FORMA COLLECTION

AMALIE SKOVDAM, EMILIE AMTOFT, SARA VANGGAARD

PRODUCT REPORT / MA4-ID11 / MAY 2025

TITLE PAGE

PROJECT TITLE
Forma Collection

PROJECT THEME
A dining chair designed to adapt rather than expire

PROJECT TEAM
MSc14, team 11
Industrial Design
Aalborg University

PROJECT PERIOD
03.02.2023 - 28.05.2025

MAIN SUPERVISOR
Christian Tollestrup

TECHNICAL SUPERVISOR
Matin Afshar

NUMBER OF PAGES
24

ABSTRACT

FORMA is a master's thesis project that aims to counteract the pressing throwaway culture within the furniture industry by promoting longevity and adaptability to provide long-lasting value. The overconsumption and premature disposal of furniture are driven by two primary factors: the dependence of corporate economic growth on the continued use of planetary resources, and consumers' frequent replacement of furniture due to aesthetic obsolescence — primarily driven by fast fashion trends within the industry.

FORMA is a dining chair designed for adaptability to changing aesthetic needs — either to keep up with current trends or to maintain a timeless design. The appearance of the chair can be transformed by interchanging the seat and backrest offered in different shapes, colors and textiles. The chair is targeted for the design brand HAY, which is reflected in its aesthetic appearance and the degree of customizable options available. The sustainable aspect of interchangeability relies on a take-back system that facilitates the refurbishment of interchangeable parts, with the aim of providing continuous revenue while substantially reducing the need for new resources.

In a broader perspective, FORMA serves as a case example of how more responsible furniture design might take shape within a proposed system for such practice - applicable across design companies and furniture types.

Amalie Mathilde Funder Skovdam

Emilie Amtoft

Sara Katrine Vanggaard Kaupang

CONTENTS

VISION, MISSION & STORY

In today's fast-paced consumer culture, even well-functioning furniture is often discarded — not because it's broken, but because it no longer fits with the latest interior trends. This project was born out of a desire to challenge that throwaway mindset and rethink how furniture can evolve with our lives.

Our mission is to offer a smarter alternative: a dining chair designed to adapt rather than expire. By allowing users to update the seat and backrest over time, the chair makes it possible to renew its aesthetic without replacing the entire piece. It's a small, practical step toward a more conscious way of consuming — one that values longevity, flexibility, and design that grows with you.

THE CHAIR WITH A THOUSAND FACES

With a classic, wooden chair frame combined with an interchangeable seat and backrest Forma Collection adapts effortlessly into various different interior styles. Whether the home is minimalist, eclectic, classic, or contemporary, the chair can be tailored to suit its surroundings — or evolve alongside them.

THE FORMA COLLECTION DISPLAYED IN VARIOUS CONFIGURATIONS, SHOWCASING THE DIVERSITY OF THE CHAIR.

LINA IS SHOWN ON A NATURAL OAK FRAME WITH BORDEAUX SEAT AND BACKREST. FILIPPA IS DISPLAYED IN BLACK STAINED OAK WITH SAGE UPHOLSTERED SEAT. MONA IS SHOWN AS PURE NATURAL OAK.

LINA, FILIPPA & MONA

In the first launch of the Forma Collection, three distinct backrests is presented as front figures, each with its own identity.

LINA is small, sharp and geometric – confident in form and not afraid to be the center of attention.

FILIPPA is elegant, composed, and dependable – with her minimal yet supportive armrests, she brings calm and clarity to any space.

MONA is soft, generous, and organic – inviting warmth and creating a cozy, welcoming atmosphere.

Together, they offer a palette of expression, allowing the chair to reflect the personality of its owner – or simply shift moods as life and interiors evolve.

BUILT TO LAST – DESIGNED TO MATTER

The chair's construction is rooted in timelessness — both in form and durability. Its frame is crafted from solid oak, available in either natural or black-stained finishes, offering a warm and versatile presence that fits seamlessly into a wide range of interiors. The use of rectangular wood profiles not only gives the chair its clean and characteristic aesthetic but is also a conscious material choice: each profile is carefully selected from standard-sized timber to reduce waste and minimize processing, ensuring a more sustainable production.

Designed for longevity, the wooden frame serves as the permanent foundation of the chair — one that doesn't need to be replaced over time. The changeable backrest and seat are attached without glue, allowing you to update the chair's appearance without compromising its structural integrity. This modular approach supports circular thinking, encouraging maintenance, reuse, and extended product life — without sacrificing style.

EFFICIENT BY DESIGN

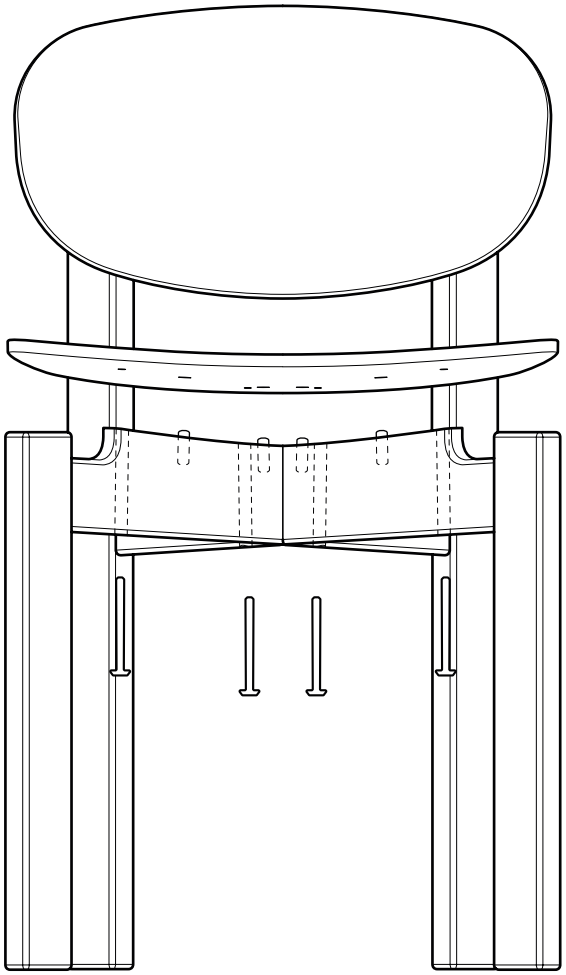
Forma Chair is constructed from four main components: two leg modules, a seat, and a backrest. The assembly process is simple yet sturdy; The two leg modules intersect to form a cross construction at the base — the foundation of the chair's strength and stability. To guide proper orientation, a small circular groove is milled into the wood where the two modules meet, ensuring they are positioned correctly in relation to each other.

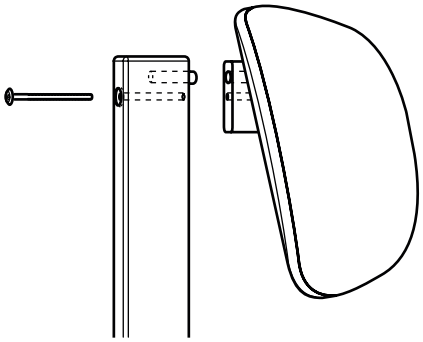
Once aligned, the cross is secured with a Ø6 mm furniture bolt, reinforcing the overall structure. The seat is then mounted from underneath using four matching bolts, guided into place by integrated dowels. Finally, the backrest is attached using two screws inserted from the back of the chair legs.

The simple cross construction combined with the use of furniture bolts enables flat-packing. By allowing the chair to be shipped in a compact format, Forma significantly reduces the environmental impact of transportation, making it a practical and conscious solution.

EASY AESTHETIC UPDATE

One of the core principles behind the Forma Collection is longevity through adaptability. To support this, the chair has been designed with a construction that allows for easy and intuitive updates. Whether you want to freshen up your space with a new color or want an entire new look of your chair, the seat and backrest can be easily replaced at home using a standard 4 mm Allen key.





After detaching the old seat, the new seat is placed directly onto the cross construction formed by the two leg modules. Here, built-in dowels guides the seat into the correct position, making it easy to attach the seat securely using hand-tightened furniture bolts from underneath. The backrest works the same way; the dowels help you align it correctly, and then you simply screw it in place from the back of the chair legs.

This tool-free and straightforward assembly ensures a confident update of your chair, resulting in a seamless transition from old to new.

MONA SHOWN ON A BLACK STAINED
FRAME WITH MATCHING BACKREST AND
A SEAT IN SAGE UPHOLSTERY.

A CHAIR FOR LIFE

In today's fast-paced world of interior trends, the urge to refresh your home isn't always satisfied by a new vase or a fresh cushion cover. Sometimes, it takes more to create the sense of renewal you're craving, without starting from scratch.

With Forma, you can update your dining area in a way that feels significant, yet sustainable. By simply replacing the seat or backrest on one or more of your chairs, you're able to create a whole new visual identity — creating a big change with a small investment.

YEAR 1

LINA IS BROUGHT HOME AS A STATEMENT PIECE TO THE ROOM.

YEAR 5

MONA IS INTRODUCED TO CREATE A SOFTER, WARMER SPACE.

YEAR 10

FILIPPA APPEARS AFTER 10 YEARS OF EVOLVING STYLE, TO BRIGHTEN UP THE ROOM.

AESTHETIC POSSIBILITIES

As part of the Forma Collection, you get to choose between two frame finishes, three upholstery options, and five lacquered colors for the backrest — allowing you to fully customize and configure your ideal chair. The frame is always available in black stained and natural oak, providing a timeless foundation, that fits into any setting.

Each year, one new backrest variant or color combination is introduced to ensure that you are always following the latest interior trends, and never go out of style.

FRAME COLORS

natural oak

black stained oak

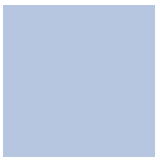
SEAT AND BACKREST COLORS

natural oak veneer

black stained oak veneer

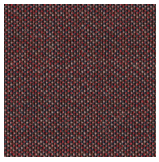
bordeaux RAL 360 30 35

sage RAL 130 80 10

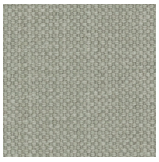


dusty blue RAL 270 80 15

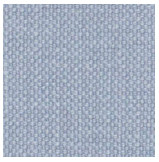
UPHOLSTERY COLORS



bordeaux Atlas 671, Kvadrat



sage Linara 529, Romo



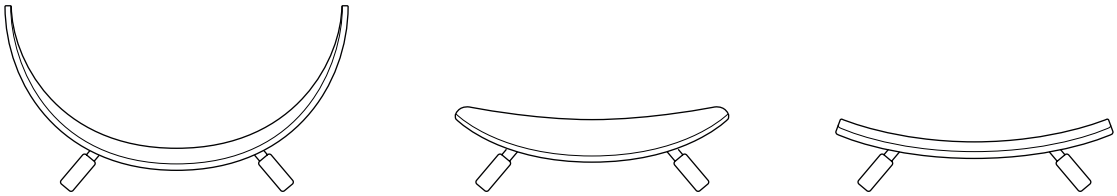
dusty blue Linara 400, Romo

AESTHETIC FREEDOM, ONE SPACER AT A TIME

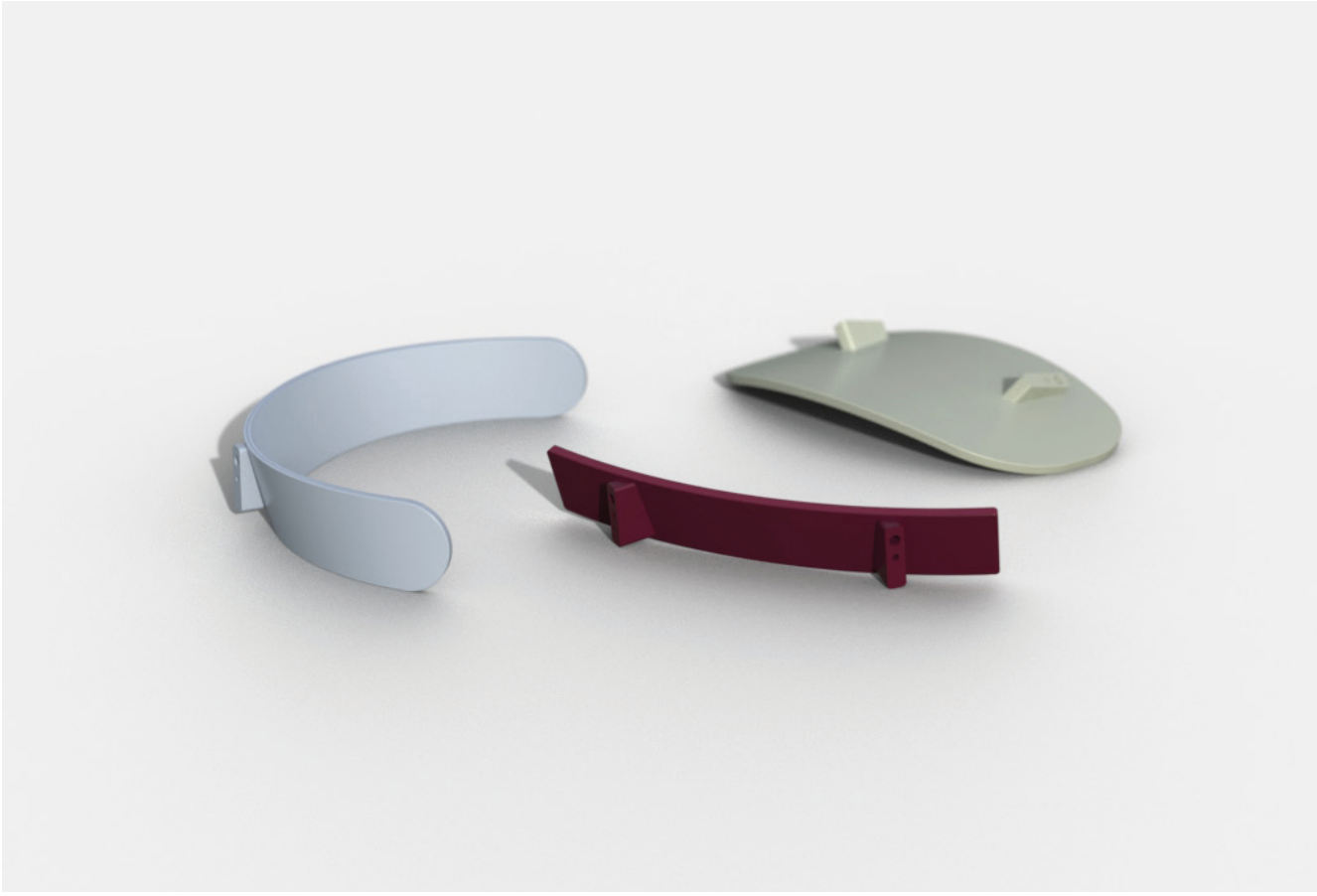
FILIPPA IN A PURE NATURAL OAK VERSION.

