would need further testing for verifying the easiness of releasing the legs for the user!

How to support the middle part of the table in width extension?

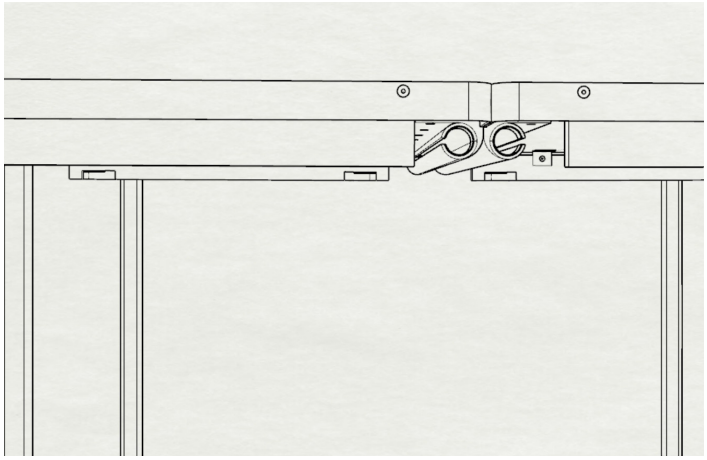
When the secondary plates are positioned to extend in the width, their support will be as shown on ill. 142.

As the width of the additional panels is only 90 cm, and the height of the frame also contributes to stability (cf. strength in the square extension version p. 90), it is assessed that there is no need for a table leg when joining the panels. However, it is an important element that the tabletops remain together, which is why there is a need for a solution that can hold the tabletops close to each other.

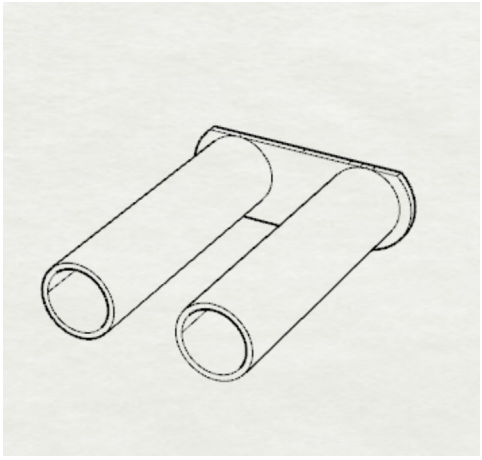


ill. 142 Support in width

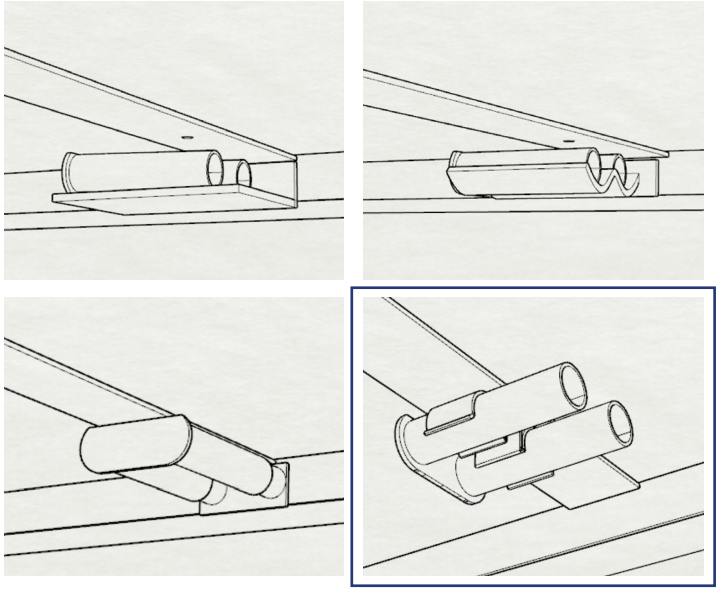
At the joint, the two rotation hinges are seen on each secondary plate. These can be used for fixation, which is why a corresponding part of the rotation hinges is designed and can be inserted here. This part will be visible when in use, which is why its end is designed with the continuous shape of a rounded square.



ill. 143 Rotation hinges next to eachother



ill. 144 Fixator



ill. 145 Solution principles

This part will be the only loose part on the table, which is a compromise being made at this stage. The vision is that this element will be part of the product maturation to avoid loose parts on the table. The part is placed in a corner (based on the interaction test) where it has to be restrained. Several different solutions are considered.

Based on interaction and fixing, two annular cylinder snap joints are placed in the corner on the side where the secondary plates are not attached.

+ **Loose parts must be stored at the table to reduce the risk of them disappearing**

chosen

Use of the table

05 interaction detailing

Refinement of interaction

Interaction experience reference

Scenarios

The variants of the table : size and form

Summary of the phase

This phase works briefly on the spiritual, contextual and principal levels in the value pyramid (Lerdahl, 2001) as it focuses on refining the interaction, finding references for the interaction and lastly visualizing scenarios to communicate the interconnections between the abstract visions though more and more concrete aspects of interaction and features in storytelling. In order to maintain Montana's credibility, this phase focuses on details to design around Montana's purpose of creating value for money. This is done to strengthen product-market fit (Haase & Laursen, 2023), reflecting their image as a high-end company and putting them in a competitive position.

Refinement of interaction

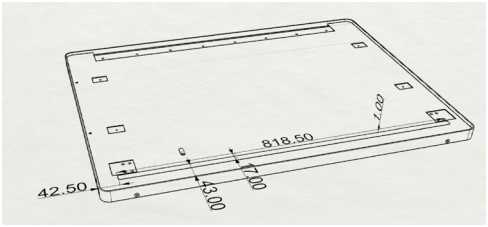
The interaction test (app. 17) highlighted possibilities for optimization with regard to interaction - among others regarding grips on the plate, the use of the corner and sides of the plate, as well as people's bodies to turn the plate for expansion to square. These areas can be optimized to increase the feedforward of the table.

Interface to guide the handling

The fingerprints from the test persons enables the team to measure where and how far into the plate people grasp. When the table has to be extended in length, most people first grab the plate by the side and then switch to holding the plate at the end. This means that there should be a guide on the underside of the secondary plates.

It is tested what kind of guide is found appropriate: a dent which is milled to the plate or an elevation on the plate.

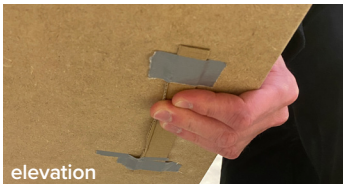
The dent feels most delicate and most guiding, as the fingers feel two edges instead of one as with the elevation, furthermore the dent gives a feeling of wanting to continue the groove out. Based on the interaction test in regard to different grips and the position of the legs, it is tested where to place the dent and how big it should be and leads to the following measurements:



ill. 149 Measures of dent

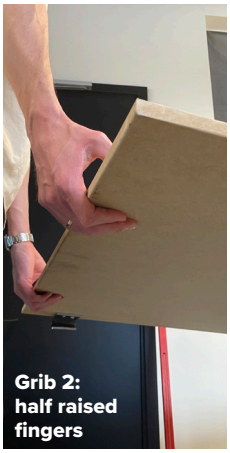
> The aim was to mill a guide on the sides as well for a full guidance, but further development of the table showed that there is not room available for the guides on the sides (due to the rotation locks (hinges in extension width, p. 64).

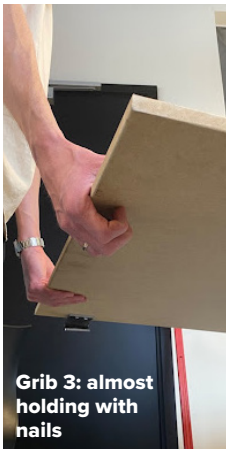
ill. 146 FDB table



ill. 147 Elevation experiment

reference: FDB table with Dutch extension

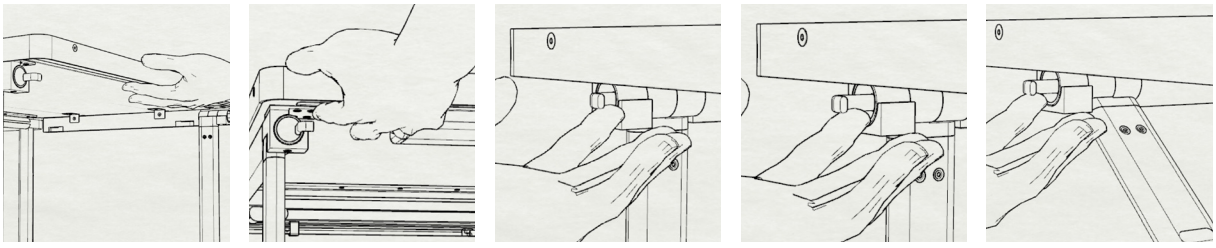




ill. 148 Grib test

Secondary use of the guidance : to guide the way to the unlocking of the legs

The dent guides the user's fingers to the locking mechanism of the fold-out legs. As the fingers slide along the groove, they will automatically be guided behind the trigger which will therefore directly be ready to pull when needing to fold the foldable legs up under the table. The trigger is 8 mm wide.



ill. 150 Guidance with dent

> The tradeoff of positioning the foldable legs over each other is the risk of folding them wrongly up under the table. However, the integration of the magnets as a “snapping mechanism” will only permit the “correct” leg to snap to the table. Hence, the user cannot finish the entire “fold up” of the legs with the wrong leg. This could definitely be a source of frustration (like an USB-A), but the aesthetic alignment of the legs was prioritized higher.

Feedforward to rotate the plate in width extension : rounded corners

To help the user understand that the secondary tabletop must be rotated 90 degrees before it can be used to extend in width, and to protect both the corner and the floor, it is desired to round off the corners.

not the desired look


ill. 151


ill. 152


ill. 153


ill. 154

On the inspiration trip (cf. “searching for inspiration in stores”), it became clear that for aesthetic reasons, the rounding must not be too large, as it is not desired to obtain an elliptical expression. From the meeting with a retailer perspective with Brdr. Sørensen (app. 03), further inspiration is drawn for different radius of corners. To be able to see the different roundings in the meeting between the primary plate and the secondary plates, plates with different radiuses on the corners are 3D printed. The corners with a radius of 18 mm are preferred.

chosen


ill. 155 Testing radius with paper


Radius of 8 mm


Radius of 12 mm


Radius of 18 mm

ill. 156 3d printed corners

To get an understanding of the radius of the corners, several are tested in 3D as well. This helps understand the overall asthetics of the table by seeing the meeting between the plates.

chosen


Radius of 18 mm


Radius of 50 mm


Radius of 100 mm


Radius of 350 mm and 20 mm

ill. 157 Testing corners

Interaction experience reference

The feeling achieved when interacting with the table is a crucial element for the experience and impression of the whole table. As it is not possible to test the feeling of the interaction on the final proposed solution with the right materials and proportions within hand in, a reference point is found for what is desired to be achieved with the interaction.

> *"The actual use and function must also be super delicious and delicate. It should not rattle, or disk or dangle. It should almost be a bit like B&O's old headphones that really run tight in rotation.*
>
> Nis Kjærgaard, Montana

It can be divided into two references: the aim for the movement of the product and the aim for the feeling the user gets when using the product.

Aim for the movement of the product

As a consumer you do not think about the feeling of opening an oven door - the consumer is not afraid to open it, and not afraid if it is hot or heavy. The consumer simply does not think about the task of opening it - and that feeling of not having to think about the task, is the one desired to achieve when interacting with the table.

ill. 158 Oven interaction reference

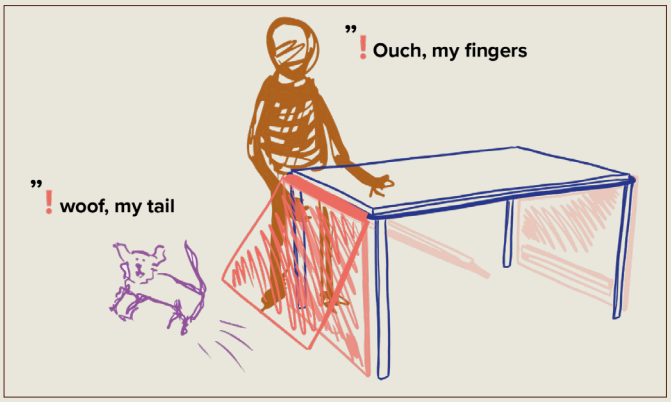
Aim for the feeling of the product

The aim is to reach that feeling of satisfaction when things either fall perfectly into place or fit together exactly. Transferred to Pivot, the plates must swing easily past the legs and up into position - still with a little, yet smooth resistance. That the foldable legs can be easily released with the magnets and then locked with a click - motions that give a small tactile feedback. Pivot should give a feeling of comfort and satisfaction as the lamp rotates exactly into place.

ill. 159 Lamp interaction reference

Safety issues...

In order to achieve these aims, it must be ensured that the secondary plates cannot swing at full speed when the consumer unlocks the retaining plates under the table. This means that with Pivot there are some safety issues, which should be of high priority for further development. A solution principle could be integrating some sort of "soft closer" when the secondary plates must swing down and out. This development process is a part of the product maturation phase in the business plan before launching the product on the market. In addition, to which extent the fingers can be trapped.



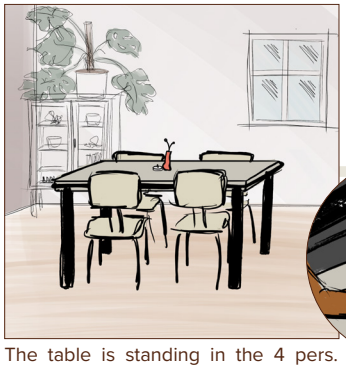
ill. 160 Safety issues

This safety issue is one of the big critical points with the table. Under the development an idea of an integrated damper came up, but no solution was found in time. As the construction is now, it is potentially very dangerous, due the the weight of the secondary plate and the free swing movement, if fingers, arms, legs, or dogs are caught between the secondary plate and the primary leg on its way down. This is a crucial problem that threatens the whole concept, and must be addressed before entering the market.

Scenarios

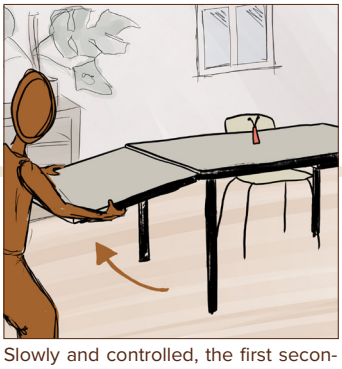
With the different interactions and features, the dance around the table is illustrated in two scenarios: one for extension in length and one for extension in width.

Extension in length

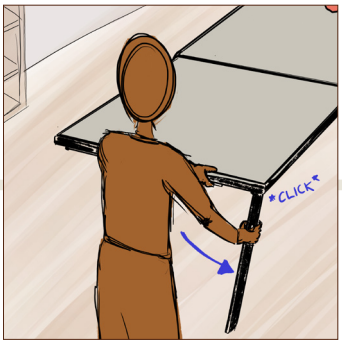


The table is standing in the 4 pers. version in the everyday life.

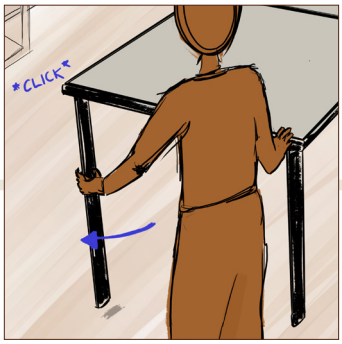
Guests are coming over later, so the table must extend contemporarily. She releases the secondary plate



Slowly and controlled, the first secondary plate is swung up.



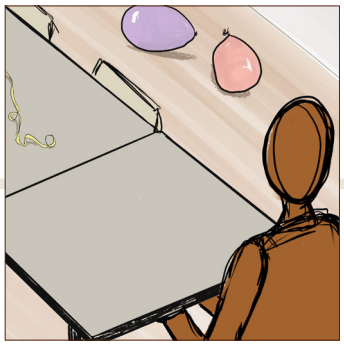
The first leg is pulled down to release from the magnet. In locks in 90°



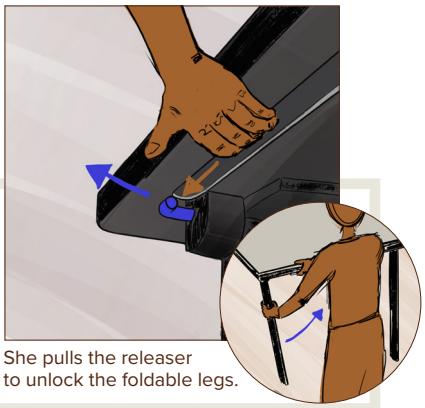
Thereafter, the second leg is pulled down - it was also just secured with a magnet.

The same procedure is done for the second secondary plate.

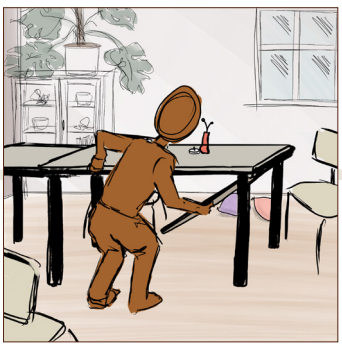
It is time for a birthday party for the family! They will be a total of 9 people.