From a business perspective, the spacers between the backrest and chair frame, is what makes all the difference, as it allows infinite aesthetic possibilities.

Instead of being limited to one fixed interface between backrest and chair frame, the spacers introduce a flexibility of the backrest that allows for any curvature, size, or shape. This makes it possible to develop future backrest variants freely — responding to evolving interior trends without compromising the core construction. In this way, the spacers become the enabler of long-term aesthetic relevance, making Forma not just a chair for today, but a design platform for tomorrow.



FILIPPA IN DUSTY BLUE, LINA IN BORDEAUX, AND MONA IN SAGE.



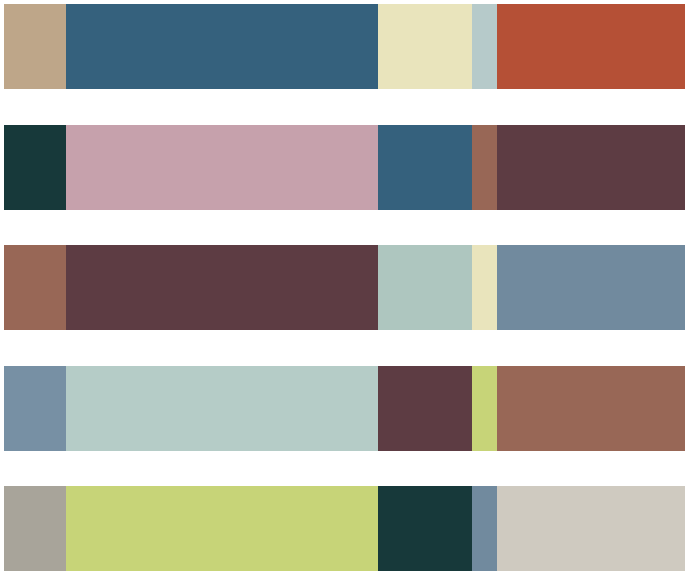
THE FUTURE OF A FORMA COLLECTION

Forma is not a static furniture piece — it's an ever changing collection designed to evolve alongside changing tastes and trends in interior design. The three initial backrest characters, Lina, Mona and Filippa, represent just the beginning. Each one captures a unique aesthetic expression, but they're also front-runners in a continuous story of renewal.

Each year, a new variant will be introduced to reflect the spirit of the time — whether through a new color, or a completely new expression through different shapes. One of the existing variants will step aside to make room for the next, keeping the collection fresh, and connected to contemporary interiors. In this way, Forma remains not only functionally long-lasting, but also aesthetically relevant.

FUTURE POSSIBLE FORMA CHAIRS WITH VARYING SHAPES, SIZES AND COLORS DEPENDING ON PREVAILING TRENDS.

COLOR INSPIRATION SS 2026+



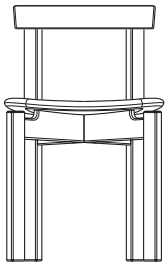
INVEST ONCE, RENEW OVER TIME

Investing in a Forma chair means choosing a long-lasting piece of furniture that evolves with you. Designed to adapt to your shifting needs and changing aesthetic preferences, the chair can be updated over time instead of replaced.

Your first purchase is a one-time investment in a fully customized configuration. Later, when your style changes or your space calls for a new look, you can refresh your chair by swapping the seat and backrest at a reduced price, without starting from scratch.

YOUR FIRST INVESTMENT IN A FORMA CHAIR

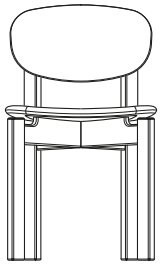
LINA



W/O UPHOLSTERY
Sales price: 3299 DKK
Retailer price: 1899 DKK

W/ UPHOLSTERY
Sales price: 3499 DKK
Retailer price: 2099 DKK

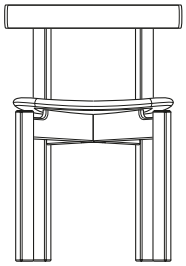
MONA



W/O UPHOLSTERY
Sales price: 3299 DKK
Retailer price: 1899 DKK

W/ UPHOLSTERY
Sales price: 3499 DKK
Retailer price: 2099 DKK

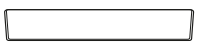
FILIPPA



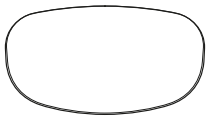
W/O UPHOLSTERY
Sales price: 3949 DKK
Retailer price: 2349 DKK

W/ UPHOLSTERY
Sales price: 4299 DKK
Retailer price: 2599 DKK

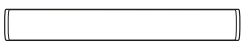
NEW UPDATE WITH TAKE-BACK SYSTEM



LINA BACKREST
New price: 749 DKK
Take-back price: 449 DKK

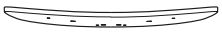


MONA BACKREST
New price: 799 DKK
Take-back price: 499 DKK

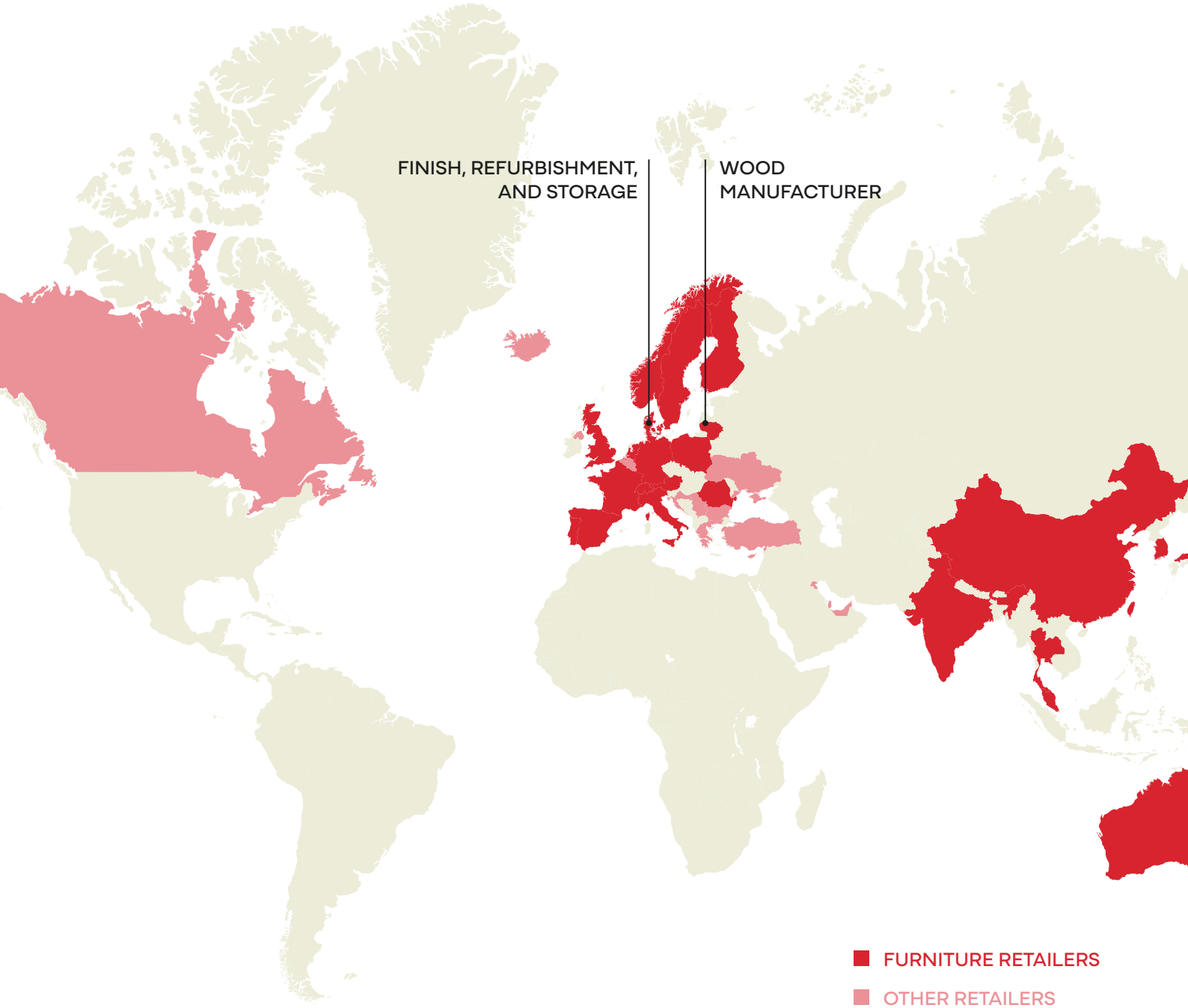


FILIPPA BACKREST
New price: 1049 DKK
Take-back price: 649 DKK

SEAT W/UPHOLSTERY
New price: 749 DKK
Take-back price: 449 DKK

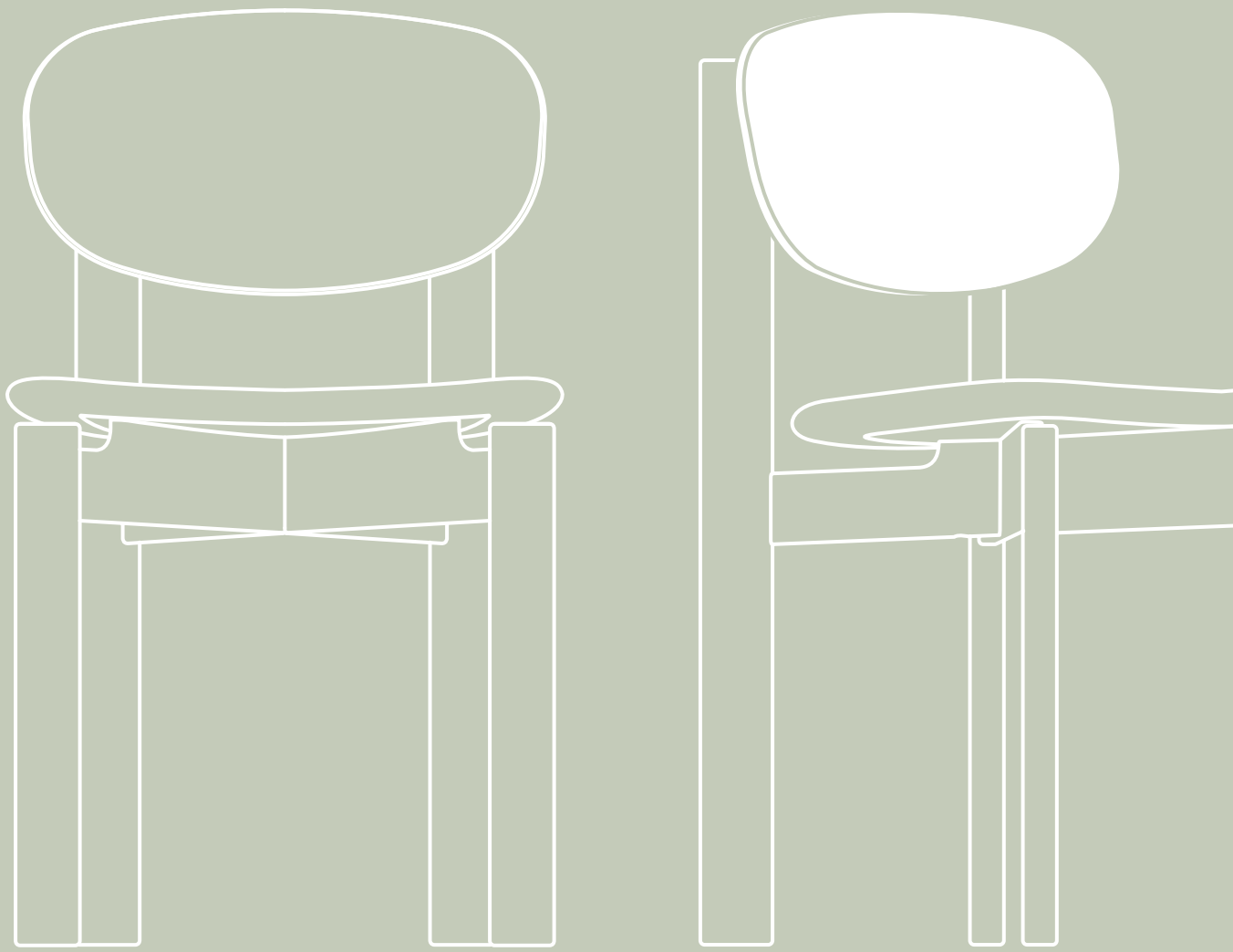


SEAT W/O UPHOLSTERY
New price: 599 DKK
Take-back price: 399 DKK



PURCHASE AND TAKE-BACK LOCATIONS

To make replacement easy and efficient, all take-back orders are handled online — either from the comfort of your home or through your local retailer. Whether you're looking for a complete makeover or just a subtle update, your new parts will be made to order, helping us reduce waste and avoid overproduction. Within 6–8 weeks, your new seats and backrests arrive at your doorstep — and as a part of the service, we take your old components back with us. That way, they can be refurbished and given a new life.