The party was a success, and now she wants to go back to the original size. She feels her way for the releaser.



She pulls the releaser to unlock the foldable legs.



The secondary tabletop is swung back under the primary table.

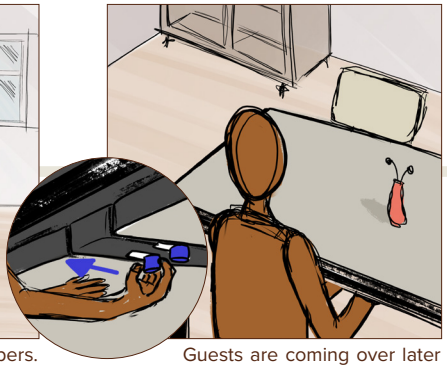
The table locks with retaining plates by pushing the tricker.

The table has transformed to the original version again.

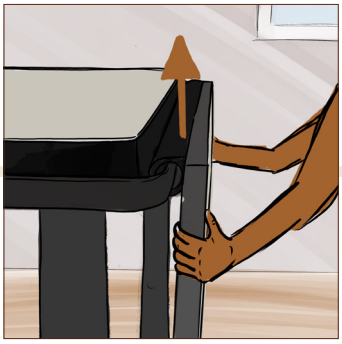
ill. 161 Scenario, extend in length

Extension in width

The table is standing in the 4 pers. version in the everyday life.

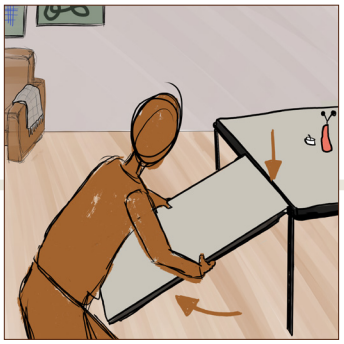


Guests are coming over later for a game of poker, and it would be perfect with a social, square table.

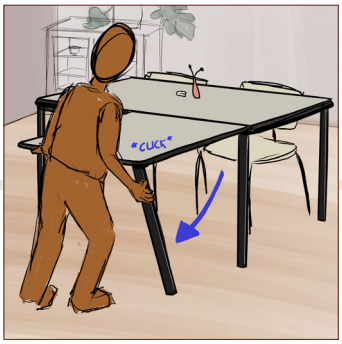


The first secondary plate is taken of the rail in vertical position.

The secondary table is carefully turnes 90° so the right hinge is at top.

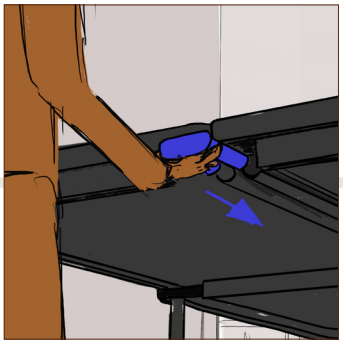


Thereafter, the secondary plate is put on the rail on the long side of the table.



The plate is swung up and the lower foldable leg is released. This is enough.

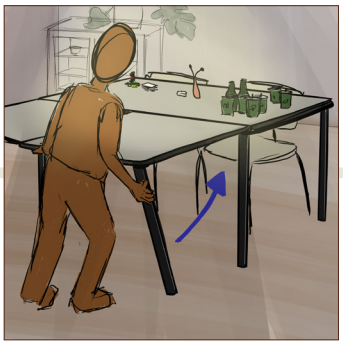
The same procedure is conducted with the second secondary plate.



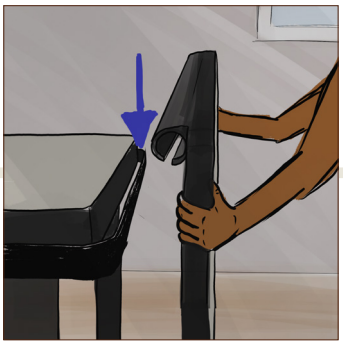
A square fixater is put in under the table for stability and stiffness.

The table is ready for a cozy, social poker evening with the guys.

Beer is spilled, but a wet cloth will do the trick. It is possible to access the edge of the table between the rail.



What an evening. The foldable leg is put back under the table and the secondary plate is taken off the rail.



The secondary plate is put back on the short side of the table from where it now can be swung under the table.

ill. 162 Scenario, extend in width

The variants of the table : size and form

As a supplement for the drawn scenarios, the following renders are used for communication and pitching for Montana before the final detailing. With those pictures, the consumer can hopefully decode the possibilities and simplicity of the dining table rather fast.

4 pers. table

the everyday life version

8-10 pers. table

the practical and space optimized version

8-10 pers. versions can both be temporary and permanent - it depends on size of family and home

8-10 pers. table

the social, exclusive "round" version

ill. 163 Variants of the table

The look of the table

06 aesthetic detailing

How to reach a timeless, conservative design to target the consumer market?

Design of the primary legs

How does it fit with the context?

The tabletops : the weapon against aesthetic obsolescence

The collection

Summary of the phase

This phase focuses on the appearance of the table and hence makes references back to the market research. The phase works on the contextual and material levels (Lerdahl, 2001) to detail the aesthetics to express the intentions of the table - a functional dining table for the private consumer market. With a focus on strengthening the product-company fit (Haase & Laursen, 2023), the look of the table is seeked to be unique yet fit with the world of Montana, including how to offer a variety of opportunities for the consumer to choose between.

How to reach a timeless, conservative design to target the consumer market?

Throughout the process, the different concept tables have received several comments about B2B aesthetics due as the look of the tables are characterized by its features. With the objective of understanding which elements point in that direction, current tables on the contract market are analyzed. It is supplemented with insights from a dialogue with Montana (see app. 16).

Why does it easily look like a table for the contract market?

A B2B aesthetic depends on the context being referred to - meeting rooms, canteen tables, institutional tables, desks, etc. which have a wide variety of expressions and aesthetics depending on the category. However, general features that characterize tables for the contract market have been identified, the same goes for B2C tables:

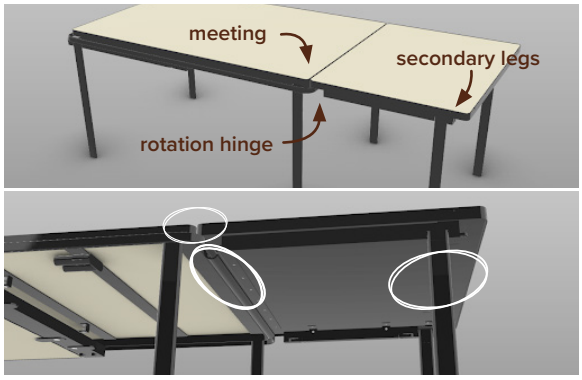
Tables are aesthetically evaluated with chairs the majority of the time. It is the correlation between the table, the chairs and the surroundings that brings the "vibe" of either private or contract market.

Contract market	Retail market
Function-driven design	Aesthetically-driven design
Robust and dimensioned with large proportions	Legs pulled in under the tabletop
Lack of details only for aesthetic reasons	Slightly inclined legs
Use of basic geometric shapes - cylinders and rectangles	Delicate, minimalistic proportions
Visible functions	Integrated functions
Must offer easy storage in the form of folding/ stacking	Use of natural (wooden) materials
Must be transportable - fit on trolleys, have wheels	Neutral, timeless colors (white, gray, black, wood)

When the different traits are lined up, it becomes clear why Pivot has aesthetic contract market tendencies.

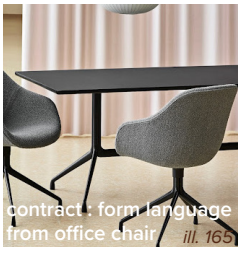
The identity of the table

Pivot's aesthetic will be functional and will differentiate itself to some extent from B2C tables. A function-driven appearance will need acceptance. The options within this is to play with honest design vs integrated design: to simplify the overall shell of the table and integrate what can be integrated. The honest design appears with the rail that runs around the table which helps to give Pivot an identity and a unique character.



ill. 164 Honest design

In addition, shapes have been used to soften the hard and austere look, which can be seen in the rounded corners, see ill. 173 for the style inspiration. An important element is now to work with the proportions of the legs to make a coherency to the rest of the table. The legs play an important aesthetic role in making the table come together and must not express hardness and robustness, nor be too fragile not to fit the thickness of when the extra plates are folded up under the table.


contract : form language from office chair *ill. 165*


ill. 166


contract : huge dimensions *ill. 167*


ill. 168


contract : robust, honest in functions *ill. 169*


product reference *ill. 170*


dining table, simple *ill. 171*


dining table *ill. 172*


product reference *ill. 173*

Integrate the functions
Simplify the look, make clean surfaces
Soften the appearance with rounded finishes on edges and corners
Consider neutral colors

Design of the primary legs

The primary legs must be attachable and thus not be a fixed part of the frame, as the aim is to flat-pack the different parts from manufacturer (in Europe) to Denmark and then assemble them at Montana's factory. Furthermore, the attaching element is an advantage in regard to reparability and allows the user to repair or replace the legs if damaged, thus not discarding the entire table. Additionally, it will ease the transport of the table when the user moves.

When the secondary plates are locked under the table, the table has a thickness of 8.9 cm. The proportions of the legs must match the other elements of the table.


inspiration and reference - the Djob table, Montana

ill. 174 Djob table

Proportions

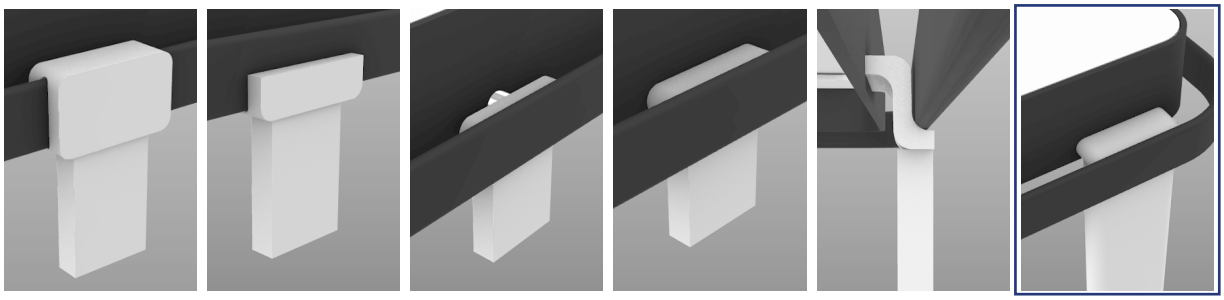
The design of the legs takes inspiration from Montanas's table Djob. The dimensions of each leg is 10 x 40 mm. These give the Djob table a light expression, which is also desired for Pivot in order not to lean towards a table for the contract market. Different proportions are tested in regard to aesthetic coherence:

chosen

ill. 175 Leg proportions

The thickness of the legs are difficult to change as they depend on the thickness of the foldable legs - those must be thin due to the locking under the primary table. The legs must be similar to create a coherent aesthetic in the extension variants.

The primary legs will have a dimension of 20 x 50 mm which creates both visual tranquility and coherence between the different elements of Pivot. The principle from the Djob table of assembling the legs and frame seems to work properly and hides the screws on the back of the legs, thus this principle is implemented on the primary legs for this table. Different designs of the meeting is shaped:



ill. 176 Meetings between leg and rail

chosen

The connector between the rail and the frame is utilized for the legs. For coherence between elements of the table, it is desired to utilize the connectors that are already placed as links between rail and frame. This means that four of the connectors will be designed differently with a tap that is inserted into the leg and screwed on. The table consists of 4 leg connectors.

How does it fit with the context?

In continuation of the previous topic of timeless design (p. 79), the context of the table must be further elaborated. The table must fit different homes and different chairs - and shifting trends in a time perspective. Today and in 20 years. At least. Hence must the aesthetics of the table either be timeless and/or able to adapt to different styles, also with an eye towards commercialisation.

The context is put in a two-dimension perspective : the vertical dimension (different homes) and the horizontal dimension (shifting aesthetics over time). The future cannot be predicted, hence this is a draft of what might change in style.

> *A table like yours can fit with any chair. An upholstered chair, a metal chair, a classic chair, a new chair. It matches many things.*
>
> Steffan, Brdr. Sørensen

Style

Colorful, playful

New style, **boheme**

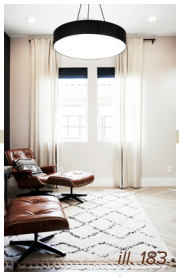
New style, **soft colors, organic forms**

Warm, neutral, nature

Same style over the years

Time

Dark, cold, stone and metal



Updated style, **designer furniture**

Updated style, **dark but warm with natural materials**

Minimalistic, soft, stone

updated style, **white, gray and black**

The table is too “unique” and functional to immediately get the label of a “classic” table

As stated in the trend analysis (p. 28), enabling a change of materials and colors really affects how the table appears in the context

According to colors on the tabletop and the chairs put together with it, the consumer can play with the “blending in” or “standing out” in the remaining home interior - additionally to renew smaller decorations instead of the large furnitures

Materials for life

ill. 187

The young couple

Linoleum
The elegant, warm and matte surface makes the perfect fit for the everyday life

ill. 188

ill. 189

The family with small children

Laminate
A tabletop with almost no maintanence - easy to wipe over with a wet cloth

The tabletops : the weapon against aesthetic obsolescence

Montana
a reversible tabletop

> *Please let this be a permanent design detail for the table*
>
> Josephine Ring, Montana

A reversible tabletop has been a high priority throughout the development. There are several advantages to this:

Aesthetic renewal : Change color as a temporary or permanent change speaks to reducing the risk of aesthetic obsolescence. The tabletop is the largest, most visible surface of the table - often, the frame is covered by chairs.

Settings : Turning the tabletop can potentially symbolize a new way of being together around the table, e.g. when events are held.

Reparability : The tabletop can easily be replaced without having to discard the whole table if wear and tear has made its impact.

The brand of Montana : Allowing the consumer to be playful and creative with the tabletops fits perfectly with the visions of Montana and the value of providing options - to let the consumer in charge of their own table.

> *There are 42 colors, and even though they might end up choosing the white, they want to have the option of being able to choose a brown or a beige or a green or something*
>
> Steffan, Brdr. Sørensen

However, the reversible tabletop comes with tradeoffs:

Dimensioning : It is not possible to make cut-outs on the underside of the table which pressures the available space for the remaining structure (when secondary tabletop with foldable legs are locked under the table).

Stability : When the tabletop is reversible. it does not have an underside for attachment to the frame, which potentially affects the stability of the table, thus this needs to be taken into account elsewhere.

An "edge" around the tabletops : When the tabletop is not supported directly under, this will require support by other means, which is why it is necessary to have some kind of edge to hold the tabletop in place. This affects the appearance of the table.

Montana strongly encourages making this work as it would be a unique selling point. This is highly prioritized and it also turns out to be possible (see "The tabletops" p. x in the following phase).

ill. 190

ill. 191

The classic lover

Veneer
A tabletop that patinates with beauty and brings character to the room with the mix of wood and metal

CMF on the frame

As the frame has to offer different colors, consideration is given to whether it should be surface treated with an anodization or a paint finish. Anodizing increases the hardness of the aluminum surface, making it more resistant to scratches and wear. This is a particularly important point as the frame is subject to mechanical wear and contact, which is the decisive factor in choosing anodized aluminum. (AAC, n.d.)

ill. 192 Anodized aluminum

Color, materials and finish (CMF)

Montana already has a selection for different tabletops, so this advantage is used to offer the consumer a choice of these for this specific table as well. For production reasons, the material of the two surfaces of the tabletop must be the same.

The selection of materials can also speak to different stages of life. The family with young children may opt out a wooden tabletop for practical reasons and potentially go for a laminated tabletop, which is more maintenance-friendly. This means that the table can follow the consumer through life by simply changing the tabletop instead of the whole table.

As the table is designed to Montana, it has to be adapted to their universe. The fact that the customer can freely select two arbitrary colors from a large selection would not be the approach if this was meant to be a startup. If we started our own company, we would offer a few pre-selected (neutral) color combinations. This way we would reduce costs and complexity during production and assembly.

> *(...) when we launch something, we launch it with many colors on the frame and on the tabletop, because we then believe that the product will be launched with a wide range.*
>
> Josephine Ring, Montana

Linoleum (Forbo Desktop)

iron	powder	mauve	pistachio	ash	orange blast
mushroom	burgundy	powder	conifer	pebble	walnut

Laminate

snow	nordic	anthracite	blue pastel	shadow	cumin

Veneer

oak	douglas white

● = new colors added - based on trend research, earth tones from Forbo's catalog is added in the selection for this table.

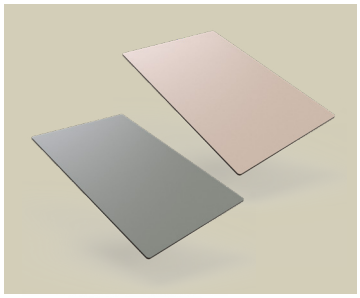
The collection

From a business perspective, Pivot fulfills the desire to be able to split the investment and allows the consumer to buy into the product. The advantage of being able to buy a little of the table at a time is that the table can be offered in different price ranges. The table without the secondary plates can reach out for the consumers who are going to invest in their first table, while they may live small, and then later buy the secondary plates to be able to expand the table. This also helps to create value in the form of product attachment, giving the consumer the opportunity to associate themselves with the table and bring it along in life.

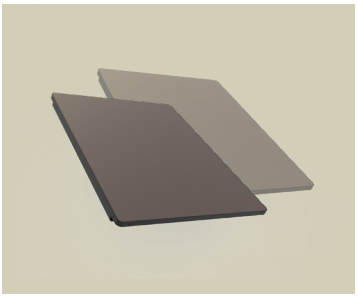
The collection can be structured as follows:

all-in-one purchase

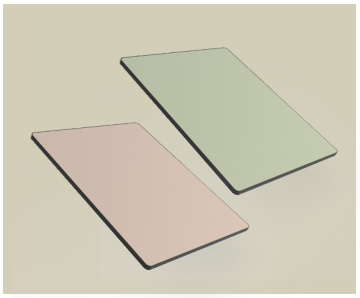
purchase primary table



purchase new primary tabletop (color/material)



purchase secondary plates (+ center locking)



purchase new secondary tabletops (color/material)

ill. 193 The collection

This table is remarkably less "split the investment" - friendly than the old table Theo for instance. The intent and value of the table is acquired with the all-in-one purchase, which, as stated, goes against the initial economic modularity advantage.

Additionally, the scaling opportunities are very limited as the dimensions of the table is dictated by the function of the rotating secondary plates. This is a huge tradeoff considering that Montana's current tables are scaled to numerous variants to increase the chance to hit the specific needs of the consumer. However, this table is more straight-forward: it offers everything in one, and the retailers only need one table to display.

In order to estimate the best possible price for the different options, it is necessary to examine what current high-end extension tables cost and what value they offer (p. 98).

Supply in the long run

The biggest barrier with modularity

ill. 194 10 year guarantee

When a company offers modularity, customized furniture and interchangeability in a long perspective, they also have a responsibility to be able to offer the same option years down the line, which depends on being able to get new supplies. Montana already offers a variety of colors and materials and has a 10-year warranty - so partnering with Montana for Pivot is tactical on that basis.

If Montana launches Pivot, they are taking a big risk on supply in the long run. It is not yet known whether Pivot is marketable and whether it will be a success or a failure - if the latter, they may have purchased materials and elements that are potentially unsellable. Additionally they have "sold" the idea of a table where the consumer is promised to be able to buy add ons in a very long perspective - a promise they would then break, which is damaging for the trust of the brand.

Durability of the table

07 strength detailing

Physical durability

The tabletops

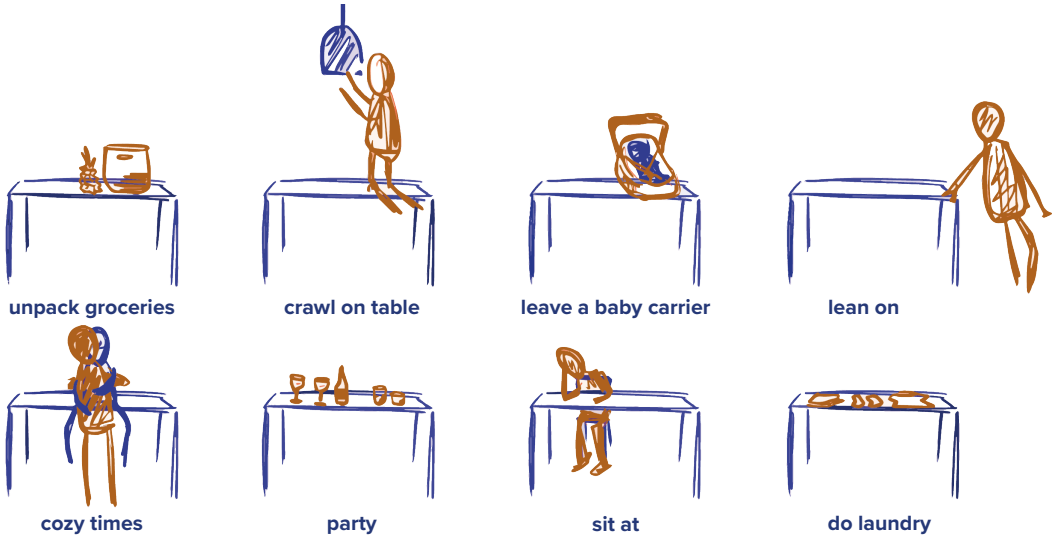
Strength in the width extension version

Summary of the phase

This phase works on the principal and material levels of the value pyramid (Lerdahl, 2001). Materials and proportions on the table are repeatedly considered throughout the process for various reasons, aesthetics mainly and to strengthen the product-user fit (Haase & Laursen, 2023) ensuring that the table can withstand everyday life. Consequently, this phase acts as a supplement to the considerations regarding materials and durability. It must be pointed out that this project has not had a high priority of durability although it is of high importance in the design of a table - instead, the focus has been to form the idea of how a two-dimension extension dining table looks and make it possible to function.

Physical durability

The function of the table does not change at the concrete level: it is the nature of the table to provide a surface for eating, working, doing puzzles, collecting lego and more. The material of the tabletop is therefore required to be able to withstand wear and tear from everyday tasks - and to be easy to clean. Additionally, the table will be exposed to applied forces from various activities and movements - all of which the table must also withstand. Not only last the forces but it must also feel durable and hence not deflect too much. The table must measure up to current European standards for tables - EN 12521 for tables for the private market and EN 15372 for the contract market (Dansk Standard, B, C. n.d.). (see app. 19 for insights on physical durability from 3rd meeting with Montana.)



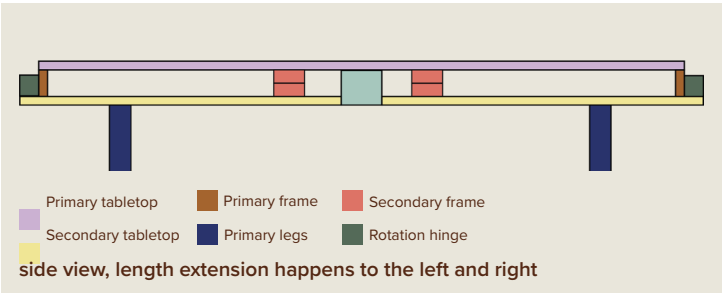
ill. 195 Physical durability

The focus of this project is not in the calculations of strength. The focus is on the other hand in the functions of the table : how to design a structure of the table that allows for a reversible and replaceable tabletop which is the part that is most exposed to wear and tear in a 20 year perspective?

Strength and stability of the table are key for the experience and feeling of a high-end table like this. Further on in the development of this table (in a perspective that exceeds this thesis) it would be natural to include FEM analysis on the (primary) table as well as physical tests on a prototype to design with the "right" dimensions, materials, and tolerances. As of now, we make loose dimension estimates based on quick comparisons with existing tables and with basic knowledge of materials.

The structure of the frame

The thickness of the primary tabletop and the secondary plates (with the fold-out legs) stored underneath the primary tabletop affects the available space for human legs. If the tabletop was not reversible, these could have been milled out so that the fold up legs could take up space in both the tabletops instead of lying "in between", which would have contributed to a lower thickness of the entire table - but due to the desire to be able to turn the top, the fold-out legs must be right up to the top / frame.



ill. 196 Structure of table, side view

The primary tabletop must be placed in a frame for support. The frame hides the edge of the tabletop, which lowers the "need" for a beautiful finish on the edges of the tabletop - however, it should still reflect a high-end tabletop, and the edges are visible when the tabletops are flipped. The edges can be treated with paint, which from the reference image of a dining table from Montana will be adequate in terms of aesthetics. They can also be covered with linoleum for a coherent finish.

ill. 197 Reference table with linoleum and painted edge

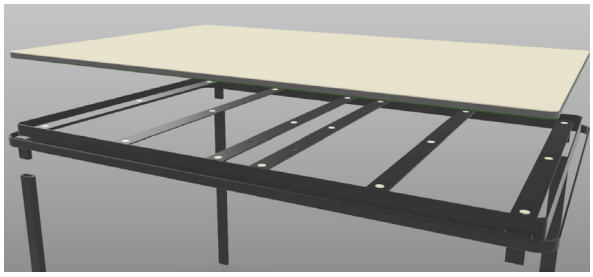
Reference table, IKEA

A reference table from IKEA, which has a reversible tabletop, has minimal wear and tear after +7 years of use. Considering that this table has no soft distance piece, and also considering the manufacturer, it seems to be a well working solution.

ill. 198 Reference, IKEA table reversible tabletop

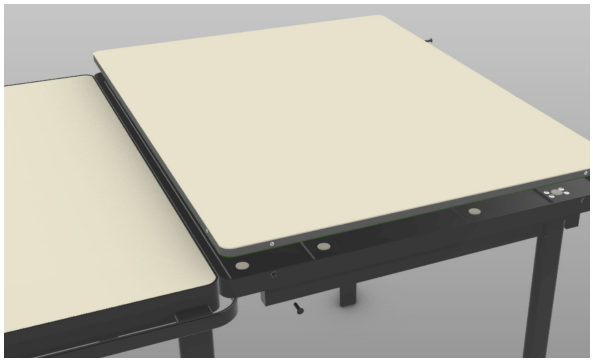
Frame must have a hole to enable "popping up" the primary tabletop
Frame must be coated with soft support for the tabletop

The primary tabletop will rest on rubber pads to ensure that the tabletop does not slip and lie loose, as well as to avoid as much wear as possible on the linoleum. There is an uncertainty as to whether the rubber pads will leave markings on the bottom tabletop, which requires testing over time in a real context. If this is the case, a reversible tabletop will not be worth it as regards to the perception of longlasting quality.



ill. 199 Construction of frame with tabletops

The secondary plates must be screwed together with the frame on the side as this cannot lie loose as it is stored upside-down. The consumer must loosen a few screws before being able to turn the top upside down.



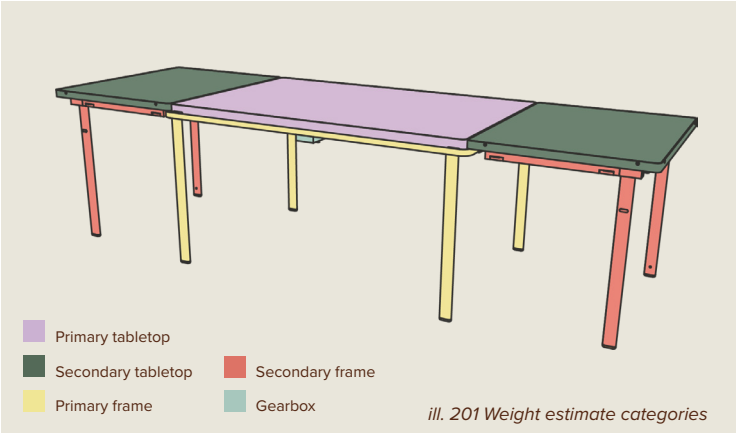
ill. 200 Secondary plate must be screwed with the frame

Weight estimate

The material of the tabletops and the material of the frame are the biggest factors for the overall weight estimate of the table. Often, the weight and the strength of the material are coherent. The overall weight of the secondary plates are critical, as it must have heaviness enough to feel robust, but at the same time be lightweight enough to allow personal handling - pick it up, turn it 90 degrees, push it 180 degrees.

The overall weight of the table must neither be too lightweight, as it should stand stable on the floor and not move when angular force is applied. At the same time, there seems to be a coherence between weight and the perception of quality.

The calculations are supplemented with real life comparisons of volumes with the same weight - especially for the secondary plates (see app. 20).



ill. 201 Weight estimate categories

Primary tabletop: 15,6 kg
Secondary tabletop: 7,8 kg
Primary frame: 8,5 kg
Secondary frame: 8,5 kg
Gearbox: 4,4 kg

Primary table without extension options: 24,1 kg
Secondary plate isolated: 16,3 kg
The table in total: 61,1 kg

The tabletops

There are standards available for testing surfaces´ resistance towards scratches, wear, and tear (e.g. EN15186 for furniture's resistance towards scratched (Dansk Standard, C. n.d.)) which would be relevant to investigate if this project was meant to be a start-up in terms of offering surface materials that would fit with a long lasting table design. However, as earlier stated, Montana is currently offering a wide variety of tabletop materials that they have concluded to have acceptable resistance towards everyday wear and tear.

Construction of the tabletops

The tabletops are 12 mm mdf covered with a finishing surface on both sides and with finished side edges. For linoleum and laminate, the construction should be somewhat similar. The construction of the tabletops are exemplified and calculated with linoleum surfaces. Both the primary and secondary plate is protected, supported and strengthened by an aluminum frame.

Estimate on deflection of tabletop

As mentioned earlier, the height of the tabletop should be kept at a minimum as it highly affects the overall thickness of the table and hence affects the comfort when sitting at the table (e.g. the ability to cross one's legs). At the same time, it is important that the deflection of the tabletop is kept at a minimum to "live up to" the experience of a high-end table. An estimate on the deflection of the tabletop at a thickness of 12 mm is therefore calculated.

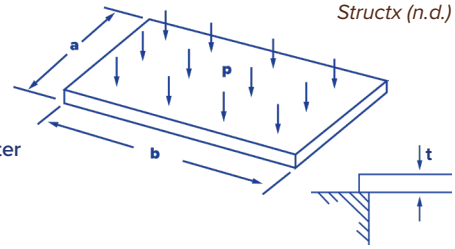
The approach is to look at the system in a simplified manner as a simply supported rectangular plate subjected to uniform pressure (see ill. 201).

Maximum stress at center

$$\sigma_m = \frac{0{,}75\ pa^2}{t^2\left(1{,}61\left(\frac{a}{b}\right)^3 + 1\right)}$$

Maximum deflection at center

$$y_m = \frac{0{,}142\ pa^4}{Et^3\left(2{,}21\left(\frac{a}{b}\right)^3 + 1\right)}$$



Structx (n.d.)

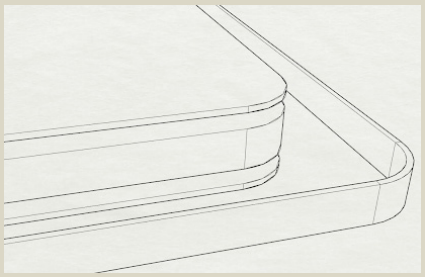
ill. 202System

> **This scenario is less critical than a concentrated load, hence will the deflection be tested with various pressures to account for the non-conservative calculation.**

For this system, the maximum deflection and the maximum bending stress can be calculated for the center of the tabletop (Structx (n.d.)). It is not possible to find the E-module of linoleum (it is too elastic), hence cavn the 4mm linoleum not be counted in.

For a 12 mm MDF, the tabletop will have a maximum deflection in the center of 8 mm at a 100 kg uniform pressure - 12 mm when the pressure is 150 kg (see app. 21). Furthermore, the maximum stress is acceptable with regard to allowable stress.

In reality (as of now), the tabletop is supported by six cross braces (see ill. 203) and not along the entire edges and these are very thin (3 mm), which means that their bending rigidity can be completely ignored - the tabletop will be the stiffest against the bending. These cross braces must hold the load, that is 12 areas, and for this reason, a quick calculation of the shear stress is calculated. With the 150 kg uniform pressure, the shear stress is 0,97 MPa which is not that high. Should 1 cross brace area hold the entire load (if pressure is applied on a corner for instance), the stress will be 12 MPa, which is also remarkably less than aluminum can withstand (see app. 21).



ill. 203 Construction tabletop

Chipboard, mdf or another lightweight material?

The choice of material for the "inner" of the tabletops is based on considerations regarding weight and strength. A low weight is desired for the secondary plates as they must be handled, carried and turned 180 degrees - however, the durability of the tabletop is of high priority. For production reasons, the construction of the primary and secondary tabletops must be the same.

Wo.dk (tabletop manufacturer) is consulted with regard to the construction of the tabletops and informs that they most often use mdf for tabletops - they do not have lightweight tabletops in store, but it can be ordered specially (which is not cheap). Mdf and chipboard have the same density, but mdf has a higher Young's modulus, which is preferable.

Material properties

Chipboard

E (Young's modulus) : 1,8 GPa
Allowable stress : 11 MPa
Density : 690 kg/m³

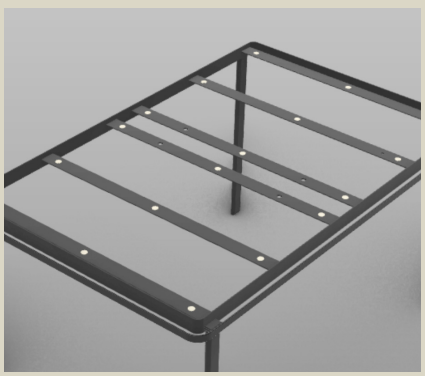
(npi, A. n.d.)