FORMA COLLECTION

AMALIE MATHILDE FUNDER SKOVDAM, EMILIE AMTOFT,
SARA KATRINE VANGGAARD KAUPANG

PROCESS REPORT / MA4-ID11 / MAY 2025

TITLE PAGE

PROJECT TITLE
FORMA COLLECTION

PROJECT THEME
RESPONSIBLE FURNITURE DESIGN

PROJECT:
MASTER'S THESIS
INDUSTRIAL DESIGN, AALBORG UNIVERSITY

PROJECT TEAM
MA4-ID11

PROJECT PERIOD
03.02.25 - 28.05.25

MAIN SUPERVISOR
CHRISTIAN TOLLESTRUP

TECHNICAL SUPERVISOR
MATIN AFSHAR

NUMBER OF PAGES
109

NUMBER OF APPENDICES
35

Amalie Mathilde Funder Skovdam

Emilie Amtoft

Sara Katrine Vanggaard Kaupang

ABSTRACT

FORMA is a master's thesis project that aims to counteract the pressing throwaway culture within the furniture industry by promoting longevity and adaptability to provide long-lasting value. The overconsumption and premature disposal of furniture are driven by two primary factors: the dependence of corporate economic growth on the continued use of planetary resources, and consumers' frequent replacement of furniture due to aesthetic obsolescence - primarily driven by fast fashion trends within the industry.

FORMA is a dining chair designed for adaptability to changing aesthetic needs - either to keep up with current trends or to maintain a timeless design. The appearance of the chair can be transformed by interchanging the seat and backrest offered in different shapes, colors and textiles. The chair is targeted for the design brand HAY, which is reflected in its aesthetic appearance and the degree of customizable options available. The sustainable aspect of interchangeability relies on a take-back system that facilitates the refurbishment of interchangeable parts, with the aim of providing continuous revenue while substantially reducing the need for new resources.

In a broader perspective, FORMA serves as a case example of how more responsible furniture design might take shape within a proposed system for such practice - applicable across design companies and furniture types.

ACKNOWLEDGEMENTS

Firstly, a huge thanks to our main supervisor, Christian Tollestrup, who continuously challenged and motivated us to test the limits - and when hitting them got us stuck, he managed to support and lead us back on track, which we are very grateful for.
Also, a big thanks to our technical supervisor, Matin Afshar, for his valued contributions to the technical and constructive development of the design proposal.

Thank you to all our interviewees, who not only helped us gain a deeper understanding of furniture disposal behavior driven by aesthetic obsolescence, but also shed light on the needs and aspirations that are essential to address in order to satisfy the desire for aesthetic renewal in the long-term.

Big thanks to Henrik Holm, who took the time to introduce us to the world of upholstery and enriched us with professional insights worth understanding in relation to traditional upholstery methods.
Furthermore, thanks to Jens Højer, who have contributed with valuable knowledge during the concept development of the design proposal by his competence and expertise within the field of furniture production.
Another thanks to Hans Høgh, who provided us with valuable insights on production costs at the time we needed this expertise to move forward in the process.
A big thanks to Søren Jacobsen, who helped us figure out the most appropriate manufacturing processes for the design proposal by providing competent sparing and cost estimation. Likewise, a big thanks to Nicolai Rytter, who helped us gain an understanding of the aspects and processes of maturing and implementing a new product proposal within a design company.

Lastly, a special thanks to Anders Hauerberg Hansen, who took his time to evaluate the design proposal with us and continuously provided sparing in regard to production, costs and market positioning. We highly appreciate his involvement in this project, as it contributed with essential and highly valuable knowledge for the development of this project.

Hans Høgh
Industrial Design Engineer, Podovo

Jens Højer
Owner & Internal Sales Manager, Rumas

Henrik Holm
CEO, AP Møbelpolstring

Søren Jacobsen
Workshop Coordinator, JLA Byg

Nicolai Rytter
Product Manager, SACKit

Anders Hauerberg Hansen
Sales & Product Manager, Vermund - VELA

READING GUIDE

This project consists of four parts: a product report, a process report, technical drawings, and an appendix. It is recommended to read the product report first, after which the process report can be explored.

The process report summarizes the entire design process of the proposal across eight phases. At the end of each phase, a design brief is provided to outline the project scope along with the established requirements.
Throughout the report, gained insights and requirements will be indicated with the following symbols:

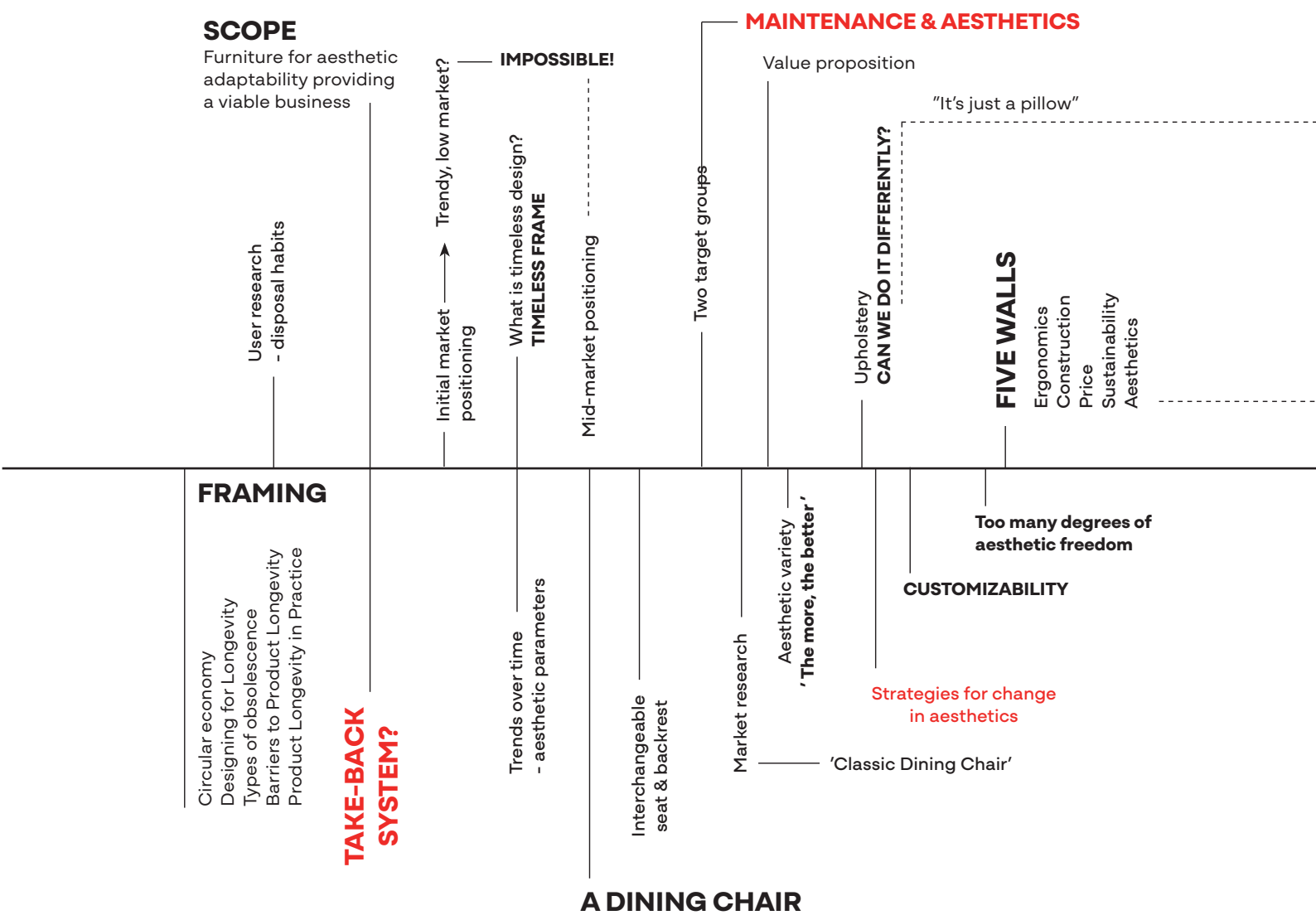
!	This icon indicates when a new, relevant insight is gained from the investigation to consider moving forward in the process
+	This icon indicates when a new requirement for the product proposal is derived from the investigation

It is important to note that the requirements will be divided into general requirements and case-specific requirements (indicated with an arrow). The case-specific requirements are specified for the product proposal, while the general requirements will be used to establish a system proposal at the end of Phase 07. In the end of each phase is a design brief in which the deducted case-specific requirements will be listed. A full overview of all case-specific and general requirements can be found on p. 104.

All references are made using Harvard Style, and a complete list of references and illustrations can be found at the end of this report.

CONTENTS

PROCESS TIMELINE



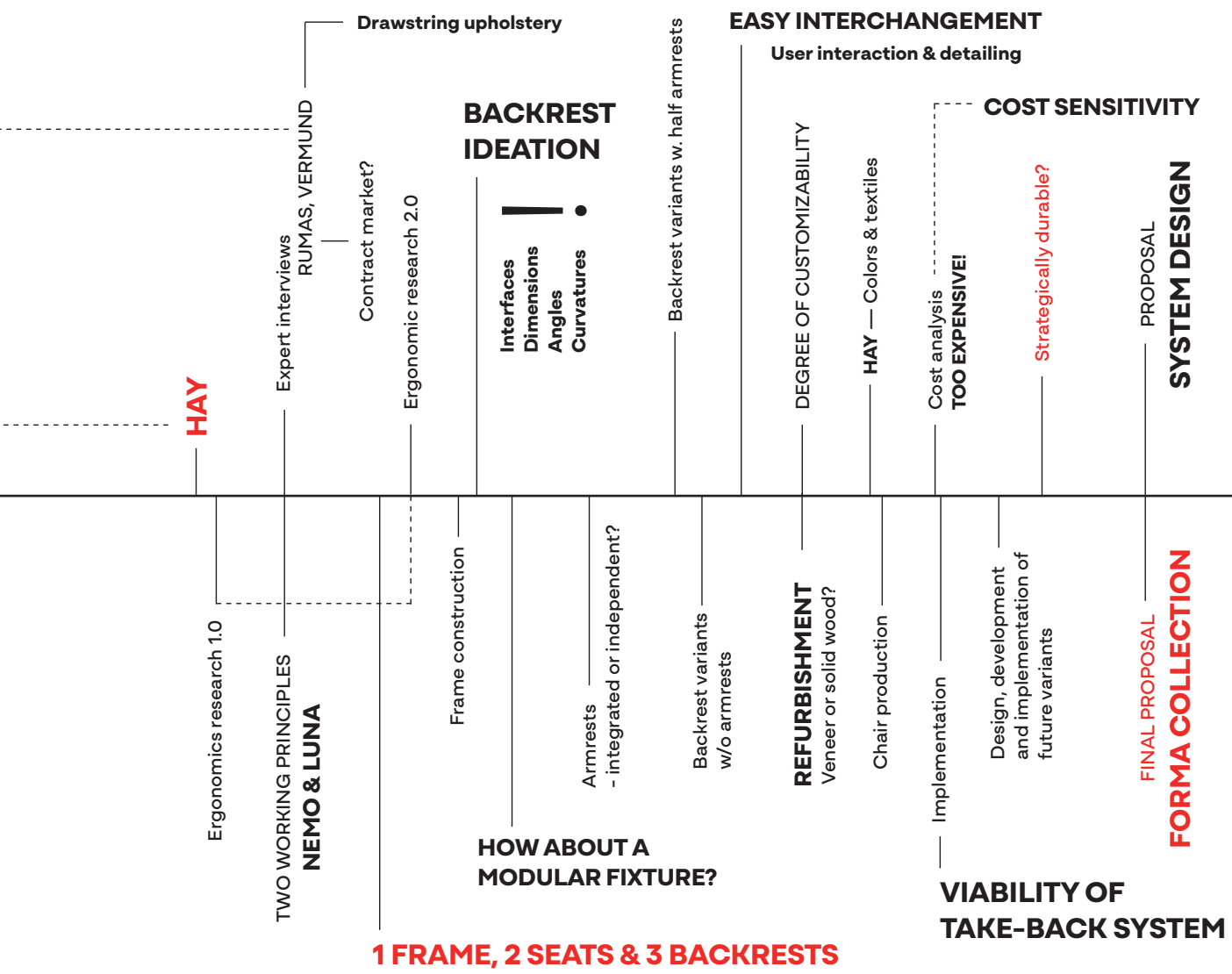
METHODS

To complement existing dimensions of designing for longevity, Strategic Durability (Haase & Laursen, 2023) has been a strategy used to focus on the competitive and strategic aspects of the design proposal. The strategy entails making three long-lasting fits with the product:

Product-user fit: Focus on addressing long-term problems and needs of the user.