MDF

Various results, calculated with both, but 4 GPa is preferable

E (Young's modulus) : 4 GPa / 2,5 GPa
Allowable stress : 20 MPa
Density : 690 kg/m³

(Makeitfrom, n.d.) (npi, B. n.d.)

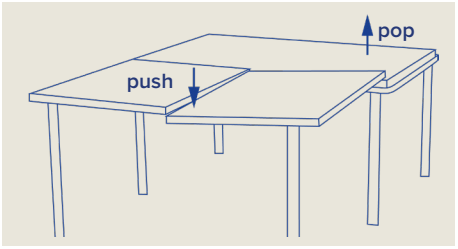


ill. 204 Cross braces

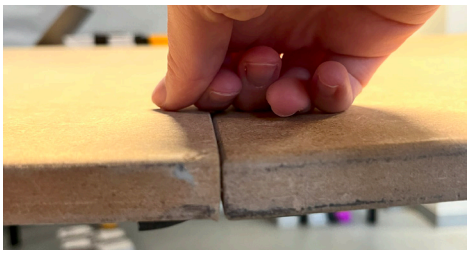
Strength in the width extension version

Understanding the deflection

With the interaction 1:1 model, a very rough test is conducted with the objective of understanding how the secondary table tops react to applied force (app. 21).



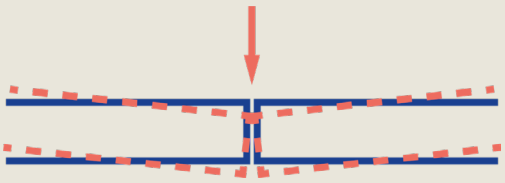
ill. 205 Tabletop deflection



ill. 206 Testing deflection

The test did not turn out as expected, but that is obvious. The deflection of the tabletops in square is highly determined by the tolerances in the joints between the primary table and the secondary plates as well as the joints between the two secondary plates. The interaction model does not at all reflect the actual joints and materials of the table. The tolerances of the model are completely off and the deflection cannot be carried over as actual results. Because of this, the majority of the deflection is pure rigid body motion and hence not the tabletop that receives an impact.

However, it showed that the secondary plates must be tightened to the corners of the primary table as these corners “popped up” in the test. Additionally, there must be designed a connecting part to lock the secondary plates with each other.

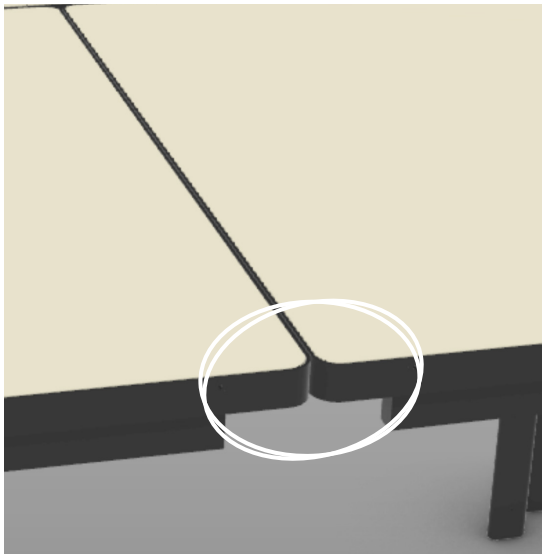


the thicker plates, the larger surfaces will meet to create stiffness

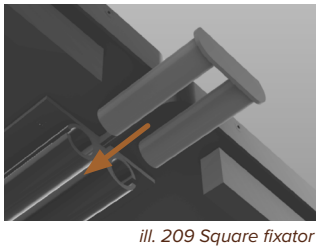
ill. 207

The experience of the deflection

The structure of the table may withstand applied force for instance from a person leaning on the tabletop, but if it deflects a lot, it feels unpleasant and there is a risk that wine glasses and candlesticks tip. The deflection of the tabletops in square is determined by the joints in terms of tolerances and stiffness of these joints. Thus is the experience with the table controlled by tolerances. Consequently, the design must highly take this into account. This is an argument that the rail and the connectors to the rail are solid components to heighten the stiffness in the joints. If the tolerances are large, the dimensions and stiffness of the tabletops will not have a high influence on the deflection, as the majority of the deflection is controlled by the rigid body rotation. It will deflect more than acceptable before the force travels to the joints and they put up resistance and the tabletop itself receives the load. The thickness of the tabletops and the distance between them also affects the rigid body motion. If the tabletops lie perfectly together, there would be an instant contact between the edges when force is applied and the rigid body motion will be lowered.



ill. 208 Support area



ill. 209 Square fixator

The secondary plates must be strapped together at the outer (middle) edge of the plates

The secondary plates must have a stiff connection to the corners of the rail - consider the stiffness of the joints in terms of material and solid components

The tolerances in the joins must be very small

Production of the table

08 construction detailing

Product architecture

Materials and production

Overall supply chain and product journey

Price : what is the value converted to in cash?

Final design brief

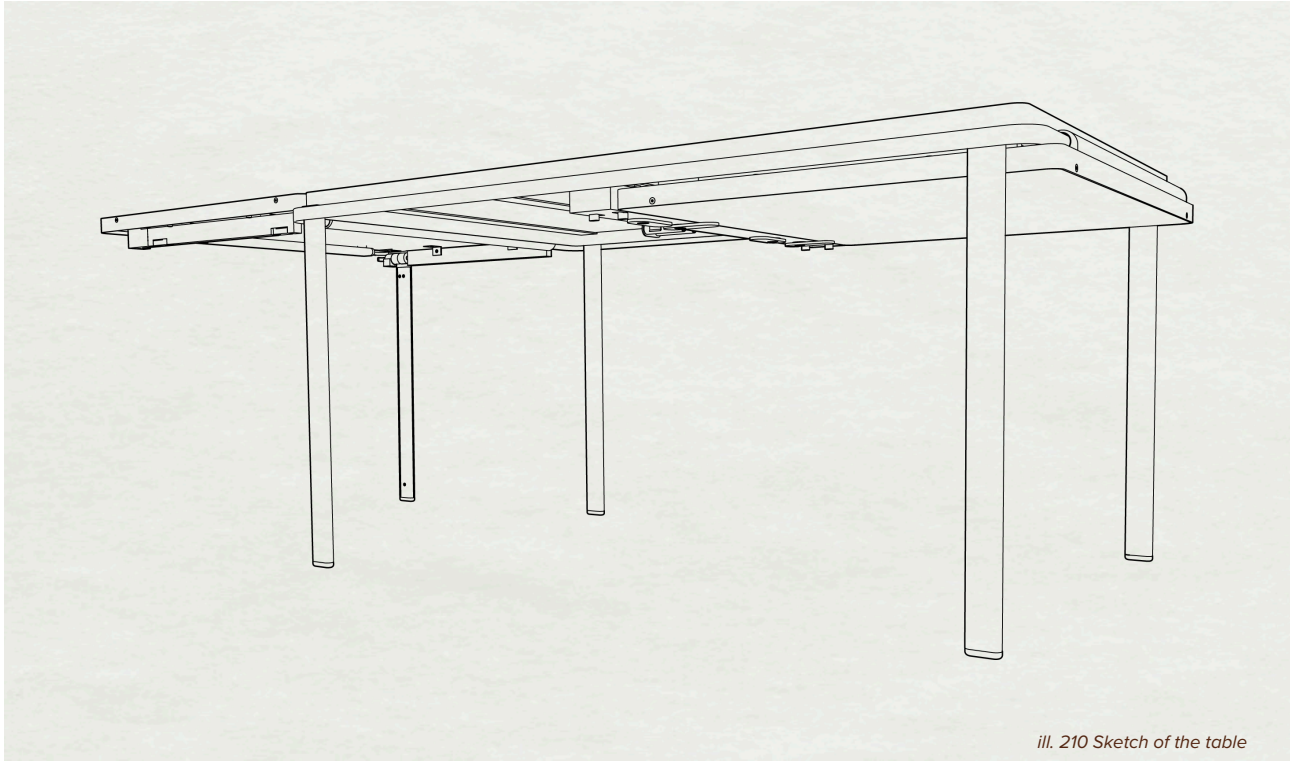
Summary of the phase

This phase works on the material level of the value pyramid (Lerdahl, 2001), focusing on the production of the components in terms of materials, production methods and product journey. The phase ends with a discussion of the pricing of the table which links the material level with the remaining three levels.

Product architecture

The product consists of a lot of parts. The table's main material is aluminum, as it is significantly lighter than steel, making it easier to make lighter constructions that can compensate for the higher price per kilo. It is suggested that the aluminum alloy is from the 6000 series, as such an alloy has good forming properties, is easy to process by extrusion and is weldable. The type of alloy may differ, as it depends on Montana's experience and what they are using today. (Alumeco A, n.d.)

This can definitely be optimized and simplified as there would be more efficient ways of reaching the same functions and similar aesthetics (see “What to mature and optimize” p. 104).



ill. 210 Sketch of the table

Bill of materials : materials and manufacturing processes included

Primary table
4x leg (primary) - aluminum, extruded profiles
4x feet (primary) - PA11, SLS print
1x tabletop (primary) - chipboard, cutted
2x linoleum (primary) - glued to chipboard and cutted
1x frame (primary) - aluminum, bended and welded
4x leg connectors - aluminum, CNC-milled
6x rail connectors- aluminum, CNC-milled
1x rail, aluminum, extruded and welded

Under table
1x gearbox - aluminum, punched and bended
4x retaining plate - aluminum, punched
4x trigger - PA11, SLS print
4x screws for the retaining plates - standard component
1x square fixator - aluminum, cutted, welded
2x annular cylinder snap joint - standard component

Standard components
screws (M4 and M5), rubber pads, fittings, gears, racks, magnets, hinges, and thredded sleeve

Secondary plates (both)
2x tabletop (secondary) - chipboard, cutted
4x linoleum (secondary) - glued to chipboard and cutted
2x foldable legs (short) - aluminum, extruded profiles
2x foldable legs (long) - aluminum, extruded profiles
4x feet (foldable legs) - PA11, SLS print
2x mounting plates (secondary) - aluminum, CNC-milled
2x frame (secondary) - aluminum, bended and welded
2x lock for square extension - aluminum, cutted
2x bar (fake lock for square extension) - aluminum, cutted
1x 90° foldable hinge, right (plate 1) - aluminum, cutted, CNC-milled
1x 90° foldable hinge, left (plate 1) - aluminum, cutted, CNC-milled
1x 90° foldable hinge, right (plate 2) - aluminum, cutted, CNC-milled
1x 90° foldable hinge, left (plate 2) - aluminum, cutted, CNC-milled
2x 90° locking mechanism, left - aluminum and PA11, punched, bended, SLS-printed, standard components
2x 90° locking mechanism, right - aluminum and PA11, punched, bended, SLS-printed, standard components
2x rotation hinge (for long extending) - aluminum, extruded

Production and assembly

Although the principle of extending the table is quite simple, multiple parts lay behind it. The following section elaborates on a few selected parts with regard to materials, production and assembly. Additional information can be found in app. 22. Tables are not an off-the-shelf product, hence is it an aim to order a minimum quantity of tables - between 50-100 tables. The quantity is based on a minimum order quantity (MOQ).

Aluminum parts

In order to find the MOQ, it must be calculated how many pieces of the different parts can be pressed from a 200 kg block of aluminum. This is the procedure Montana normally uses when launching a new product on the market. The part that results in the lowest quantity, gives the MOQ.

Table legs

Aluminum with an alloying from the 6000 series: Low alloy, therefore good formability and easy to extrude.

Production

1. Extrusion of an aluminum profile
2. After extrusion the legs are cutted in a length of 685 mm
3. Holes are drilled for screws for the assembly (enabling flatpack)
4. Same procedure is done to the foldable legs with the dimensions of 20x50 mm, radius: 10 mm, length: 656 mm

Calculating MOQ

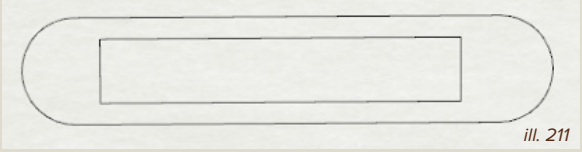
200 kg aluminum block
Density: 2,7 g/cm^3 - Density of 1 m legs: 438 cm^3
Length of legs: 68,5 cm (primary), 65,6 cm (secondary)

438 cm^3 · 2,7 g/cm^3 = 1182,6 g/m

20.000 g / 1182,6 g/m = 169 m
169 m / 0,685 m = 246 primary legs
246 legs / 4 = 61 tables

the MOQ

169 m / 0,656 m = 257 secondary legs
257 legs / 4 = 128 secondary tables = 64 complete tables



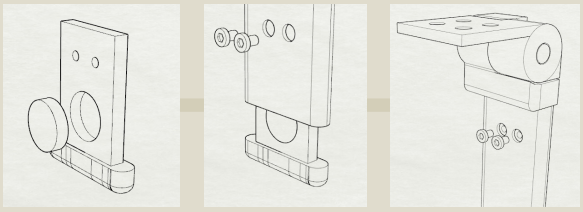
ill. 211

Cross section of profile.
Size of the leg: 20x50 mm, radius: 10 mm, length: 690 mm

The rotation hinge is the one from which the fewest quantities can be obtained, which is why **58 tables are taken as the MOQ**.

With a MOQ at 58 pieces, the production methods are taken into consideration thus special tools e.g for injection molding. Due to the MOQ, it is not worth investing in specialized tools.

Assembly of secondary legs



The magnets are inserted into its cut-out space in the foot

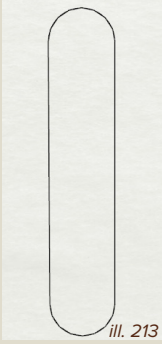
The foot is inserted into the leg and then screwed on

The leg is attached to the matching hinge and then screwed together

This is done for all four legs

ill. 212

The rail



ill. 213

5x25 mm,
radius: 2,5 mm

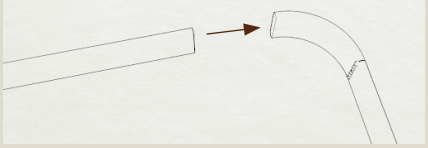
Production

1. Extrusion of an aluminum profile
2. 2 pcs. cutted in length: 77,4 cm
3. 2 pcs. cutted in length: 126,4 cm
4. 2 pcs. cut 4 pcs. in length: 15,5 cm (included 5 cm waste in each end due to the bending process) ted in length: 77,4 cm
5. Each piece is cut to the above dimensions, with the 4 smallest pieces bend in a 90 degrees with a radius of 35 mm. and cut to size, then welded together
6. This is followed by grinding of the joints

From a 200 kg block aluminum there can be produced 121 rails (see app. 23)

Assembly of the rail

One bended corner is welded to a piece with a length of 77,4 cm

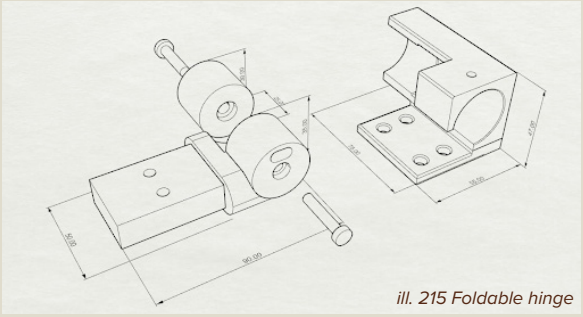


A piece with a length of 126,4 cm are then welded to the same corner

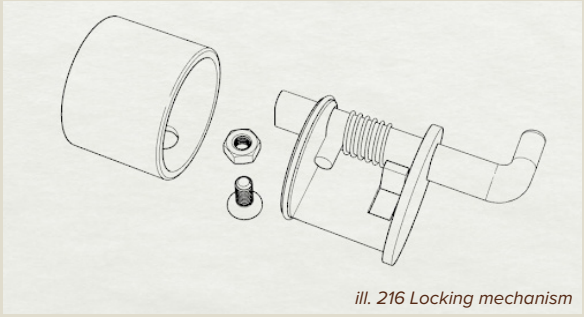
The same procedure is done to all pieces - they are welded together

ill. 214

90° foldable hinge and the spring lock



ill. 215 Foldable hinge



ill. 216 Locking mechanism

90° foldable hinge

One hinge consist of three parts

Size of part one: 50x35x90 mm

Size of part two: 47x55x75 mm

Size of part three: Ø30x25 mm

Made of solid aluminum ENAW6082: 50x50mm, length: 3m, 55x55mm, length: 3m, Ø30, length: 3m (Alumeco, A, B, C, n.d.)

Part one is CNC-milled of a piece of 50x50 mm, length 90 mm

Part two is CNC-milled of a piece of 55x55 mm, length 75 mm

Part three is CNC-milled of a piece of Ø30 mm, length 25 mm

To get hinges enough to reach MOQ 8, 6 and 2 bars are need for part one, two and three (in that order) (see appendix 22 for calculations, calculations for production and materials)

The two secondary tabletops consists of 4 different hinges due to the fact each hinge are inverted

The three different parts are screwed and welded together with a M4 screw and a M4 threaded sleeve

The locking mechanism

The locking mechanism consists of five parts: 1) a cylindric house, 2) a insert, 3) a hook with a stopper, 4) a spring, 5) a rubber gasket

The cylindric house is cut from a Ø30 t2 profile

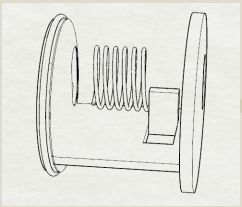
The insert is SLS printed in PA11 (Podovo, n.d.) (Weerg, n.d.)

The trigger is a 10x5 mm bar with rounded edges and a 90° bend and a threaded hole for the stopper

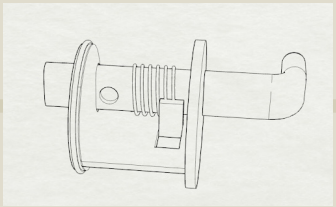
The spring is a standard component

The parts are manually put together

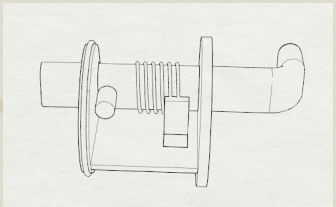
Assembly of the locking mechanism



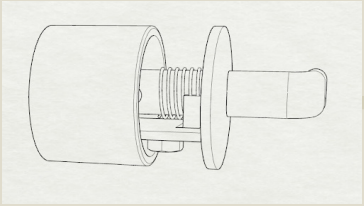
The spring and gasket are placed on the insert



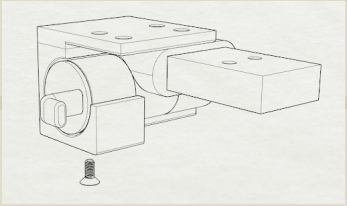
The trigger is passed through the holes and through the spring



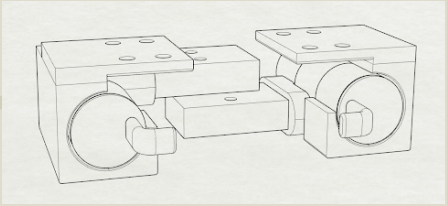
The stop block is screwed into the cabinet



A nut is placed in the insert and it is put into the housing



The lock is mounted in the hinge



Same procedure is done to the inverted locking mechanism

ill. 217

Overall supply chain and product journey

Montana already has suppliers around the world and in Denmark, which are also utilized for this table. Therefore, the starting point is based on the continents that Montana currently uses to produce different parts for their dining tables.

Suppliers

Denmark

Welløv+Ottesen (WO.dk), Randers : Tabletops (receives Linoleum from Forbo)

BSM, Bjerringbro : Locking mechanism + foldable legs (potentially more post maturing)

Podovo, Nørresundby : 3D print, trigger, feet + cap

Poland

Main parts for the frame : Rail, legs, frame, gearbox, hooks, fixator (Being half assembled and then flatpacked and sent to Denmark for assembly)

China

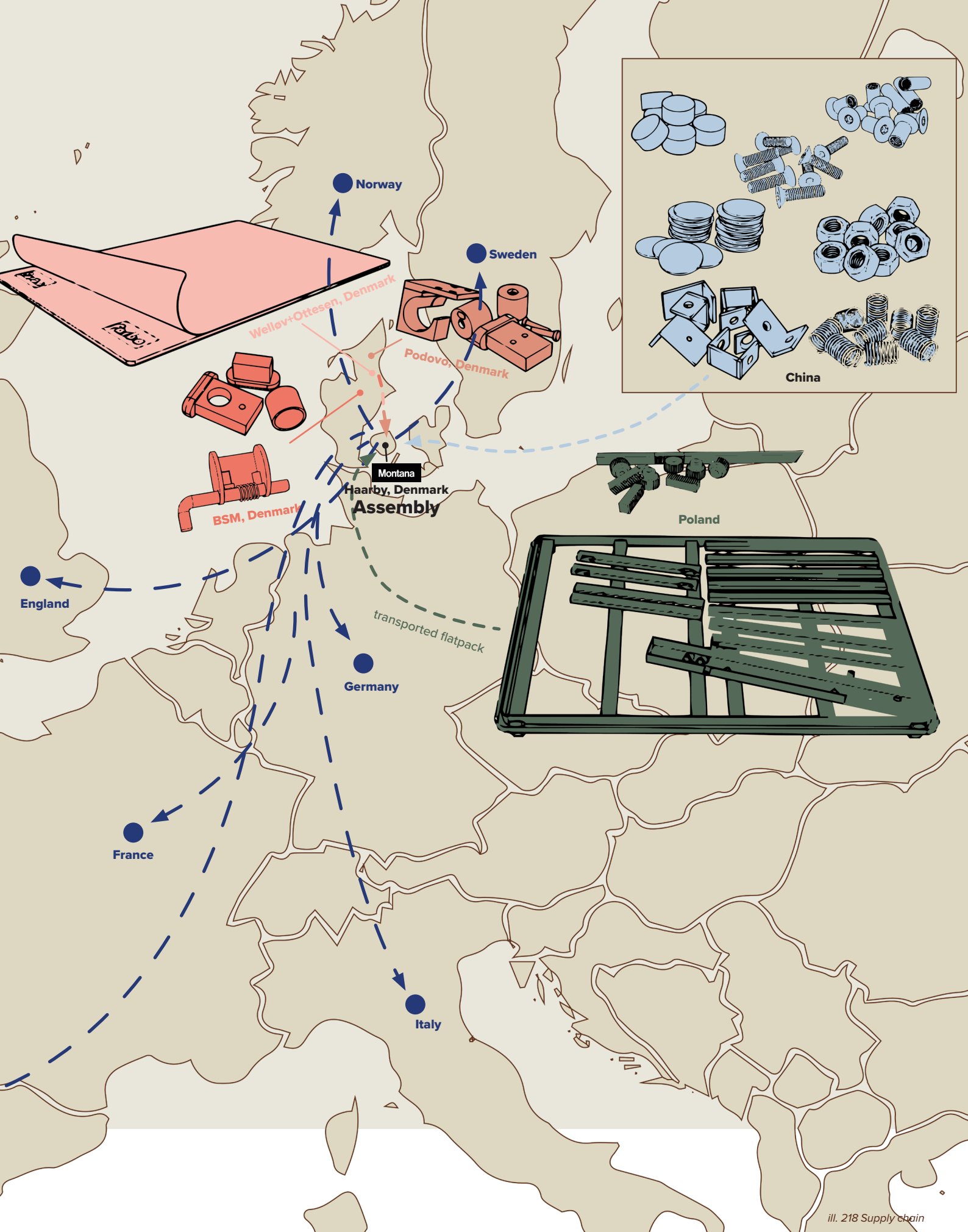
Standard components

Retailers : countries

Denmark
Norway
Sweden
Germany
Italy
France
Poland
Etc. (see p. 37 for Montana's established markets)

Made to order

Since Montana offers their customers to customize their own furniture, they work on a made-to-order basis. This also means that they try to keep their stock as low as possible. Likewise, it also has an impact on their unit count in the 0-series, which will be low as their furniture is not off-the-shelf.



ill. 218 Supply chain

Price : what is the value converted to in cash?

The pricing of the table is based on Montana's overall procedure when fixing the price for a new product. In this particular case, the market analysis and comparison is complex as there are no existing tables with the same USP's (2-dimension extension especially). For that reason it is a staking to convert the value proposition to a price and it is highly dependent on a huge marketing- and branding assignment. Having an estimate on a sales price for the product (and a marketing plan ready), Montana would negotiate with retailers on a purchase price in relation to the markup required.

> *I would do some market research and try to show the table to stakeholders to get a better impression of the price point. Because, to be honest, I do not have an immediate feeling - whether or not it becomes too technical for the general person to buy into.*
>
> Josephine Ring, Montana

Price fixing procedure

01 Analyze the market and competitors with similar unique selling points

02 Fix a desired sales price

03 Count backwards - what is the cost price for retailers (markup price for retailers around 2*)

04 What is the production price? (markup price around 5*)

**Markups are generally very varying from product to product. Some products make a better profit than others.*

Production estimation

Brdr. Sørensen (the furniture store in Aalborg) owns the brand Rübner that among others produces high-end dining tables with a linoleum tabletop and a steel frame. They have suggested making contact with WO Interior (making tabletops) and BSM (making steel frames) to help with a production estimate. The calculations are based on their feedback and material prices for a low volume production as the minimum order quantity is estimated to be 58 complete tables. Further to be noticed, a talk with BSM (more in "What to mature and optimize, p. 104") gave an insight that around 70 % of the price will be man hours for production and assembly, for a table like this. It is estimated from the material costs covering the 30 %. Packaging, transportation, payment fees etc. isn't included in these estimations. Additional calculations on the amount of used material can be found in app. 22. The estimation is made for a complete table with two secondary plates (see app. 23).

Tabletops
Primary (1 pcs.): 1500 DKK
Secondary (2 pcs.): 2000 DKK
Total: 3500 DKK

Frames (incl. crossbars, legs and rail)
Frame, primary (1 pcs.): 501 DKK
Cross bar, primary (6 pcs.): 590 DKK
Rail (1 pcs.): 83 DKK
Primary legs (4 pcs.): 164 DKK
Frame, secondary (2 pcs.): 695 DKK
Cross bar, secondary (4 pcs.): 784 DKK
Backplate (2 pcs.): 754 DKK
Secondary legs (4 pcs.): 156 DKK
Total: 3727 DKK

Additional components
Foldable hinge (4 pcs.): 1103 DKK
Rotation hinge (2 pcs.): 172 DKK
Gearbox (1 pcs.): 100 DKK
Rotational lock and bar (2 pcs.): 1037 DKK
Total: 2412 DKK

Extra parts
Screws, threaded sleves, gears, racks, fittings, rubber pads, magnets, springs, triggers, etc.
Total: 500 DKK

Total material cost: 10139
Production and assembly: 23658 DKK

Total cost primary: 10127 DKK
Total cost secondary: 11837 DKK

Total cost: 33801 DKK

This price is unacceptably high, caused especially by the high material prices and the complex components that need a lot of man hours to produce. If this was a "finished" table, it would not be possible to make a business out of it. However, it is not "finished" as of now.

The price will be possible to lower remarkably by going to a specialized supplier and by scaling the production to a higher quantity and choosing other production methods and by redesigning components, more on that in ""What to mature and optimize, p. 104".

Comparison to the market

As the comparison with the market is troublesome, the approach is to compare to extension tables in the dining table assortment in Brdr. Sørensen and list cost and benefits. Next, a price for the extra added value is estimated.

Name	Rübner	HAY Copenhauge CPH30	Piet Hein Super Ellipse	CH322 Wegner	Naver Nano GM 3640
	 *ill. 219*	 *ill. 220*	 *ill. 221*	 *ill. 222*	 *ill. 223*
Size	200x100 → 320x100	160x80 → 260x80	170x100 → 270x100	160x95 → 280x95	190x100 → 290x100
Price	18.995 DKK (without extra leafs) **28.193 DKK**	16.995 DKK (without extra leafs) **19.997 DKK**	**34.962 DKK**	29.995 DKK (without extra leafs) **37.725 DKK**	20.011 DKK (without extra leafs) **25.305 DKK**

Cost & value “standard extension table”

- \+ Extension in length → from 6 to 10
- \+ Simple and minimalistic appearance
- \+ 6 person table in “standard”
- \+ Brand value
- — Extra leafs stored elsewhere
- — No change in setting (changing form by offering a social setting)
- — No opportunity for renewing aesthetics

20.000 DKK - 38.000 DKK

Cost & value Pivot table

- \+ Extension in length → from 6 to 8-10
- \+ Extension in width → change in setting
- \+ Reversible tabletop
- \+ Opportunity to buy new tabletops (change color and material)
- \+ Brand value (Montana)
- \+ Extra leafs stored with the table
- — 4 person table in “standard”
- — Functional driven aesthetics

35.000 DKK

The pricepoint of the table is compared to 5 high-end tables. There are also tables on the market at a lower pricepoint that can extend in length (from IKEA for instance) but these will not be competitors for Montana. However, it could have been interesting to investigate pricepoints for mid-end tables on the market.

The above mentioned sale price of 35.000 DKK might seem extremely stupid as the rough cost calculations estimates a production price of 34.000 DKK - in this price, the markups are not even added. However, the 35.000 DKK is a shot in the dark as both the market and the production is risky as of right now, but it would be an aim to compete with the popular extension tables on price, even though the value that Pivot brings, should be worth more - but at first, consumers must understand and get used to the value that this new take on a table brings. The sales price is determined based on a future 2 years product maturing to optimize, simplify and dimension the table. It would however be likely that the profit is lower for this table as this table is a firstmover on the market. The price must be attractive and understandable for potential consumers.

Design brief 4.0

A new take on a dining table for Montana

Functionality

- Must be able to extend in length and width - hence change size and form (p. 25 + p. 26)
- Must be able to change aesthetics that does not require additional purchase (p. 26)
- Must be transportable (p. 25)
- Basis must fit 2-4 people and expand from here (Mapping of life p. 25)
  - Extension to 6 pers. in length (p. 38)
  - Extension to 8 - 10 pers. in length, symmetrical from primary table (p. 38 + p. 46)
  - Extension to 8 - 10 pers. in width on the same side (p. 38 + p. 46)
- Must store 2 secondary plates at the table (p. 28)
- Extension must be a one-man job (p. 28)
- Secondary plates must be in level with primary plate in all extension options (p. 38)
- Primary plate and extension plates must be connected in length and width extension (p. 38)
- Minimum 3 support points for primary plate (p. 38)
- Minimum 3 support points for secondary plates at extension (p. 38)
- Fixed support for primary plate (must touch ground) (p. 38)
- Fixed support for secondary plates at extension (must touch ground) (p. 38)
- Dimensions: primary table 140x90 cm, secondary table 70x90 cm (p. 60)
- Table height: 72-74 cm (p. 45)
- 64 cm air between floor and bottom surface of the table (p. 51)

from concept development

from detailing of Pivot

- Secondary plates must rotate 180 degrees for storage - attachment/deattachment - extension (p. 61)
- Secondary plates must have foldable legs attached for support (p. 63 + p. 66)
- The foldable legs must be able to be blindly released with one hand (p. 63)
- The user must be able to use the floor for support when turning secondary plate from length to width extension (p. 63 + p. 72)
- Locking of secondary plates must be possible from both sides (p. 63 + p. 65)
- Locking of secondary plates must be possible blindly (p. 63 + p. 65)
- Retaining of secondary plates under table must be locked / released separatly (p. 63 + p. 65)
- The hinge for width extension must enable angular and horizontal attachment to rail (p. 63 + p. 64)
- Loose parts must be stored at the table (p. 68)
- The secondary plates must be locked tightly in width extension (p. 68 + p. 90)

Aesthetics

- Must blend in with existing Scandinavian interior design (p. 19)
- Must fit Montana's universe (p. 37)
- Must offer a reversible tabletop with different colors (p. 40 + p. 82)
- Wish: primary and secondary legs are alike in shape and proportions (p. 80)

Market implementation

09 business detailing

Business strategy

A table for Montana?

Roadmap towards implementation

If it is not a table for Montana, what then?

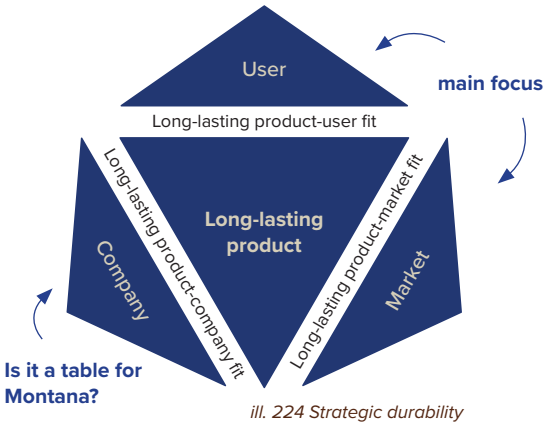
Summary of the phase

This phase works on the spiritual and contextual level (Lerdahl, 2001) to develop business strategies towards implementation to the market on the basis of a continuous collaboration with Montana. The phase discusses the potentials of the table with a critical eye and outlines the necessity of product maturing and branding of the product. Furthermore, the phase sums up to which extent the product has created a strong strategic fit (Haase & Laursen, 2023) and questions if this is a table for Montana or not.

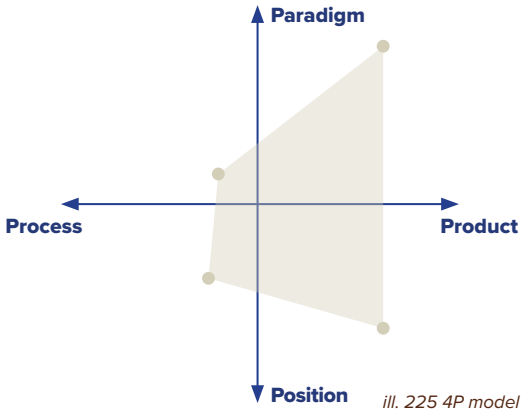
Strategic durability : creating a fit between user, market and company

The business aspect is based on Montana's current strategies, markets and procedures for implementations of new products.