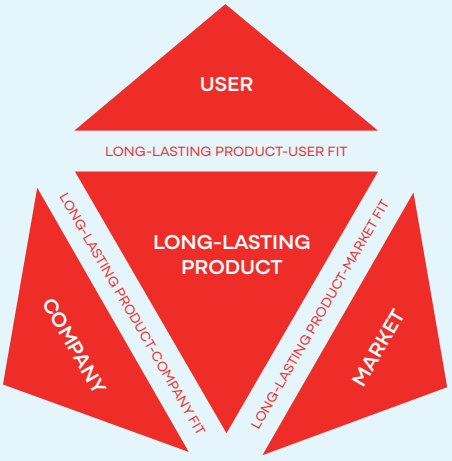
Product-market fit: Focus on creating long-term competitive advantages in the market.

Product-company fit: Focus on enhancing the long-term credibility and developing products that are based on a company's core competencies and strategic strengths.



The focus of each of these strategic fits will be present in different phases of the process report, depending on which one of them is addressed during the concept development. The project aims to cover the main aspects of creating a strategic fit with both the user, market, and company.

When each of the strategic fits are addressed in a section, it will be indicated with the symbols seen below:



INTRODUCTION

More than 10 million tons of furniture waste is produced annually in EU. Most of this is comprised by furniture produced within the last 10-15 years, that are still partially or fully functional at the time of disposal (Erasmus, 2017).

The underlying mechanisms of this tendency are constituted of two main contributing factors. One being that global economy is driven by continued economic growth without decoupling it from the use of planetary resources. The other factor is the rising consumerism trends for fast fashion in the furniture industry. This tendency contributes to increased consumption and premature disposal of furniture due to aesthetic obsolescence - thus functionally intact furniture, which has not yet reached the end of its intended lifetime, are disposed.

This clearly calls for action: furniture must be designed with strategies that actively counteract this throwaway culture, promoting longevity, adaptability, and long-lasting value for users. But how is this possibly done, while providing a viable business case for companies in terms of decoupling their economic growth from the use of planetary resources?

PHASE 01
FRAMING AND SCOPE

Theory
Take-back systems as a circular business strategy
User research on furniture disposal habits
What is our scope?
Average furniture lifetime
Initial market positioning
Why is furniture so hard to recycle?

CIRCULAR ECONOMY

Circular economy is a system where products and materials are kept in circulation through different processes that seek to ensure that materials never become waste and natural resources are regenerated. Thereby, the system aims to transform linear throwaway economy into a circular economy by decoupling economic activities from the consumption of finite resources (Ellen MacArthur Foundation, 2025).

The different processes of circular economy (Ill. 1), related to the consumption and use of products, aim to maintain the highest possible value of the product. The most value and integrity are kept in the innermost loop, whereas the least value is maintained in the outermost loop (Ellen MacArthur Foundation, 2022). **Thus, the project focuses on designing to maintain the product's highest possible value and integrity.**

Within the circular economy are four essential resource strategies (Bocken et al., 2021), seen in Illustration 2.

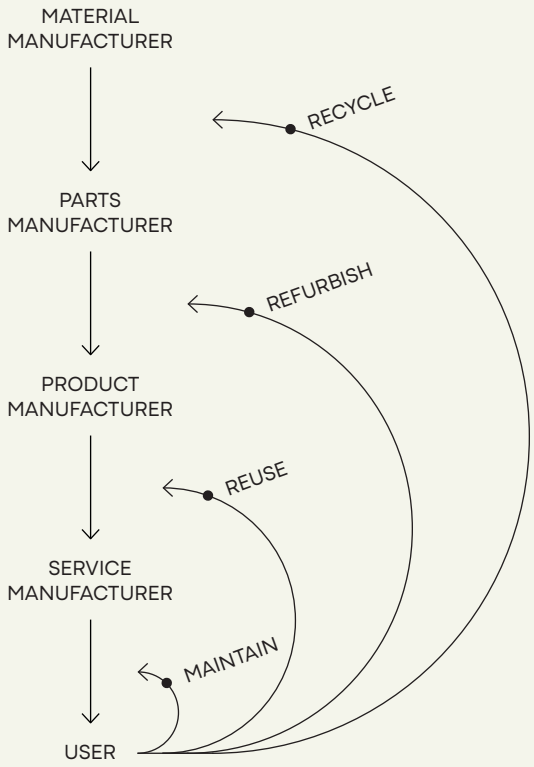
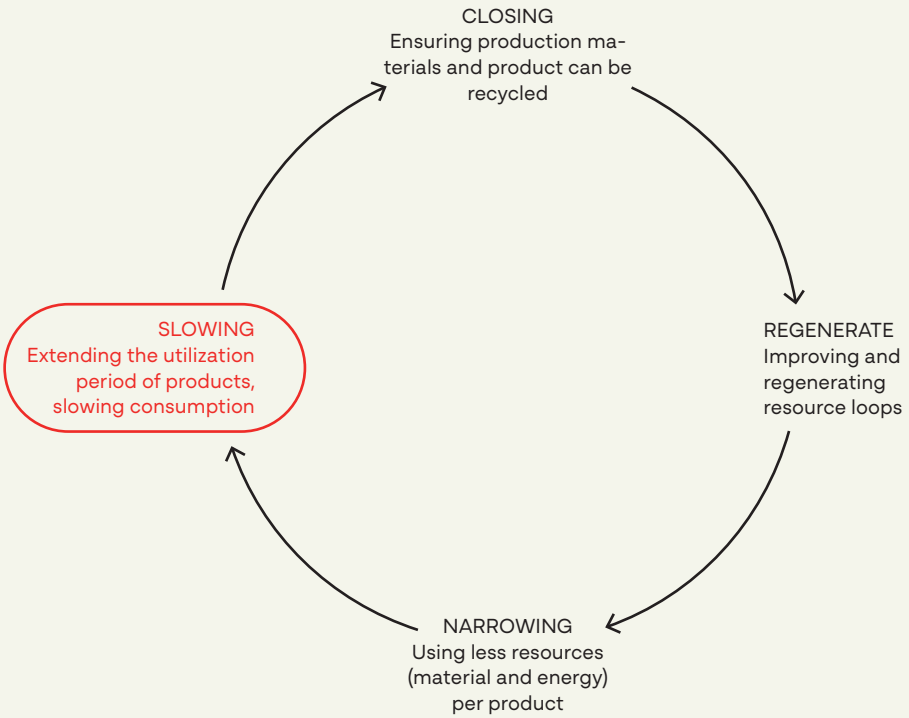


ILLUSTRATION 1: CIRCULAR ECONOMY (ELLEN MACARTHUR, 2022)

ILLUSTRATION 2: RESOURCE STRATEGIES



In relation to maintaining the highest value and integrity of the product, materials, and resources used, the focus of this project is on 'slowing' the resource loops by extending the product lifetime.

DESIGNING FOR LONGEVITY

To extend product lifetimes it is essential to design for product longevity. When designing for product longevity, it encompasses four closely related factors, that must be addressed at the same time to achieve product longevity (Jensen et al., 2021b; Haase and Laursen, 2023). **In this project, the main focus is on product obsolescence, as it can result in end of life for the product, even though it is still fully functional.**

PRODUCT LIFE CYCLE

Refers to the life stages of the product from extraction of raw materials to end of life in terms of disposal (and recycling in closed loops).

PRODUCT DURABILITY

Refers to the physical properties of the product in terms of withstanding use and keeping its functionality intact.

PRODUCT OBSOLESCENCE

Refers to the user's emotional attachment to the product. If attachment lacks, it might result in end of life for the product despite it being fully functional.

PRODUCT LIFETIME

Refers to the active lifetime of the product, in which the product is in use.

(JENSEN ET AL., 2021; HAASE AND LAURSEN, 2023)

KEY STRATEGIES FOR SLOWING RESOURCE LOOPS

Another inherent aspect of product longevity is maintaining the integrity of the product, meaning it should remain in its original state for as long as possible (Haase and Laursen, 2023). As seen in Illustration 3, product integrity can be maintained at three different levels.

Based on these levels of integrity, there are three key strategies that can be applied to slow the resource loops (Haase and Laursen, 2023), seen in Illustration 3.

The overall focus for this project is on the strategies for long use, as product durability, emotional durability and attachment, and strategic durability are fundamental aspects to address to maintain relevance of the product and avoid premature obsolescence. Some of the other strategies for extended use or recovery, such as 'Design for upgradability and flexibility' and 'design for refurbishment' are to be applied to practically support the overall strategies for long use.

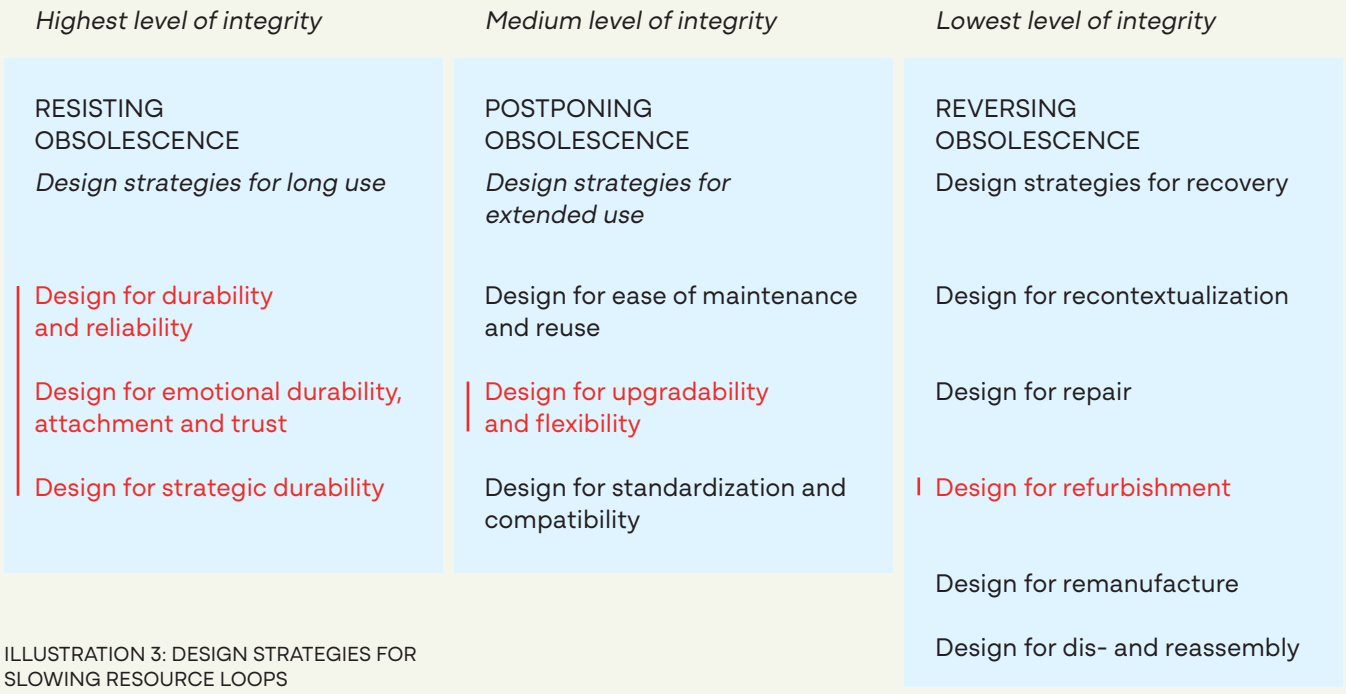


ILLUSTRATION 3: DESIGN STRATEGIES FOR SLOWING RESOURCE LOOPS

TYPES OF OBSOLESCENCE

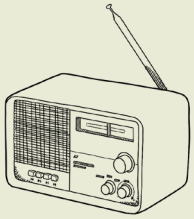
As previously stated, products are often discarded prematurely due to product obsolescence. According to Cooper (2010), there are four ways in which the obsolescence of a product occurs, seen in Illustration 4.

For this project, aesthetic obsolescence is the primary type of obsolescence that the design proposal aims to address.

In terms of aesthetic obsolescence, there are two main aspects to consider: (1) wear and tear, and (2) fashion and style.

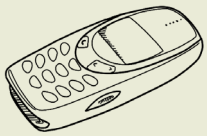
'Wear and tear' refer to the product being either faded, dirty or worn out. Thereby, the appearance of the product looks used instead of new (Burns, 2010).

'Fashion and style' refer to the product being affected by temporary trends in terms of forms and appearances. Products reflecting such temporary trends will be prone to annual, seasonal or social changes, causing the product to 'go out of fashion' (Burns, 2010). Both of these aspects are addressed in this project.



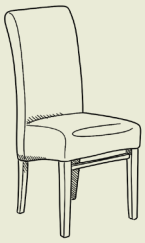
TECHNICAL OBSOLESCENCE

Product becomes obsolete due to technological change in terms of either models, technology, features or performance.



SOCIAL OBSOLESCENCE

Product becomes obsolete due to social or regulatory changes on a societal, national or global level.



AESTHETIC OBSOLESCENCE

Product becomes obsolete due to its aesthetic appearance.

ECONOMICAL OBSOLESCENCE

Product becomes obsolete due to costly or unavailable options for maintenance, repair or upgrade.