The creation of Pivot has included several development phases with different strategies to achieve a strategic fit. The development has dealt with all three categories, striving to create a strong product-user fit, a strong product-market fit and a strong product-company fit. In order to understand how Pivot deals with the challenges and to understand to what extent the different strategies are being implemented , a summary is made.



ill. 224 Strategic durability (Haase & Laursen, 2023)



ill. 225 4P model

The 4P model: the table is a rather radical innovative product within the dining table category, see elaborative considerations in app. 24.

Product-user fit

Pivot's entire foundation is based on the user and their needs throughout the stages of life. The table deals with product obsolescence, aiming for emotional durability and product attachment. With Pivot's core value about being a compangong through life aims for creating an emotional bond between the user and the product and stimulates memories and nostalgia, making the user less likely to dispose of the table (Linda). Pivot has a strong product-user-fit in terms of the user's needs, dreams and behavior, but in order to get even stronger, the product maturation phase must take the interaction into account, including product simplification.

Product-market fit

Pivot is a new take on a dining table and by analyzing the market it is clear that it brings something new and innovative to the red ocean market (see 4P-model and app. 24). It is therefore difficult to conclude in advance whether it provides any competitive advantages that will make consumers choose Pivot over other tables. The design of the table takes place in its unique and differentiating features which aims for being competitive, to provide Montana the credibility advantage of being a high-end table that sets them apart in the market. An aim for Pivot has been to create a strong product-market-fit - but it cannot be answered yet if it will be a success or not.

Product-company fit

Making Montana first-movers is risky and costly. The development of Pivot has to some extent focused on Montana's strategic strengths; the customer needs to be able to quickly like and understand the concept, and once they have bought into it, you can start playing. This is transferred to Pivot - easy to understand the value it brings, and then a learning process begins to understand the interactions. Product-user-fit and product-market fit has been the main focus of the project. Therefore, there is a lack in the product-company-fit by having designed a complicated table in its product architecture, which goes against Montana's values of simplicity. This therefore requires a product maturation that will make Pivot fit their vision, values and culture (Haase & Laursen, 2023).

A table for Montana?

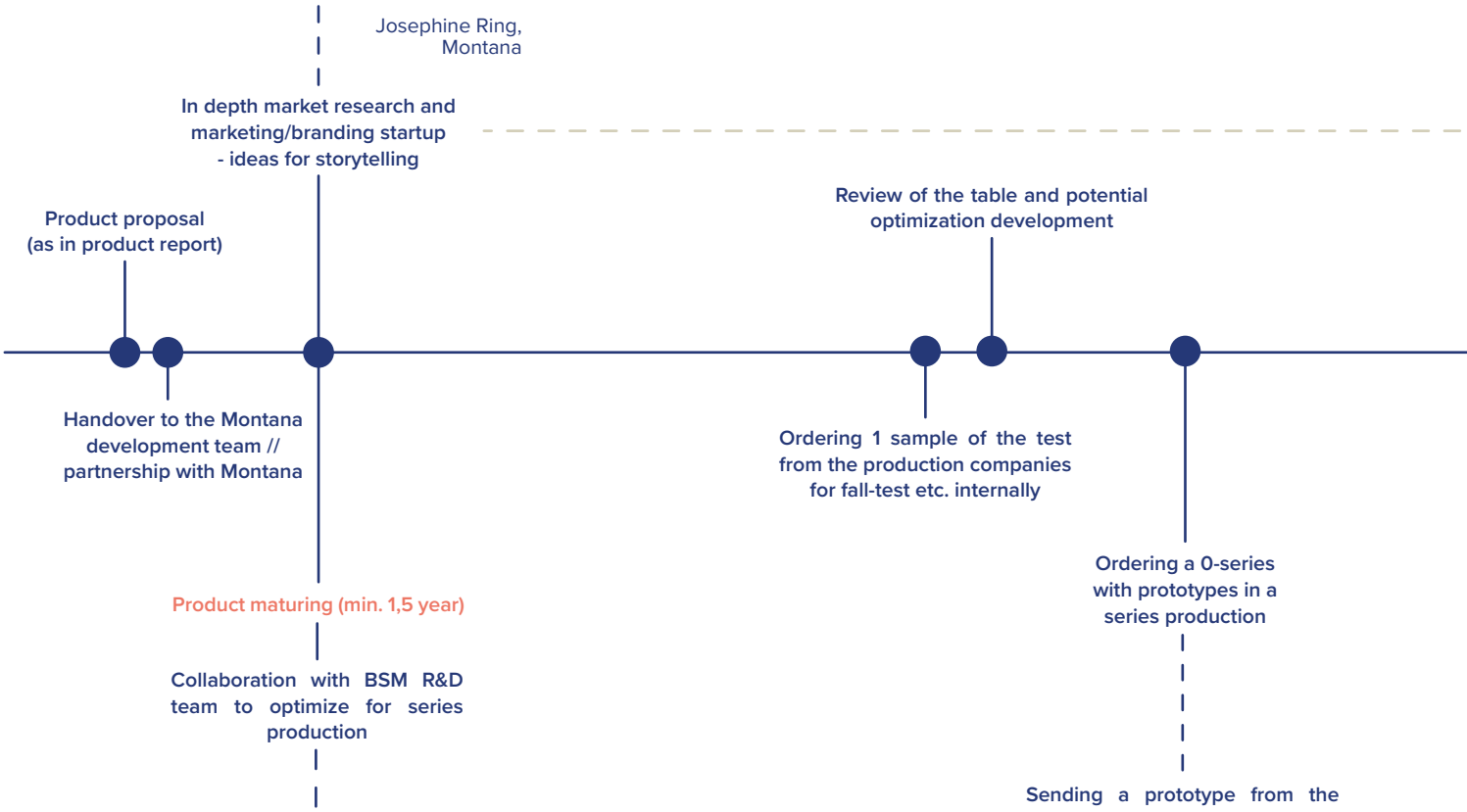
Making a pivot with Pivot puts things into perspective and questions whether the table is a Montana table or not. Pivot has characteristics that are designed from and fit into Montana's design DNA, including having to 'play' with the product. Likewise, Pivot's strengths in working with aesthetic obsolescence speak well to Montana's value of offering the consumer different colors for the furniture. The fact that the tabletop can be turned and thus offer two colors is a characteristic that fits Montana perfectly. Whether the table is too functional for them is a question neither they nor we can answer, as it first and foremost requires courage to dare to include it in the portfolio and then mature the product and optimize it by cutting down on components.

> ***You've really come a long way with it, and I think it's still exciting! It's not to say that it's irrelevant, but I just have a hard time assessing it immediately.***
>
> Josephine Ring, Montana

Roadmap towards implementation

The following plan towards launch on the market is backed up by meetings with Josephine Ring (Portfolio Manager) and Nis Kjærgaard (Product Development Manager) from Montana, who compares this project with their typical projects with similar products. Additionally it is based on a meeting with BSM (metal production company), who elaborate on a typical project like this. The plan is based on a collaboration with Montana - either with a joint partnership or a sale of the product proposal.

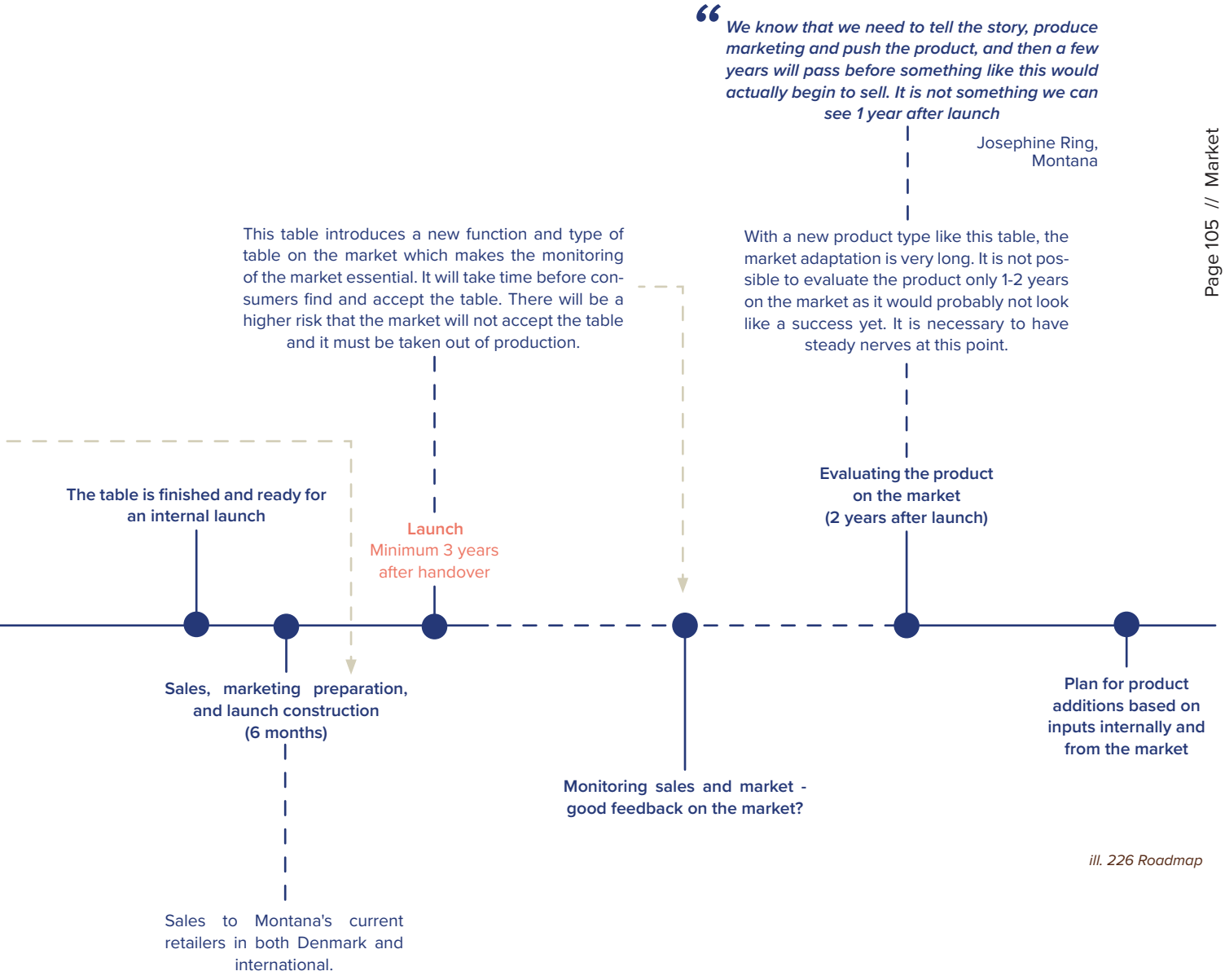
> *"This is a gambling. You do not know whether it is a golden egg or a flop, to be honest... One thing is sure, this is a huge communication and branding job, and our creative team must fall in love with it*
>
> Josephine Ring, Montana



What to mature and optimize?

Reaching out to BSM, a steel processing company, and showing the Pivot table gave some very good points to focus on for maturing and optimizing the table. Michael, a project officer from BSM, looked through a 3D-model of the table and concluded that changes are needed before it can go into a serial production and that it right now would be rather expensive to make. But when going through a maturing phase in collaboration with specialists in production optimization it will be possible to lower the price through changes in materials, production methods and types of material e.g. going from an aluminum bar to bended sheet if possible. Another cheap and very accessible production method besides bending in a press brake is laser cutting and especially cutting in sheets.

Two concrete examples on where to optimize could be to bolt the rail, leg connector and frame together instead of welding. Changing this process can eliminate a rather big and complicated welding fixture.Another small but in a big scale production influential thing could be to eliminate all the countersunk screws that one countersunk screw will have an estimated cost of 2 DKK. This means when producing e.g. 10.000 tables with 25 countersunk screws will give extra costs of 500.000 DKK.



ill. 226 Roadmap

If it is not a table for Montana, what then?

Montana is not obligated to continue with this project. The entry point for establishing the collaboration was the shared vision and ideas of modularity. However, as the project has proceeded, it has shifted focus towards a more functional table, that would also fit other furniture companies - for instance the Danish company Skovby Furniture, who are experts in extension tables.

This is a risky table - there are no similar products on the market, and Montana would need to investigate the market further and more importantly consider the marketing of such a table. How to communicate the abstract visions and possibilities in an instant moment to a consumer?

If Montana does not dare to continue the development of the table, the most plausible plan for an actual implementation to the market would be to approach Skovby Furniture for sales. It is offhand not realistic to go to market with a high-end functional table as self-employed without a name or legacy that consumers trust in relation to quality and design.

Epilogue

10 wrapping up (for now)

Conclusion

The team has addressed the thesis differently by proposing a new agenda for furniture products, based on an urge to contribute to the transition towards more responsible design - approaching how to design a product that is adaptable to shifting needs over time and hence not rigid. The team has collaborated with Montana and the table is targeted to them.

The overall aim was to challenge and make a discussion starter for furniture design - how to walk away from the throw-away society and think more long term. The result is Pivot, which is not just a dining table, but a table to live with and around. It can adapt to shifting needs throughout life. It can extend in length and size, thereby offering seatings from 4 - 10. Additionally it offers a chance in form regarding a rectangular or square form. Lastly, it has a reversible tabletop, enabling aesthetic renewal and opportunity for replacing the tabletop if it wears down or new colors are needed.

Based on the unique selling points of the table, it should definitely be implemented on the market as it contains a proposal to a solution towards not needing to replace dining tables. However, it comes with a “but”. This is a very risky table; on multiple parameters. There are no tables on the market to compare cost and value against and hence to analyze business potentials. Additionally, it is a very expensive table, which puts the risk even higher. Lastly, the proposal requires product maturing that, worst case, would kill the table due to construction and cost.

A really good idea, approach and discussion starter - is it sellable? No one knows.

Reflection

Product

The functions and construction of the table

The principle of the table is the function of the secondary plates that can swing on the rail to enable length and width extension. For this, construction is a huge factor towards validating the table, which has not been investigated fully - a tradeoff of the focus on the framework. FEM and a 1:1 prototype of the table would be highly necessary for testing, and the team has gained reassurance from the steel industry regarding the possibilities of maturing the construction to enable the functions and interactions to work as intended. In addition, the complexity of the product is the result of a short development; there was only time to "solve" the headaches but no time for simplifying the solutions.

The looks of the table

The table proposes temporary and permanent extensions, but it puts requirements for the aesthetics and overall coherence of the look in the extended versions. Taking a look at the table, the aim for the appearance of the table in the extension versions are not entirely met yet, as the (position of the) legs characterize a temporary extension. However, the overall look of the table is rather simple - as simple as it gets with all these functions.

The business of the table

As of now, the product proposal is very expensive to produce. It questions whether it is possible to make a business of this table, which can only be answered if Montana takes the risk to invest in R&D with help from production experts. A table with this complexity would require a partnership with an established brand like Montana, hence would it not be realistic to continue without Montana. However, the project still initiates a discussion on dining tables that would be valuable for branding and making a statement - which fits with Montanas brand ambitions.

Responsible design - is this table "less bad"?

One could argue that the table wants a lot of things at the same time - the result of a new take with "new" functions. In the development, the table became filled with parts and features that may point the table in a direction where one could question where the "responsible" aspect of it is? This is "hidden" in the aim with an adaptable table to prolong the time the consumer has the table. However, it would be relevant to consider additional "responsible" initiatives to consider the triple bottom line to a greater extent. For instance look at materials, local production etc. It is interesting to discuss whether this table is less bad than tables on the market - one thing is sure, it wants something more with the aim of having the consumer to consume less.

Process

Prototypes

A functional high-end table demands great interactions. And spot on proportions. The lack of 1:1 prototyping was in retrospect a large hindrance to the development, as it would have provided a lot of answers and insight to proceed with the development. The team is left with an uncertainty towards the evaluation of the actual usage of the table. The scale of the product and the time between final idea and hand-in resulted in down prioritizing mock ups. For that reason, this process was highly driven by 3D modeling as the functional and construction level was difficult. The tradeoff of this is the lack of testing the movements and interaction.

A wicked problem

This project has worked with a really wicked problem - more complex than first expected. Thinking the team would have plenty of time to work on aesthetic details when designing in the furniture category was utopia, as the product proposal should be the result of countless iterations and table concepts, going back and forth between problem and solution space (ill-defined problem - what is the issue with dining tables on the market?), before the foundation of the product proposal was found one month before hand-in. Looking at the process in retrospect, it highlights a lot of modular table concepts, some more simple than others. The result of this very tangled process is a potential confusion whether or not the project ended on the right path.