ILLUSTRATION 4: TYPES OF OBSOLESCENCE
(BURNS, 2010; HAASE & LAURSEN, 2023)

BARRIERS TO PRODUCT LONGEVITY

When designing for longevity, a large number of barriers hinder both businesses and consumers in maintaining or increasing product longevity (Jensen et al., 2021a). According to Jensen et al. (2021a), there are 14 barriers to developing and creating viable businesses based on long-lasting products. These barriers are divided into three main fields: business barriers, product development barriers and usage barriers. The barriers that are particularly relevant for this project are the two densely highlighted barriers.

The barrier 'Inability to follow fast-moving trends and fashions' deals with the aspect of aesthetic obsolescence, while the barrier 'lack of attachment to products' deals with the aspect of lacking emotional attachment - both of which acting a hinder to product longevity. The barriers lightly highlighted are barriers that will also be considered alongside the main barriers when designing the proposal for the project.

ILLUSTRATION 5: BARRIERS TO PRODUCT LONGEVITY (JENSEN ET AL., 2021)

PRODUCT LONGEVITY IN PRACTICE

Companies, overcoming these barriers for longevity, have successfully branded themselves as able to produce long-lasting products, positioning themselves as producers of 'high-quality' products (Jensen et al., 2021a). In a business aspect, long-lasting products are seen as "products that are durable and considered to be useful and desirable by users for a long period of time, while simultaneously providing a viable business." (Jensen et al., 2021a, p. 1).

To make product longevity a viable business case for companies, they must strategically integrate quality, sustainability, and commercial viability. Therefore, companies must identify the type of financial incentive structure that makes them able to increase value based on longevity and the quality of their products (Vind, 2024).

Companies currently benefitting from long-lasting products are using Circular Business Models (CBM), such as Product Service Systems - providing renting, leasing or take-back systems. Such business models encourage companies to increase the longevity of products, as it minimizes repair and replacement expenses (Jensen et al., 2021a). **Product service systems gives companies outstanding opportunity to increase customer loyalty and create new sales, as it allows for increased customer interaction (Vind, 2024).**

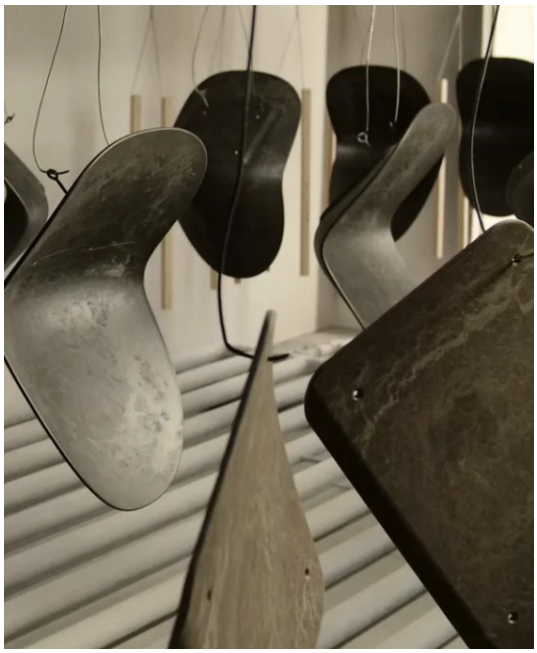


ILLUSTRATION 6: MATER CHAIRS MADE FROM COFFEE WASTE SOLD THROUGH TAKE-BACK SYSTEM

Examples of companies with such systems are the design brand, Mater, who offer a circular take-back system, as their products are made from waste materials, that can be recycled and transformed into new furniture up to five times (Vind, 2024).

Focusing on the business barriers 'Inability to follow fast-moving trends and fashions' and 'lack of attachment to products', some companies have succeeded in designing long-lasting products which are highly influenced by fashion (Jensen et al., 2021a).
As such products are typically more prone to premature substitutions before being worn out, the practical approach is to only consider fashion in the interchangeable parts of the product. This can be done by allowing only specific elements of the product, which is easily interchanged, to reflect fashion-driven design. Thereby, it is only the longevity of the interchangeable parts that is compromised, rather than the longevity of the entire product.
Such ability to cater fashion-focused customers can position companies in unique markets and sustain their market relevance, while simultaneously maintaining product longevity (Jensen et al., 2021a).

Bang & Olufsen is offering the Beosound Level portable speaker. It is designed on modular principles with the purpose of allowing users to dynamically change and customize the visual expression of the product to changes in personal taste or interior trends, in order to stimulate emotional durability and attachment. This modular approach also eased maintenance, service and repair along with disassembly for disposal and recycling (Vind, 2024).

Stykka is offering long-lasting kitchens, built for adaptability, customizability and upgradability - as a strategy against the frequent replacement of kitchens. Their products are built for disassembly and replacement of parts. They offer replacement of the kitchen fronts, either due to wear or if the customer gets tired of the visual appearance of the kitchen. Damaged or worn-out parts are taken back by Stykka for repair, remanufacturing, or recycling (Vind, 2024).

Based on this, the practical approach of allowing specific elements of the product to reflect fashion-driven design or change the visual appearance of the product, in order to increase the longevity of the entire product, will be used in the development of this project.

As a circular business model for designing a long-lasting product, take-back systems are further explored.

ILLUSTRATION 7: BEOSOUND LEVEL PORTABLE SPEAKER

ILLUSTRATION 8: STYKKA KITCHEN

STYKKA
Offering replacement of kitchen fronts, either due to wear or if the customer gets tired of the visual appearance of the kitchen.

TAKE-BACK SYSTEMS AS A CIRCULAR BUSINESS STRATEGY

A take-back system is a circular business model in which companies take responsibility for their products at the end of their life cycle. Instead of relying on customers or public waste systems to dispose of used furniture, companies establish processes to collect, inspect, and either repair, reuse, recycle, or responsibly dispose of their own products. This approach supports a shift from linear consumption to a more circular and sustainable model.

Several furniture brands, such as Vitra, Normann Copenhagen, and IKEA, have already implemented take-back systems as part of their sustainability strategies. These companies demonstrate how such systems can create long-term value by extending product lifespans, increasing customer engagement, and building stronger brand loyalty through responsible end-of-life practices.

Implementing a take-back system requires careful planning and investment, not only in logistics and strategic partnerships (such as with Producer Responsibility Organizations), but also in designing products that are suitable for disassembly, repair, or recycling. The success of a take-back model also relies on thoughtful planning to avoid market cannibalization, where remanufactured products could reduce demand for new ones.

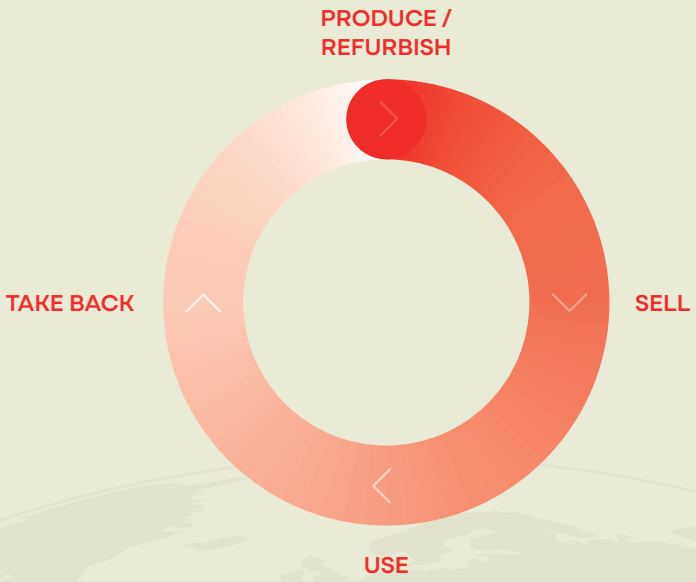
However, due to the limited time frame of this project, the complexities related to logistics and potential digital technologies are considered out of scope. Similarly, concerns around market cannibalization are not addressed further, as the take-back system of a piece of furniture is assumed to operate on a relatively small scale.

Aiming to design a circular piece of furniture, a take-back system is considered a viable business strategy, as it aligns with Circular Economy principles while providing benefits for both the business and the customer.

POTENTIAL BENEFITS OF TAKE-BACK SYSTEM

- Reducing the need for new raw materials, lowering material costs over time.
- Remanufacturing and resale of returned products open new revenue streams and market segments.
- Providing incentives for product returns (e.g., discount vouchers) increases return rates and strengthens the product flow within the circular model.
- When combining lean manufacturing principles (which focus on making production more efficient) with circular economy strategies (which aim to keep products and materials in use for as long as possible), take-back systems can improve both environmental impact and financial performance by optimizing labor and production efficiency.

ILLUSTRATION 9: TAKE BACK SYSTEM



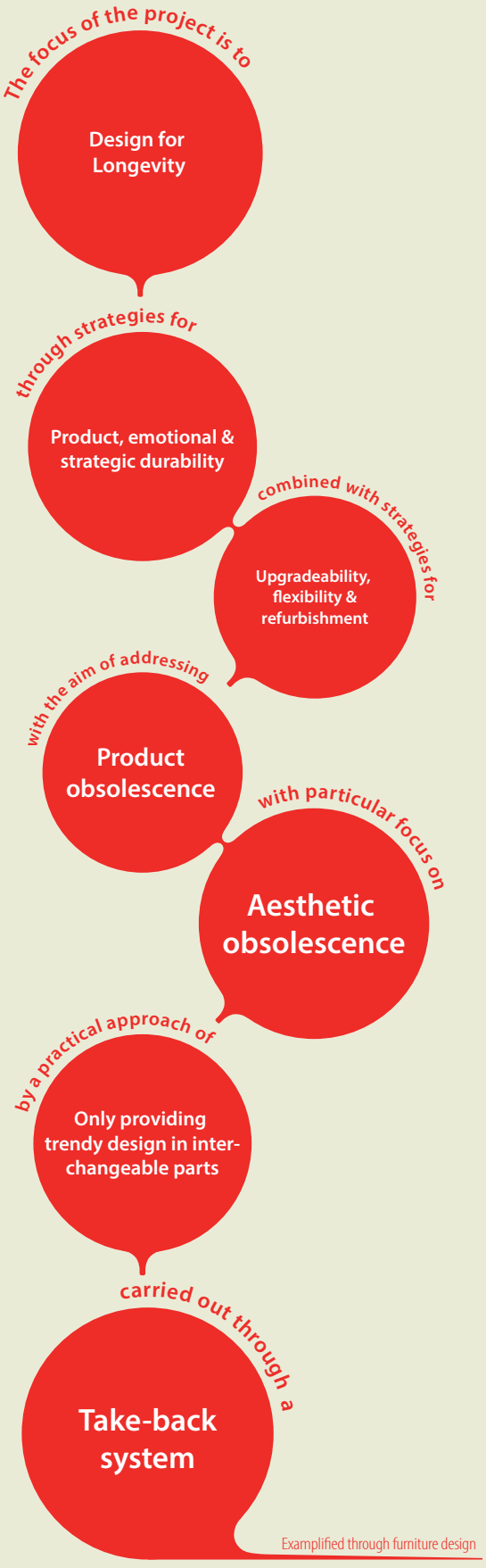


ILLUSTRATION 10: THEORY RECAP

THEORY RECAP

Based on the presented theory and its interconnection shown in illustration 10, the initial scope of the project is established.

FURNITURE DESIGN

The scope of the project will be exemplified through furniture design, as it is a product category well-suited for long-lasting design for several reasons. Furniture is not susceptible to technical obsolescence, while its daily use creates opportunities to build emotional attachment and strengthen the incentive to preserve it. Furthermore, the rising trend of fast fashion in the furniture industry presents a clear call to action: furniture must be designed with strategies that actively counteract this throwaway culture, promoting longevity, adaptability, and lasting value instead.

FURNITURE DISPOSAL BEHAVIOUR

With the intend of confronting consumer society with a product that avoids becoming obsolete, it is necessary to map out exactly what causes consumers to dispose of their furniture. In the research article Consumer Motivations and Barriers for Online Resale of Furniture (Skovdam et al., 2024), such disposal habits are identified through several interviews. Key takeaways from the article can be summarized in four categories:

REFURBISHMENT MOTIVATION AND BARRIERS

- Some consumers are willing to invest time and money into refurbishing furniture in order to extend its lifetime
- Some consumers refrain from refurbishment due to lack of skill or confidence, the perceived effort involved, or a preference for acquiring something new instead.
- If refurbishment is technically possible, it is not always pursued if the aesthetic outcome is still unsatisfactory.
- Financial considerations can act as a motivator to save money instead of buying new furniture, but also a barrier if the cost is deemed unjustifiable.

PERCEIVED QUALITY AND LIFESPAN

- Consumers associate high-quality materials, particularly solid wood, with durability and long-term value.
- Furniture made from lower-quality materials, such as plastic or particleboard, is often seen as temporary and more disposable.
- There is a strong expectation that price reflects quality, with many consumers more willing to invest in furniture if it appears durable and well-crafted.
- Items perceived as low-cost and low-quality are more prone to be discarded, especially if they originate from mass-market brands such as IKEA.
- Expectations regarding product quality are influenced by the origin of the product.

FINANCIAL INVESTMENT AND LONGEVITY

- Initial financial investment plays a key role in consumers' relationship with their furniture.
- Furniture of high initial investment is generally kept longer, as consumers perceive them as longer-lasting and worth maintaining.
- Cheaper furniture of low initial investment is more frequently and easily discarded due to little emotional or financial attachment - especially when affordable alternatives are readily available.