Framework vs design

Designing in the furniture category with the aim to present something new that exceeds presenting a new color or material, requires time. In this project, the design problem emerged due to an identified consumer behavior at an abstract level. Proposing something new, while maintaining the core function of the table, requires a reasoning starting with a philosophy of a long lasting living table that follows the consumer through shifting needs and trends. The task has thereafter been to channelize it into concrete features, interactions and construction of a table. How does this abstract aim look at a concrete level? This framework was very time consuming and the design process constantly jumped between all four levels of abstraction to make connections between all levels. Additionally, the framework was almost too impossible to solve within this project. Hence, the time allocated for the actual design became limited as it was troublesome to innovate and find the solution principles to unravel how to extend in width and length. Seeking for a new take on a dining table has the overall tradeoff of a product proposal that is just in the beginning of its development, which is a bit frustrating. However, a project of 4 months cannot result in a product ready for the market. This time, this product proposal is further away from the finish line than all other projects the team has worked on, but the framework is special. It has potential. And it is a discussion starter.

What a thesis. Our heads have exploded a hundred times, but we are left with a pride of bringing something new to the table, which has received a lot of credit - fighting the norm of dining tables. Now, it just needs 2 years of product maturing.

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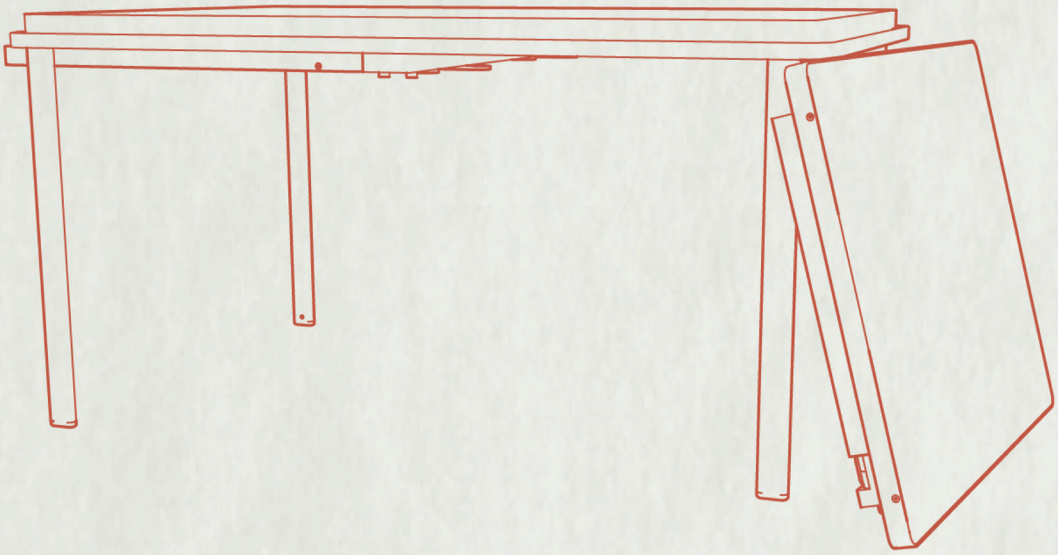
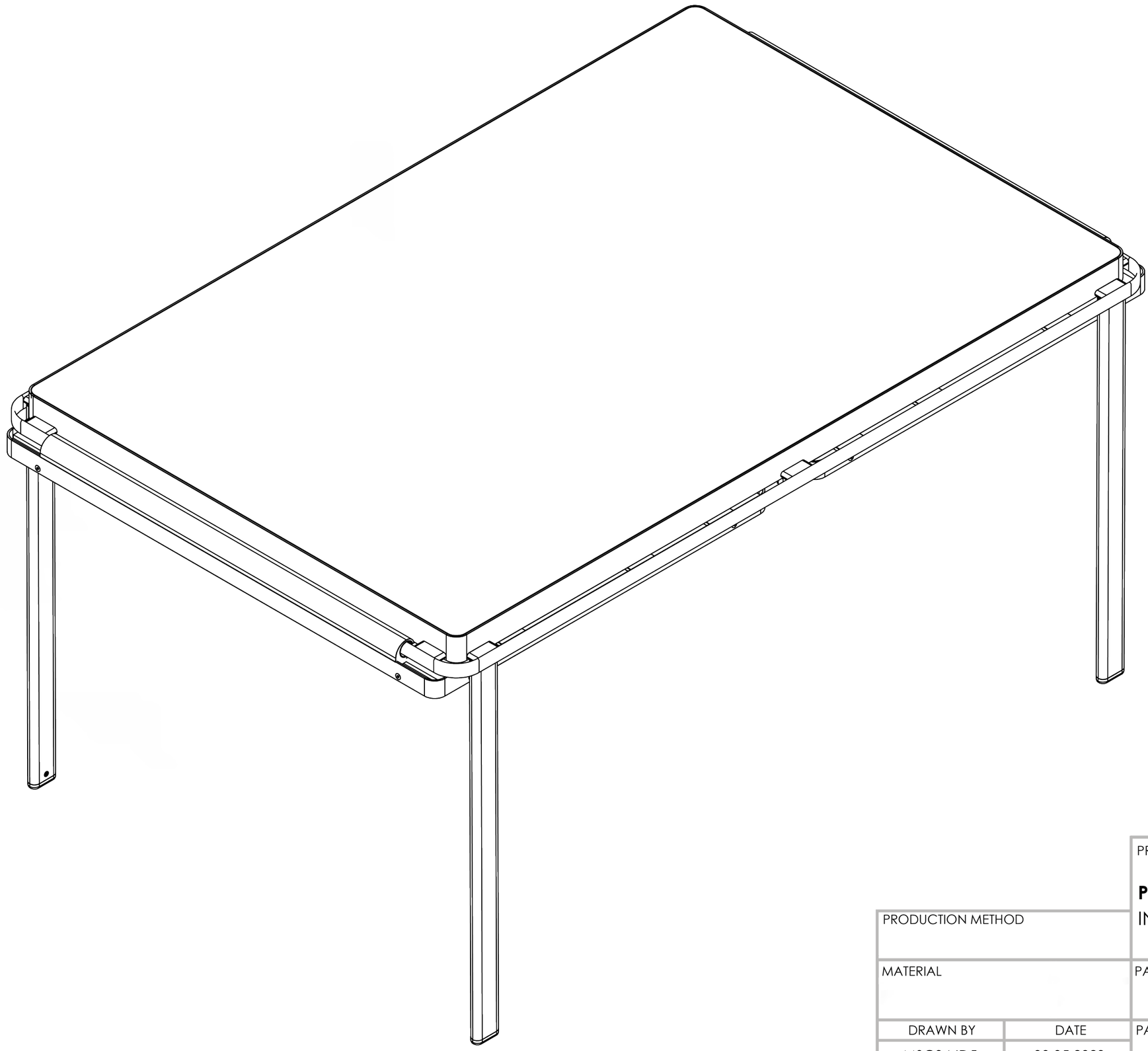
List of illustrations

Pivot

a living table

Technical drawings : MA4-ID5 : June 2023
Camilla Frederikke Andersen, Martin Vestergaard Schjøtt,
Nikoline Sander Jensen





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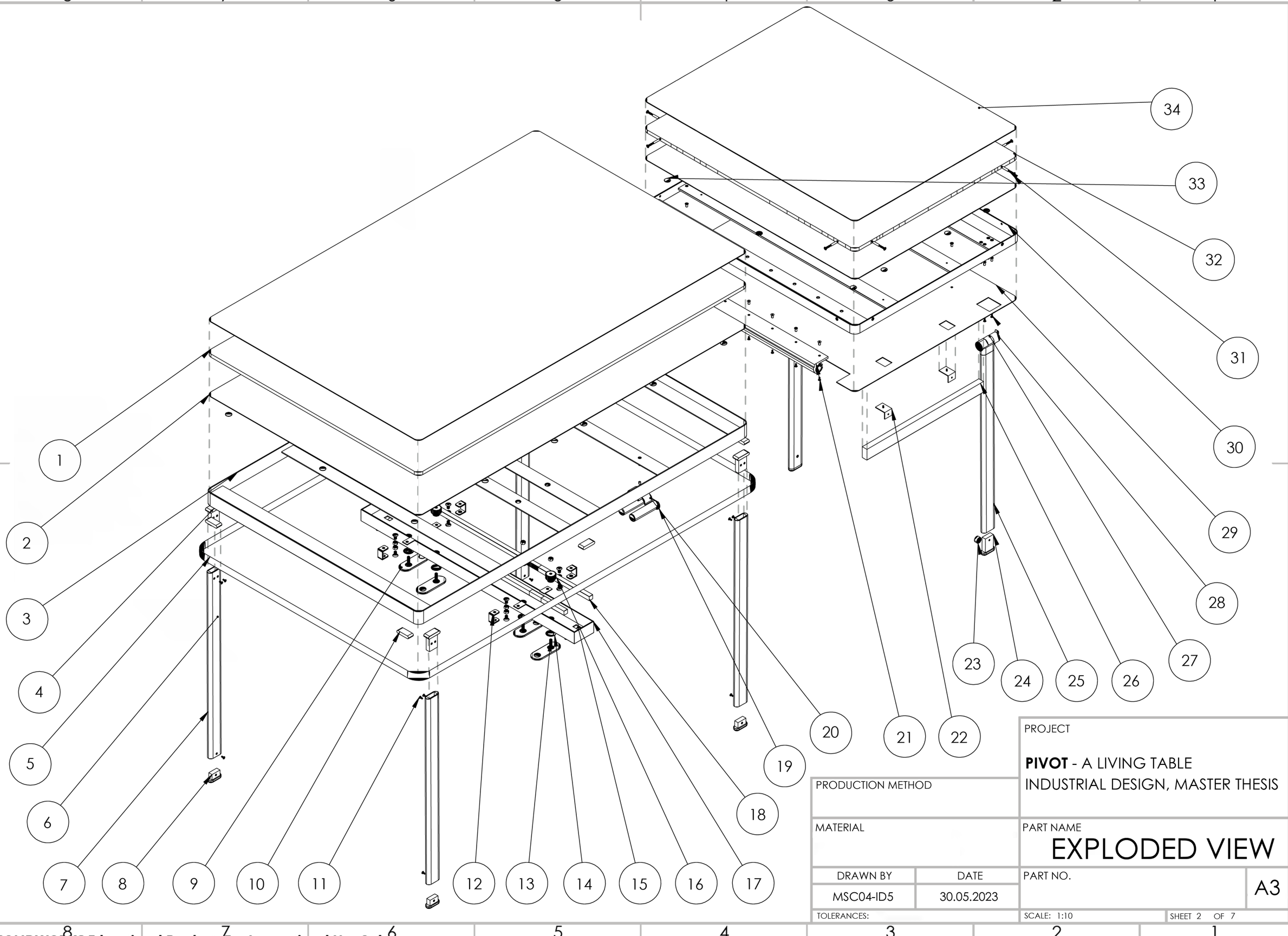
TOLERANCES:		SCALE: 1:6	SHEET 1 OF 7



PROJECT			
PIVOT - A LIVING TABLE INDUSTRIAL DESIGN, MASTER THESIS			
PRODUCTION METHOD			
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		EXPLODED VIEW	
DRAWN BY	DATE	PART NO.	A3
MSC04-ID5	30.05.2023		
TOLERANCES:		SCALE: 1:10	SHEET 2 OF 7

ITEM NO.	PART NAME	MATERIAL	QTY.
1	Tabletop (primary)	MDF	1
2	Linoleum (primary)	Linoleum	2
3	Frame (primary)	Aluminum, anodized	1
4	Leg connector	Aluminum, anodized	4
5	Rail	Aluminum, anodized	1
6	Steel plate	Steel	4
7	Leg (primary)	Aluminum, anodized	4
8	Feet (primary)	PA11	4
9	Retaining plate	Aluminum, anodized	4
10	Rail connector	Aluminum, anodized	6
11	Screw M4	Standard component	34
12	Fitting for gearbox	Standard component	4
13	Screw M5	Standard component	20
14	Washer	Standard component	4
15	Trigger	Aluminum, anodized	4
16	Gear	Standard component	4
17	Gearbox	Aluminum, anodized	1
18	Rack	Aluminum, anodized	2
19	Square fixator	Aluminum, anodized	1
20	Snap joint	Aluminum, anodized	1
21	Rotation hinge	Aluminum, anodized	2
22	Fitting for width hinge	Standard component	8
23	Magnet	Standard component	4
24	Feet (secondary)	Aluminum, anodized	4
25	Leg (secondary)	Aluminum, anodized	4
26	Bar	Aluminum, anodized	2
27	90 degree foldable hinge	Aluminum, anodized	4
28	90 degree locking mechanism	Aluminum, anodized	4
29	Mounting plate	Aluminum, anodized	2
30	Frame (secondary)	Aluminum, anodized	1
31	Threaded sleeve	Standard component	16
32	Tabletop (secondary)	MDF	2
33	Rubber pad	Rubber	42
34	Linoleum (secondary)	Linoleum	4