ILLUSTRATION 11: TIMELESS AND TRENDY CHAIRS

AESTHETIC SATISFACTION AND DESIRE FOR RENEWAL

- Many consumers replace furniture not because it is broken, but because it no longer fits their evolving style or interior. This reflects a general desire for aesthetic renewal.
- When a piece of furniture is seen as timeless or visually satisfying, it is more likely to be retained.
- Neutral colors are often perceived as timeless, resulting in the furniture being retained longer than furniture with more vibrant colors.
- Personalization, such as adapting or refurbishing furniture to match individual taste, can increase attachment and reduce the likelihood of disposal.

These different insights should be taken into account when developing the design proposal. Specifically, the design proposal should focus on addressing the following insights.

! The design proposal should address premature disposal due to changes in aesthetic preferences or 'desire for renewal'

! It may be beneficial to offer options for personalization to increase attachment and reduce likelihood of disposal

! Refurbishment must be financially viable for the consumer.
The design proposal should seek to eliminate barriers for refurbishment, such as lack of skills, confidence or convenience

SO, WHAT IS OUR SCOPE?

As depicted in the explored theory as well as the conducted user research, aesthetic obsolescence can be an explanation for premature replacement of furniture. The aim of this project is to explore how we can design with that in mind and create aesthetics that remain relevant and valued over time.

One could argue that design classics have succeeded in doing so, achieving lasting appreciation through timeless design. Yet, timeless design is a concept that is difficult to measure and even harder to determine whether one has achieved as only time will tell. This led to the initial problem statement:

Is it possible to avoid aesthetic obsolescence in furniture design by addressing shifting in trends and aesthetic preferences?

At this point it is unclear what the output of the project will become. The aim is to map out a system or a strategy that can be implemented in furniture design for more responsible practices. However, as it is a design-project and not a system-project the vision must be conceptualized through a product.

INITIAL CONCEPT

The initial idea for this project is to design a piece of furniture consisting of one or more permanent elements and one or more interchangeable elements. Over time, the interchangeable parts can be replaced with new ones, offering a different expression by giving the furniture a "new outfit" that feels more contemporary. This way, when the consumer experiences the need for renewal, the replacement is limited to a small part of the furniture, rather than the entire piece.
It is also considered that the replacement of parts could be facilitated through a product service system, such as a take-back system provided by the company, with the aim of implementing the design proposal as part of a sustainable business model.

INITIAL MARKET POSITIONING

The initial user research suggests that furniture from brands such as IKEA and Jysk is often replaced, whereas heirlooms and more expensive pieces tend to be maintained and preserved. To help define an initial market positioning, a mapping of various Danish design brands was conducted, focusing on price level and how trend-driven their product portfolios are.

This mapping, shown below, indicates a possible correlation between price and how trend-based the products are. To address the issue of frequent furniture replacement, it was decided to target the segment of low-investment, trend-driven designs.

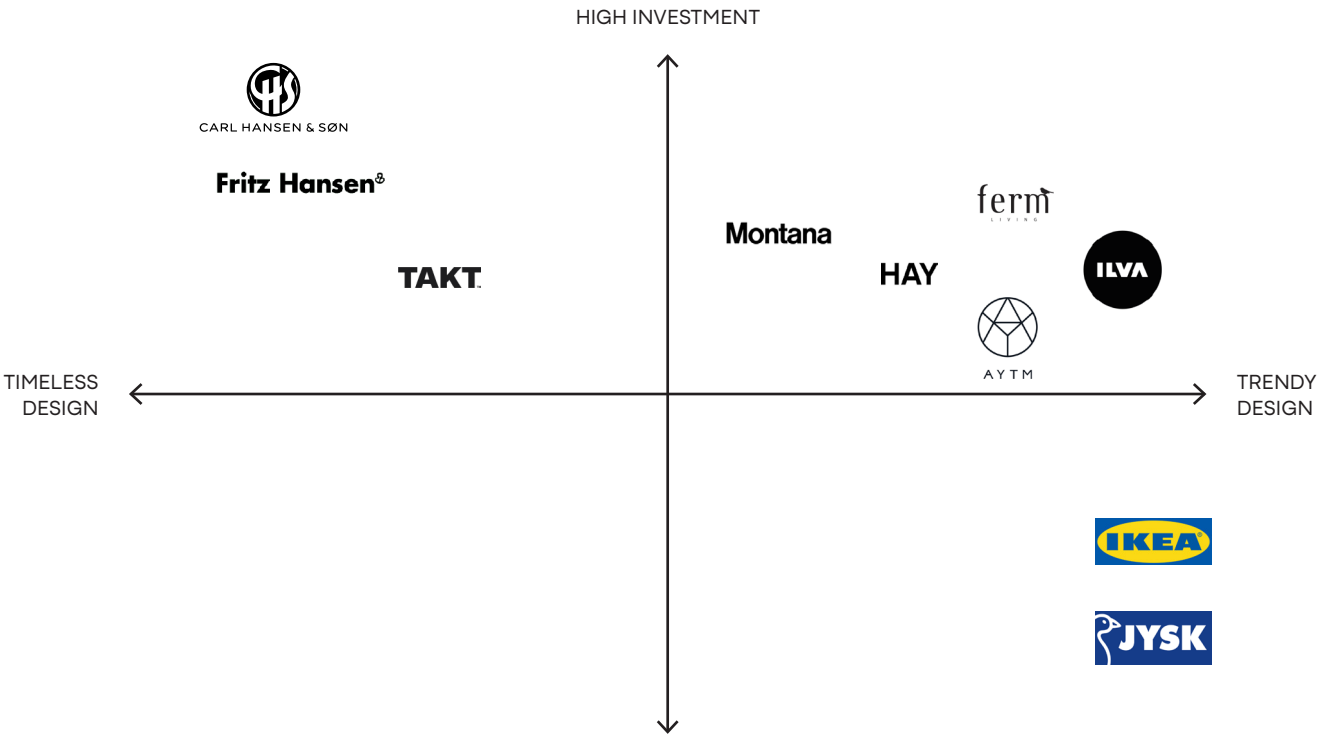
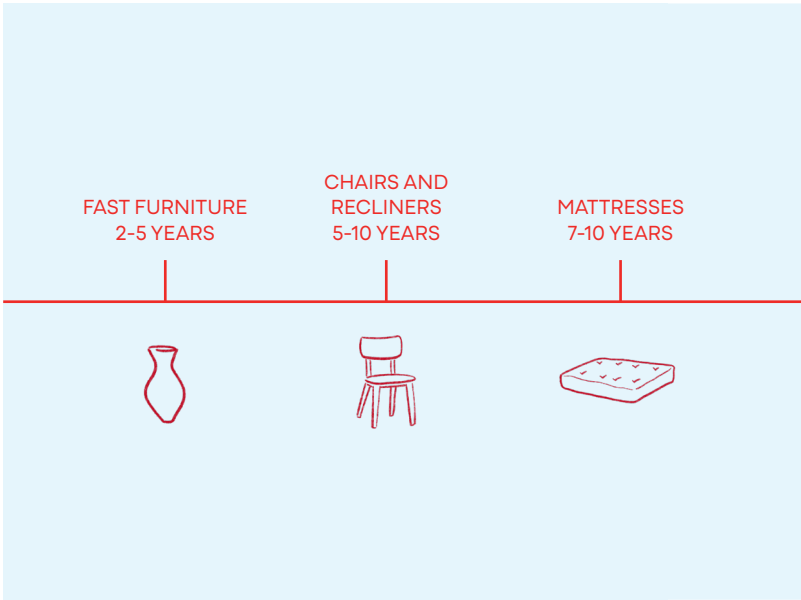


ILLUSTRATION 12: INITIAL MARKET POSITIONING

AVERAGE FURNITURE LIFETIME

The following figures are commonly cited estimates yet not results derived from scientific studies. Due to the timeframe of the project, the data has not been independently verified but has been used as a reference for selecting the product category and mapping the expected lifetime of the final design proposal.



OUR FOCUS

WHY IS FURNITURE SO HARD TO RECYCLE?

Approximately 10 million tons of furniture waste is generated in EU annually (Erasmus, 2017). It is estimated that only around 10% of this is recycled, while the remaining 80-90% is either incinerated or ends up in landfill. But why is it so challenging to recycle furniture?

MIXED MATERIALS
Furniture is often constructed from a mix of materials that must be separated in order to recycle the product. Plastic veneers, metal fasteners and textile elements are often glued or stapled together, making the separation difficult.

LOW QUALITY
Cheaper furniture is often made of composite materials – such as particle board or MDF – that is glued together using strong formaldehyde-based adhesives and easily breaks during disassembly.

DESIGN
A lot of furniture is not designed for disassembly or repair. Joints are glued or stapled, not allowing separation of materials.

ECONOMY
Separating materials is costly and resource heavy, why the cheaper and easier option is incineration or landfill.

! Full disassembly of different materials must be of high priority, to ensure the possibility for appropriate recycling at the end of product lifetime.

\+ It must be possible to seperate all materials
→ No elements of different materials should be glued

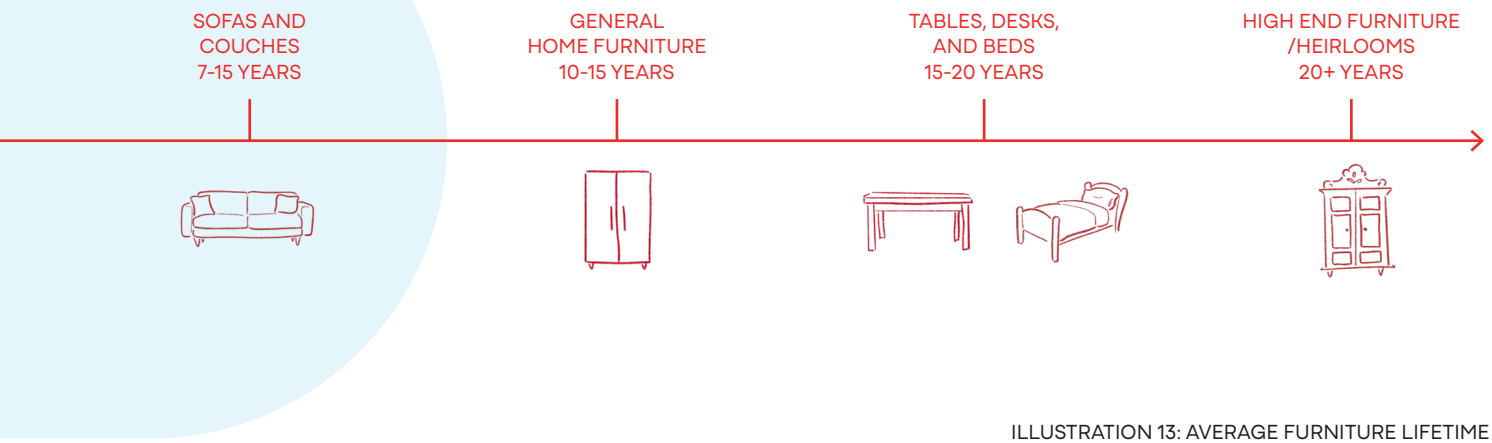


ILLUSTRATION 13: AVERAGE FURNITURE LIFETIME

INITIAL DESIGN BRIEF

INTRODUCTION

This project focuses on designing a piece of furniture that can evolve with the changing trends within interior design. The furniture should be able to adapt to current trends and aesthetic preferences, to eliminate the premature replacement due to desires for renewal.

AIM

To address the rising trend of fast fashion in the furniture industry, where furniture is replaced when trends or aesthetic preferences are changing. Instead, consumers should be investing in furniture that is adaptable for the future, to extend its lifetime and minimize risks of aesthetic obsolescence.

PROBLEM STATEMENT

Is it possible to avoid aesthetic obsolescence in furniture design by addressing shifting in trends and aesthetic preferences, while also constituting a sustainable business case?

TARGET GROUP

Price-conscious consumers, who tend to buy into low-investment, trend-driven designs to reflect current trends within their interior. Their furniture is frequently replaced as no remarkable economic losses are experienced during replacement.

VALUE PROPOSITION

A furniture that can change in aesthetic appearance due to either changing trends, aesthetic preferences or 'desire for renewal'

CONTEXT

- Consumer retail market, private homes
- Low end furniture design stores

REQUIREMENTS

No elements of different materials should be glued (p.23)

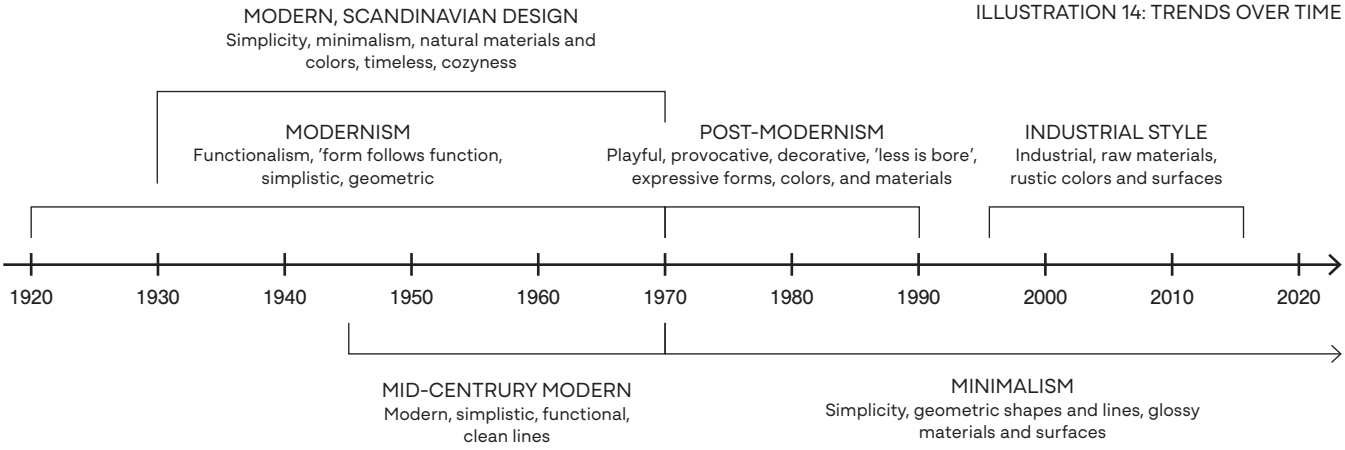
PHASE 02
ABOUT A CHAIR

Trends over time
What is a timeless design?
Feedback from Milestone II
Choosing a product category
Market segments
Initial idea generation
Target group and costumer types
Change in aesthetics as a sustainable initiative
Market research on construction principles
Modular chairs on the market
Archetypes of dining chairs
Value proposition
Variety testing
Designbrief 2.0

TRENDS OVER TIME

To establish an understanding of trend-based design and how it can be applied in relation to the interchangeable parts, an analysis is conducted of the trends and periods that have influenced furniture design over time (App. 1).

ILLUSTRATION 14: TRENDS OVER TIME



From this analysis, insights have been gained regarding the design parameters that have affected the aesthetic appearance of furniture design during these trends (App. 1). The main design parameters identified are displayed on Illustration 15.

Therefore, the interchangeable parts of the furniture, should be able to aesthetically vary based on these parameters in order to adapt to and reflect future trends. Contrarily, this analysis has underlined, that the permanent parts of the piece of furniture should be able to reflect a timeless and long-lasting aesthetic appearance – as it is a permanent part that should last the entire lifetime of the chair without aesthetically changing.

ILLUSTRATION 15: DESIGN PARAMETERS

BALANCE	COLORS	SURFACE PATTERNING
SYMMETRY/ASYMMETRY		PATTERNED/UNIFORM
TACTILITY	COMPLEXITY	MATERIALS
	MINIMALISM/MAXIMALISM	
PROPORTIONS	FORMS	LINES
MASS/STRUCTURE		GEOMETRIC/ORGANIC

+ Interchangeable parts must be able to reflect a trend-based appearance

+ Permanent parts must have a timeless appearance

WHAT IS TIMELESS DESIGN?

Timelessness is a quality of not being affected by time, meaning that a timeless design can withstand the passing of time and maintain its relevance regardless of changing trends and consumer preferences (Lobos, 2014).

Timelessness can be an important design strategy for extending product lifetime. The main aspects of this strategy involve that the product should be continuously relevant to the user in terms of both functionality and appearance (Lobos, 2014).

By incorporating these strategies in the design of the permanent parts, the design proposal will be more likely to stay relevant and valuable for longer, while allowing for repairability and gracefully aging (Lobos, 2014). Consequently, designing the permanent parts to reflect a timeless design should also act as a contributing factor to encourage users to maintain and keep the furniture for longer.

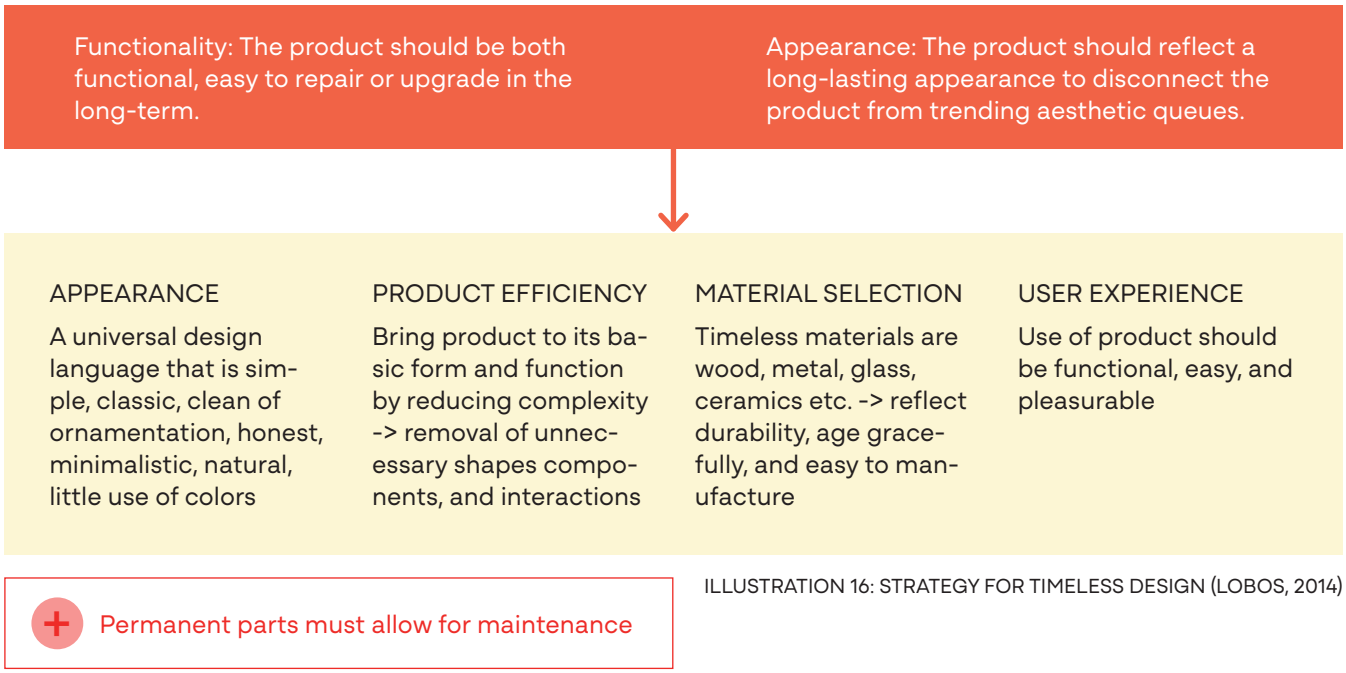


ILLUSTRATION 16: STRATEGY FOR TIMELESS DESIGN (LOBOS, 2014)

FEEDBACK FROM MILESTONE II

The overall vision of the project is recognized as a sympathetic mission, however questions were raised regarding the scope and the market positioning. How does this concept differ from, for example, sofas with interchangeable covers? A lot of companies are looking for a solution to this exact problem, which prompts the questing of how this proposal is different or any better? Additionally, IKEA or Jysk customers are not the right target group, as it would not be feasible to offer this solution at a competitive price point for that segment. A proof of concept is necessary to evaluate whether the idea could realistically find a place in the market.

"KEEP THE CHALLENGE, BUT CHANGE THE WAY YOU ATTACK IT"

CHRISTIAN TOLLESTRUP, MAIN SUPERVISOR

"THIS IS IMPOSSIBLE..."

CHRISTIAN TOLLESTRUP, MAIN SUPERVISOR

REFLECTION

For the Milestone a product category had been somewhat blind-picked, with the purpose of communicating the project scope more clearly. However, it became evident that the choice of product category must be supported, by a confirmation that the design proposal would actually resonate with a customer group. Based on these reflections it is decided to develop some material that can be presented to various potential users, in order to determine the hooks and objections that the concept evokes. It is also concluded that the market positioning needs to be reassessed - even though it feels somewhat discouraging to shift focus away from the segment where the problem seems most significant.

CHOOSING PRODUCT CATEGORY

To pressure test the potential of the concept proposal, the idea was presented in a series of interviews. Seven unstructured interviews were conducted with individuals of varying demographics, approached in the interior section of Magasin. In addition, six semi-structured interviews were carried out with contacts from our personal networks (Appendix 2). The concept was visualized through sales materials developed for three distinct brands: Jysk, HAY, and Fritz Hansen (Appendix 2). These materials illustrated the concept through four different furniture categories: dining chairs, coffee tables, sofas, and shelving systems.

The goal of the study was to determine the overall hooks and objections associated with the idea of a furniture with the possibility of changing its aesthetics through interchangeable parts. Additionally, it aimed to assess whether brand affiliation or price point influenced trust in the concept, as well as determine within which furniture category the concept appeared to resonate better. The full investigation can be found in Appendix 2, while an overview of the discovered hooks and objections can be found on the following page:

SUMMARY AND CONCEPT EVALUATION

The hooks are focusing on the quality of having the opportunity to renew/exchange parts of the furniture in relation to different life situations or resale. Furthermore, both an economic and sustainable incitement is present, along with a general willingness to invest in furniture of higher quality. Furthermore, it is noted that the willingness to keep and maintain furniture is connected to higher economic investment. These insights suggest a potential match between the concept and brands of medium-high investment.

The objections are focused on a general lack of interest in the concept and are pronounced by people who are prone to buy cheaper furniture. The mindset of these customers generally is that the low economic investment, as well as the low quality of the products, justifies their frequent exchange of furniture. This raises concern about whether the concept aligns with a cheaper brand, as a mismatch between the concept and the perceived quality of such brands appears to be present.

Furthermore, some respondents expressed concern about whether the ability to exchange certain parts of the furniture will be enough to satisfy the 'desire for renewal' as well as whether the customer is able to perform the exchange of as high quality as if done by a professional. Lastly, there is a general objection against refurbishing furniture considered timeless, design classics, as people tend not to modify those from the original design.

CONCLUSION

Based on the findings from the interviews, dining chairs were chosen as the primary furniture category to further develop, as no objections were raised against this category. Furthermore, the market positioning is reassessed. As the concept didn't appear to resonate with consumers of low-investment, trend-driven furniture, and high-end customers were hesitant about aesthetic-altering refurbishment, targeting the mid-range segment is considered the most viable approach.

- ! Consumers tend to have more long term faith in larger, well-known brands compared to smaller, local businesses
- ! The price of the renewal can be a measure for controlling the frequency of exchange
- ! Consumers tend to consider 1/3 of the initial price of the furniture as a fair investment for the renewal of the exchangeable parts

- \+ The chair must be positioned in a mid price point
- \+ The chair must be developed as part of a well-established, known brand
- \+ The chair must have easy percieved interchangeability
- \+ The chair must have easy practical interchangeability
- \+ The interfaces must have a high degree of feedback and feedforward

PRODUCT CATEGORY

ILLUSTRATION 17: SOFA FROM HAY

SOFA

+ The cover can get worn out quickly
+ Hard to clean properly
– Seem like a comprehensive task
– Must be expensive
– How will the foam sustain?
– Low reuse-value of the old cover
– Is often already bought for long time use

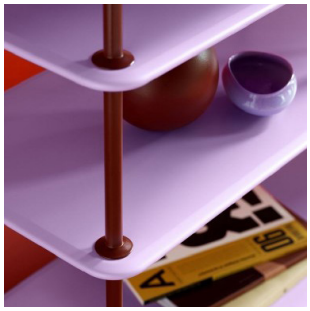


ILLUSTRATION 18: SHELVING SYSTEM FROM MONTANA

SHELVING SYSTEM

+ Seems easy to change the interchangeable parts
+ Shelves can get worn out quickly
– Shelves are not getting worn easily
– Anonymous furniture (for some respondents)

ILLUSTRATION 19: COFFEE TABLE FROM HAY

COFFEE TABLE

+ Tabletop can get worn out quickly
– Already easy to maintain

DINING TABLE

+ Tabletop can get worn out and scratched quickly
– Is often already bought for long time use
– Already easy to maintain

ILLUSTRATION 20: DINING CHAIR FROM HAY

DINING CHAIR

+ Is used a lot and can get worn out quickly
+ Seems easy to change the interchangeable parts
+ Hard to clean properly (if upholstered)

BRAND

JYSK

+ Low budget
– Trendy designs
– Low faith in quality
– Low faith in capability to do refurbishments
– Low faith in continued access to spare parts

! Customers in this segment tend to prioritize affordability over environmental considerations.
! Customers in this segment often perceive the products as temporary or short-term furniture solutions

HAY

+ High expectations to quality
+ Customers in this segment display willingness to perform maintenance
+ Customers in this segment display willingness to perform refurbishment
+ High value retention
– Trendy designs

! Customers in this segment tend to prioritize style and trends and can demonstrate higher consumption

Fritz Hansen

+ Timeless design
+ High faith in quality
+ High faith in capability to do refurbishments
+ High faith in continued access to spare parts
+ Customers in this segment display willingness to perform maintenance
– Customers in this segment do not tend to refurbish
– Expensive

! Products from this brand is considered 'long-lasting'

MARKET SEGMENTS

It is possible to divide the furniture market into four primary segments: Value Segment, Mid-Market Segment, Premium Segment, and Luxury Segment.

To explore the characteristics of each segment, various furniture companies were examined through desktop research. For each company, factors such as choice of materials and price range within the chosen product category - dining chairs - were noted.

Below is an overview of key characteristics for each segment, including target audiences, common design traits and materials, as well as examples of companies operating in each.

Based on the insights derived in 'Choosing A Product Category' it is decided to target the Mid-Market Segment focusing on a well-established and recognized brand.

VALUE SEGMENT (LOW-COST)

Characterized by a focus on low prices, functionality, and mass production.