PROJECT

PIVOT - A LIVING TABLE
INDUSTRIAL DESIGN, MASTER THESIS

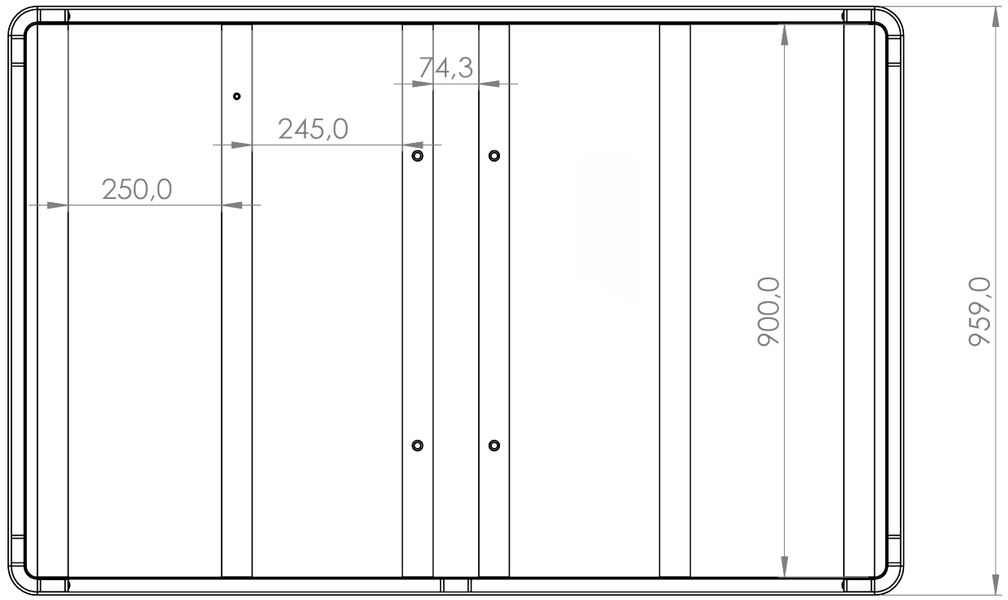
PRODUCTION METHOD

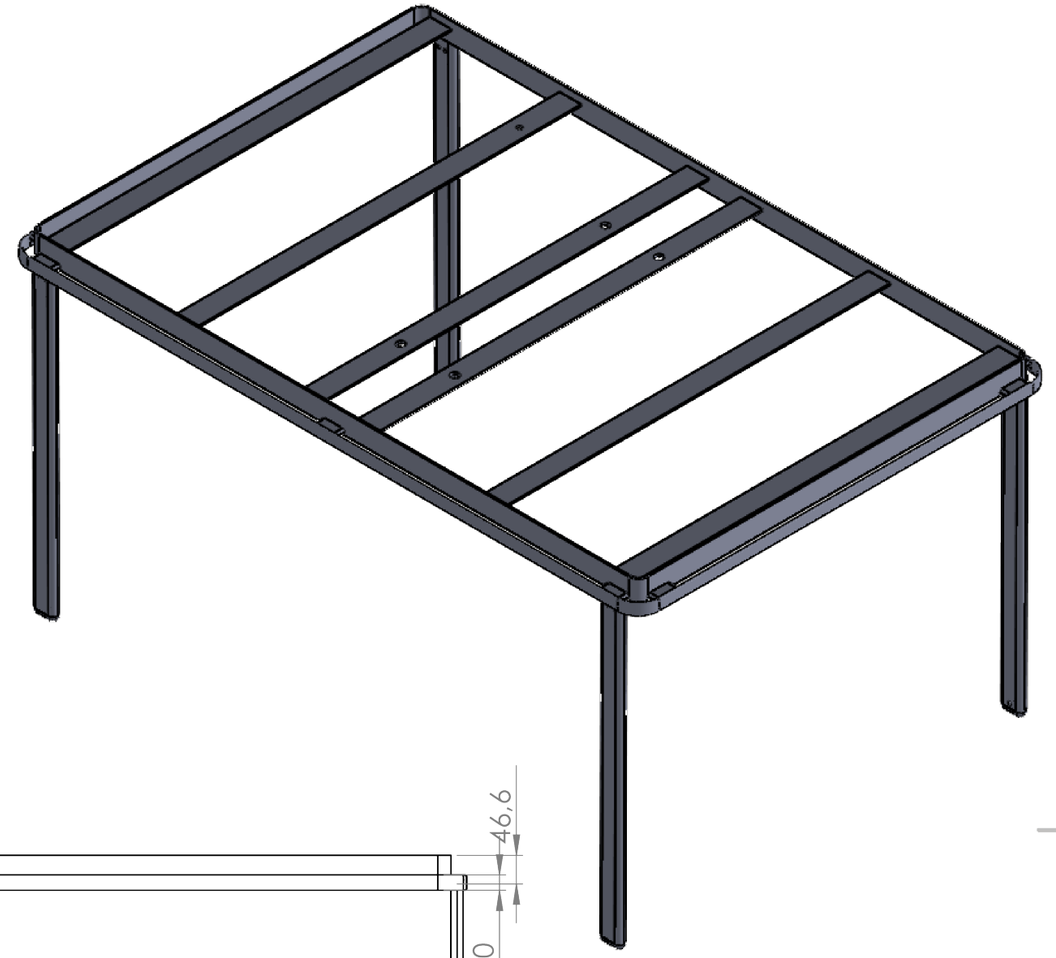
MATERIAL

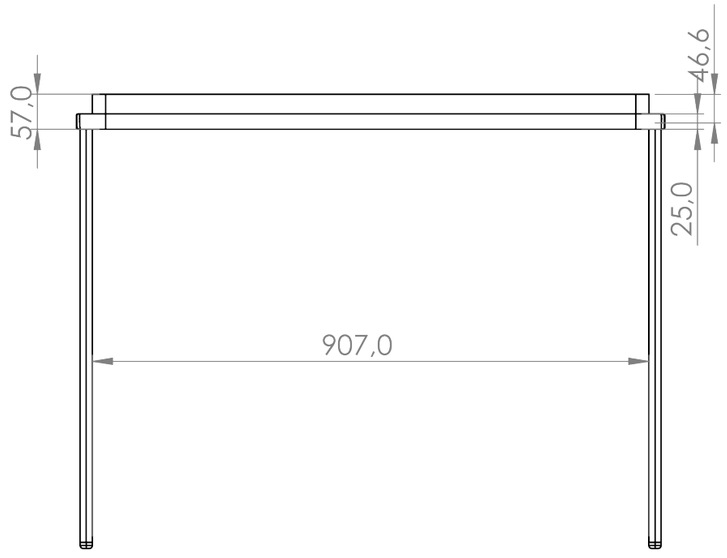
PART NAME
BOM

DRAWN BY	DATE	PART NO.	A3
MSC04-ID5	30.05.2023		

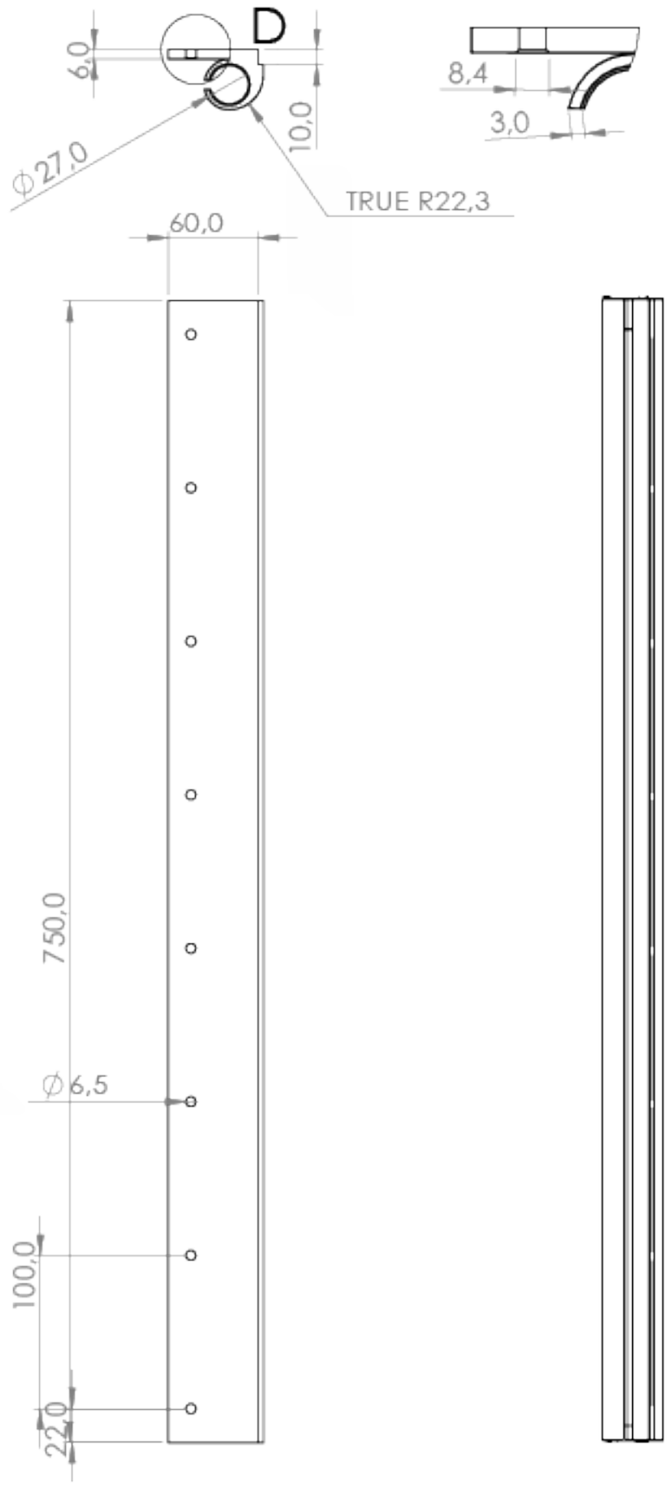
TOLERANCES: SCALE: SHEET 3 OF 7

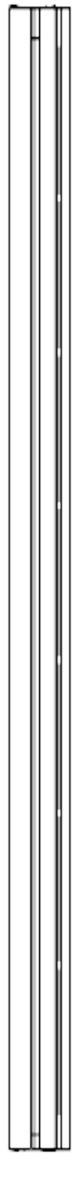




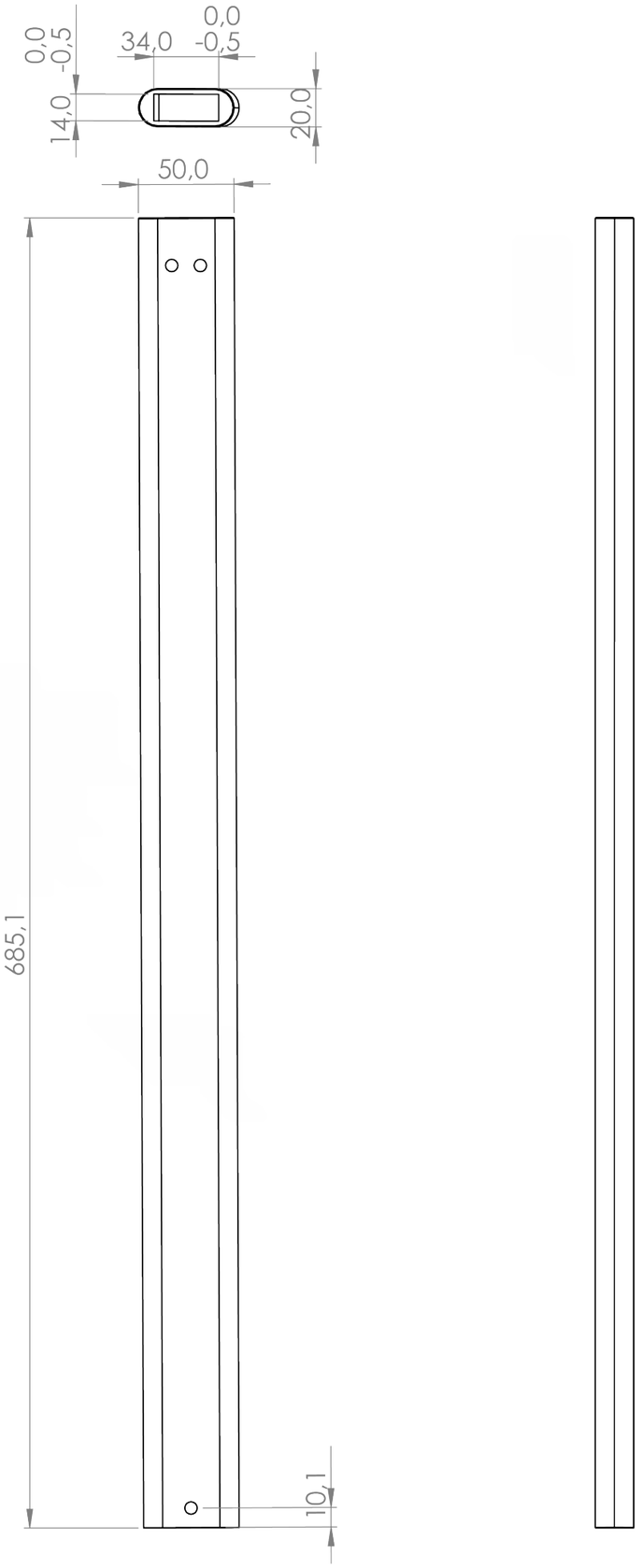


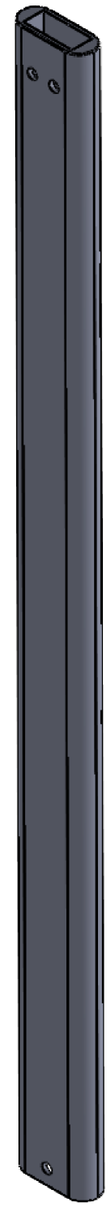
PROJECT	**PIVOT** - A LIVING TABLE INDUSTRIAL DESIGN, MASTER THESIS
PRODUCTION METHOD	Bended and welded
MATERIAL	Aluminum, anodized
PART NAME	Frame (primary)
DRAWN BY	MSC04-ID5
DATE	30.05.2023
PART NO.	3
A3	
TOLERANCES:	ISO 2768 - medium
SCALE: 1:10	MEASURES IN MM
SHEET 4 OF 7	



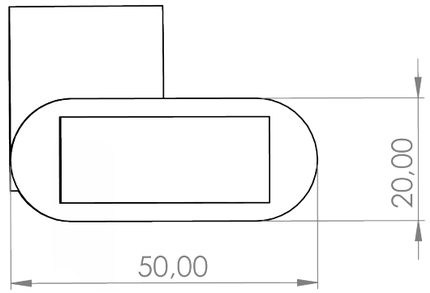


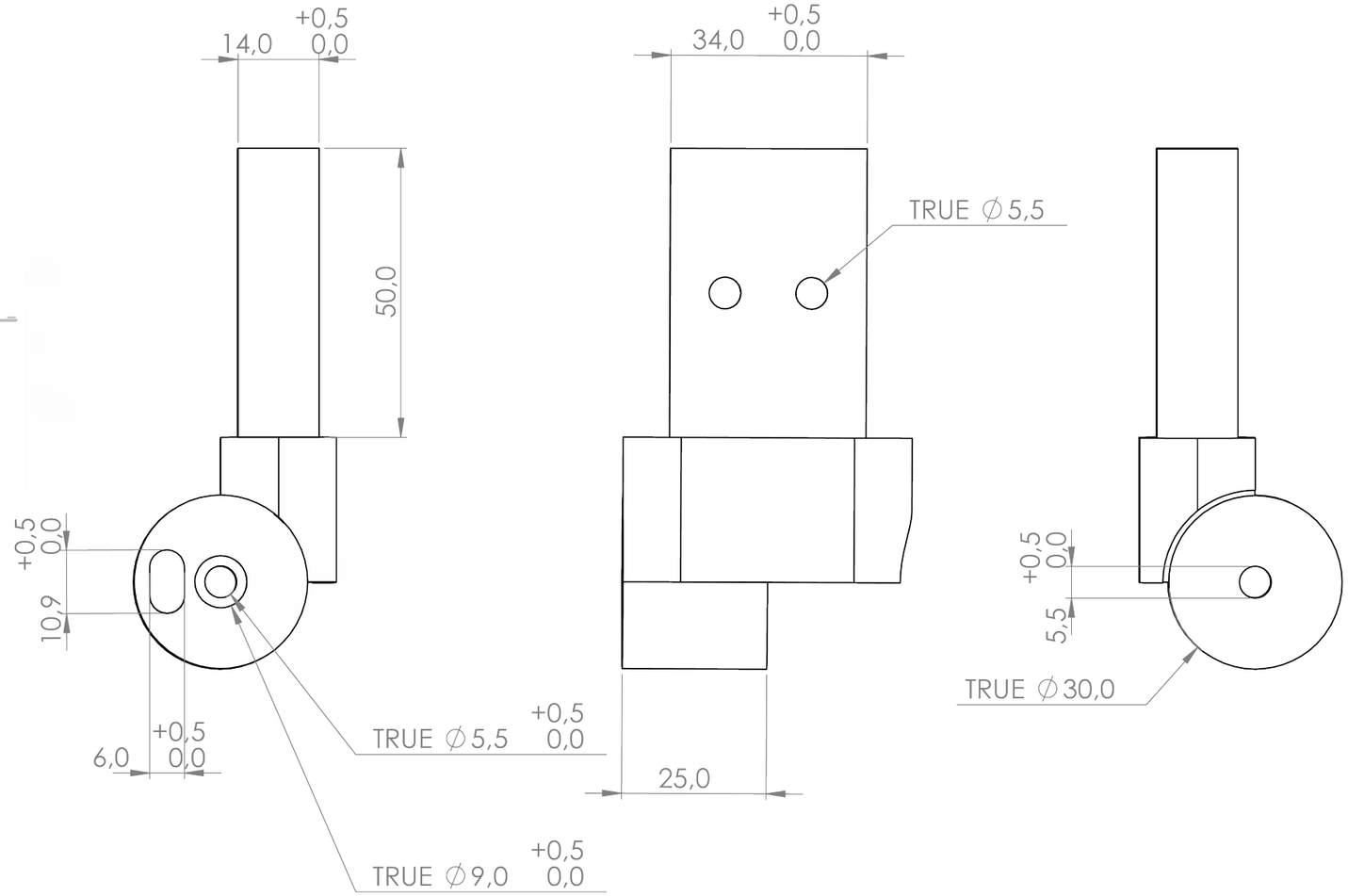
PROJECT	**PIVOT** - A LIVING TABLE INDUSTRIAL DESIGN, MASTER THESIS
PRODUCTION METHOD Extruded	
MATERIAL Aluminum, anodized	PART NAME Rotation hinge
DRAWN BY: MSC04-ID5 / DATE: 30.05.2023	PART NO. 21 / A3
TOLERANCES: ISO 2768 - medium	SCALE: 1:4 / MEASURES IN MM / SHEET 5 OF 7

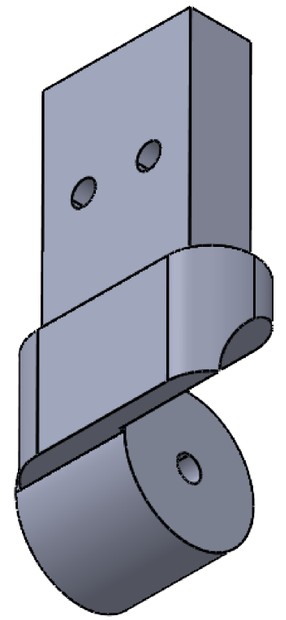


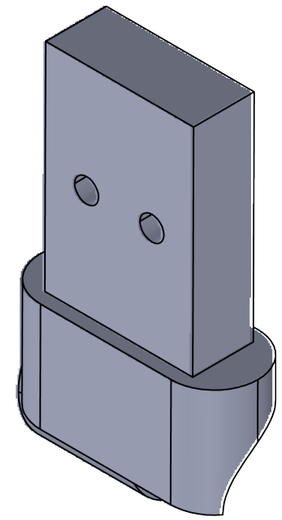


PROJECT		**PIVOT** - A LIVING TABLE INDUSTRIAL DESIGN, MASTER THESIS	
PRODUCTION METHOD Extruded			
MATERIAL Aluminum, anodized		PART NAME Leg (secondary)	
DRAWN BY	DATE	PART NO. 25	A3
MSC04-ID5	30.05.2023		
TOLERANCES: ISO 2768 - medium		SCALE: 1:3	MEASURES IN MM / SHEET 6 OF 7









PROJECT	**PIVOT** - A LIVING TABLE INDUSTRIAL DESIGN, MASTER THESIS
PRODUCTION METHOD	Cutted and CNC-milled
MATERIAL	Aluminum, anodized
PART NAME	90 degree foldable hinge
DRAWN BY	MSC04-ID5
DATE	30.05.2023
PART NO.	27
	A3
TOLERANCES:	ISO 2768 - medium
SCALE:	1:1
MEASURES IN MM	
SHEET	7 OF 7