TARGET GROUP
Price-conscious consumers, first-time buyers, and students.

COMPANIES IN THIS SEGMENT
JYSK, IKEA, ILVA (partially)

TYPICAL PRICE RANGE FOR DINING CHAIRS
200–1,000 DKK per chair

Examples

- JYSK: Dining chairs from 249–799 DKK
- IKEA: Typically 300–1,000 DKK
- VidaXL: 200–900 DKK

MATERIALS
MDF, veneer, plastic, lower-grade wood types (e.g., pine, rubberwood), metal, and synthetic upholstery.

DESIGN
Simple and functional, often trend-inspired but made with cheaper materials and production methods.

MID-MARKET SEGMENT

Characterized by better quality and design than the value segment, but still at affordable prices accessible to a broad consumer group.

TARGET GROUP
Households with moderate budgets, families, and quality-conscious consumers.

COMPANIES IN THIS SEGMENT
HAY, ILVA, Sinnerup

TYPICAL PRICE RANGE FOR DINING CHAIRS
1,000–3,500 DKK per chair

Examples:

- ILVA: 1,000–2,500 DKK
- Bolia: 1,500–3,500 DKK
- HAY: 2,000–3,500 DKK

MATERIALS
Higher-quality wood (e.g., oak, walnut, ash), better upholstery, and more durable fabrics like velvet or genuine leather.

DESIGN
Greater focus on detail and comfort, often Scandinavian inspired, though still produced at scale.

PREMIUM SEGMENT (UPPER MID-MARKET)

Characterized by high quality, superior materials, design focus, and often more sustainable solutions.

TARGET GROUP
Design-conscious consumers willing to invest in quality.

COMPANIES IN THIS SEGMENT
BoConcept, Bolia, Fritz Hansen (lower end), Montana, &Tradition

TYPICAL PRICE RANGE FOR DINING CHAIRS
3,500–8,000 DKK per chair
Examples:
• &Tradition: 3,500–6,000 DKK
• Carl Hansen & Søn (some models): 4,000–7,000 DKK
• Fritz Hansen (lower end): 5,000–8,000 DKK

MATERIALS
Solid wood (typically oak, teak, walnut), premium leather, sustainable textiles, and high-quality foam/ upholstery.

DESIGN
Unique shapes, high comfort, often designer pieces with a timeless aesthetic.

LUXURY SEGMENT (HIGH-END)

Characterized by exclusive materials, craftsmanship, unique design, and often handcrafted or custom-made products.

TARGET GROUP
High-income consumers and design enthusiasts.

COMPANIES IN THIS SEGMENT
Carl Hansen & Søn, Fritz Hansen (higher end), Brødrene Sørensen (higher end)

TYPICAL PRICE RANGE FOR DINING CHAIRS
8,000–40,000+ DKK per chair
Examples:
• Fritz Hansen : 8,000–15,000 DKK
• Carl Hansen & Søn (CH24 Wishbone Chair in exclusive variants): 7,000–15,000 DKK
• Poltrona Frau: 15,000–30,000+ DKK

MATERIALS
Solid hardwoods, hand-stitched leather, exclusive textiles, brass or steel frames with special finishes.

DESIGN
Top-tier craftsmanship, iconic design classics, often produced in limited editions or handmade.

+ The chair must be positioned in a mid segment price point
→ The sales price of the chair must not exceed 3500 DKK

ILLUSTRATION 21: INITIAL IDEA GENERATION ON DINING CHAIRS

INITIAL IDEA GENERATION

Based on the choice of dining chairs as product category and the revised market positioning, an initial idea generation was conducted. In terms of determining the permanent and interchangeable parts of the chair, it seemed obvious to work with the seat and the backrest as interchangeable and the frame as permanent. The idea generation focused on the interchangeable parts of the chair, hence different principles for interchangement and aesthetic variety were generated, as shown in ill. 21.
However, it was clear that the generation of ideas and the subsequent evaluation reflected a lack of structure and limitation. Hence, there was a need for establishing some boundaries for generating and evaluating concept ideas upon.

TARGET GROUP AND COSTUMER TYPES

By evaluating the statements and findings from the group of consumers that hooked on the concept, it was found that these can be divided into three target groups based on their motivation for hooking: aesthetically driven, maintenance driven and those in between (see Ill. 22). This finding aligns with the two main aspects of aesthetic obsolescence, 'fashion and style' and 'wear and tear', each of which is represented in the two main target groups.

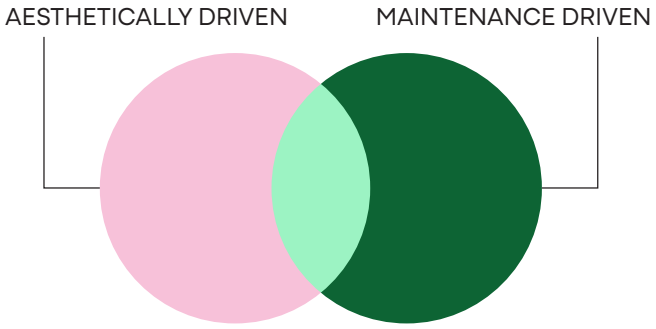


ILLUSTRATION 22: TARGET GROUP

The characteristics of the two main target groups, deducted from their identified behavior patterns, are presented on ill. 23.

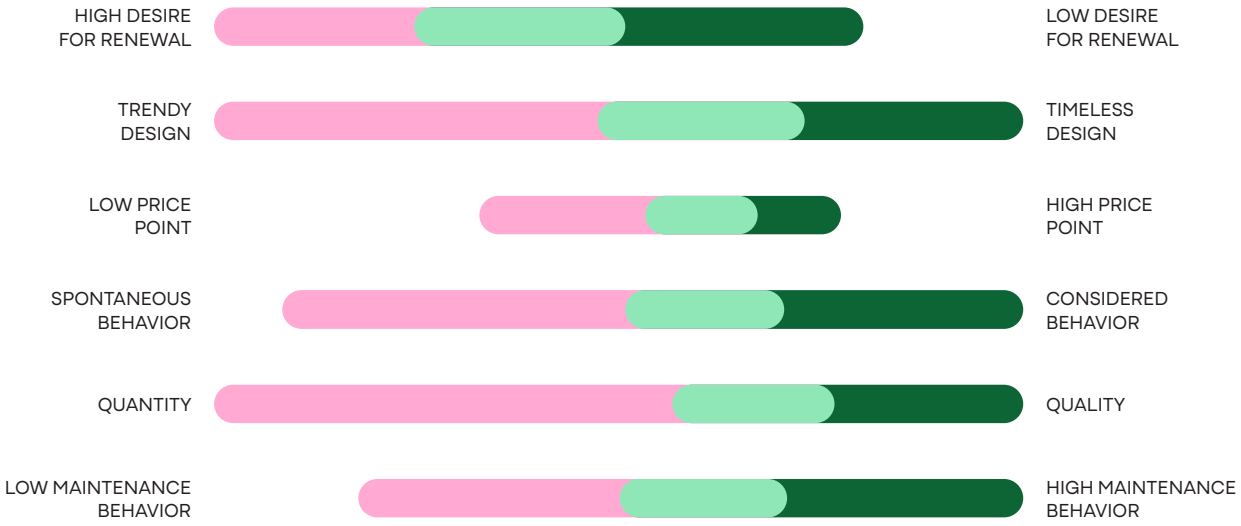


ILLUSTRATION 23: BEHAVIOR PATTERNS OF TARGET GROUPS

From these characteristics, it is clear that the aesthetically driven target group is driven by a high desire for aesthetic renewal and therefore values that the interchangeable parts reflect the newest trends. On contrary, the maintenance driven target group is driven by a low desire for renewal, as they value the possibility of preserving a timeless and well-maintained appearance of the interchangeable parts. The third target group in between represents a combination of these motivations.

Emotional Customer Types

To understand what further motivates the two main target groups, their behavior and motivation when buying products is further explored by the theory behind Emotional Customer Types (Dollerup and Gade, 2024) (App. 3).

There are four different emotional customer types, and their distinct motivations and desires, when buying a product is displayed on Ill. 24. Based on these different types of customers, the main target groups seem to resonate with the red and green type of customer.

Within these two types of customers are some prominent consumerism trends. The green customer type is driven by sustainability and its initiatives on being more preserving and careful to nature. The red customer type is not solely driven by sustainability itself but distastes hyper-consumption, thus seeks new ways of minimizing their consumption. Furthermore, the red customer type is highly driven by microtrends, hence their need for frequent renewal (Dollerup and Gade, 2024).

Thereby, the design of the chair should be able to address the two main target groups of this project in different ways to accommodate their individual desires and consumer behavior. Hence, the interchangeable parts of the chair must be able to reflect aesthetical renewal in terms of both styles and fashion, and in terms maintaining a known, well-maintained appearance.

ILLUSTRATION 24: RED AND GREEN COSTUMER TYPES

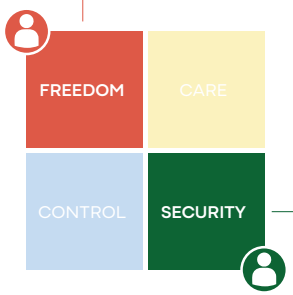
AESTHETICALLY - DRIVEN

RED CUSTOMER TYPE
Seeks excitement and the unexpected, thereby frequent renewal is essential, when addressing this customer type.

Prefer to be presented with many different options for the product they are buying.

KEY WORDS: CURIOS, PASSIONATED, ADVENTUROUS
AIMS: TO TRY SOMETHING NEW - FIRST
CHARACTERISTICS: GREAT NEED FOR STANDING OUT
SELF-IMAGE: INNOVATIVE, INDEPENDENT, FREEDOM-SEEKING

PRODUCTS FOR THIS CUSTOMER TYPE:
MUST BE DYNAMIC, INSPIRING AND ABLE TO CONTINUOUSLY CHANGE.



GREEN CUSTOMER TYPE
Seeks the well-known and predictable, thereby providing familiarity and trust is essential, when addressing this customer type.
Prefer to be presented with products and options that are the same or look like the ones they are used to and trust.

KEY WORDS: DECENT, TRADITIONAL, LOYAL
AIMS: TO PRESERVE THINGS AS IS
CHARACTERISTICS: PREFERS CONSISTENCY, HABITS, AND ROUTINES
SELF-IMAGE: SANE, CALM, SERIOUS

PRODUCTS FOR THIS CUSTOMER TYPE:
MUST HAVE A HIGH DEGREE OF RECOGNIZABILITY - AND MUST NOT CHANGE REMARKABLY.

MAINTENANCE - DRIVEN

+ Interchangeable parts must be able to reflect both a trend-based and timeless appearance

CHANGE IN AESTHETICS AS A SUSTAINABLE INITIATIVE

One thing is how respondents answer when asked about a fictional concept, another thing is their actual purchasing behavior. To better understand how consumers truly value the option of interchangeable parts and aesthetics at the point of purchase, a number of companies were contacted. These companies all offer one or more sofa models with interchangeable covers and were asked to share insights on how this feature is prioritized by customers compared to sofas without this option (Appendix 4).
The overall observation is that design, price, and comfort tend to outweigh the importance of interchangeable covers, and environmental considerations are generally low among consumers. However, Bolia has experienced an interesting shift in recent years. In 2023, they redesigned their Sepia Sofa Series to include interchangeable covers. As a result, the sales of the series increased from a sales index of 73 in 2023 to 241 in 2024. According to Bolia, customers are choosing models with interchangeable covers primarily for two reasons, namely hygienical purposes and the option to update the sofa's color if their interior style changes.

ILLUSTRATION 25: BOLIA SEPIA SOFA
INCREASE IN SALES INDEX FROM 73 IN 2023 TO 241 IN 2024, AFTER THE SERIES WAS REDESIGNED TO INCLUDE INTERCHANGEABLE COVERS

MARKET RESEARCH ON CONSTRUCTION PRINCIPLES

To get insights on the current market of dining chairs, a range of furniture stores in Aalborg were visited. These included JYSK (representing the value segment), Møbelkompagniet, FDB, Ilva, and Sinnerup (mid-market), as well as Brdr. Sørensen (high-end). The goal was to explore what is feasible within each price range in terms of construction methods, materials, craftsmanship, form language etc. Observations from the visits were documented through photographs, which were later clustered and analyzed. A summary of the key insights regarding the Mid-Market segment is presented below, while the complete research can be found in Appendix 5.

ILLUSTRATION 26: MARKET RESEARCH ON CONSTRUCTION PRINCIPLES

- ! Highly organic or complex curvatures are not possible
- ! Highly complex construction or composition is not possible
- ! It is possible to make the chair frame in solid wood
- ! It is possible to create routed holes for screws to enhance aesthetic value
- ! It is possible to make joints based on visible through-elements
- ! Screw joints can be used as an aesthetic design detail
- ! The aesthetics of the underside of the chair should be given medium priority
- ! It is possible to use simple joinery techniques
- ! Both textile and leather can be used in the upholstery
- + Fasteners and similar components must be standard parts

MODULAR CHAIRS ON THE MARKET

Another part of the market research included identifying and investigating existing modular solutions for seating furniture, that allow consumers to change the appearance of the chair throughout its' lifespan. This was explored through desktop research.

THE CROSS CONSTRUCTION ALLOWS FOR FLAT PACK, WHICH MAKES IT POSSIBLE FOR THE COMPANY TO TRANSPORT 5–7 TIMES MORE CHAIRS THAN OTHERWISE, THEREBY REDUCING THEIR CO_2 FOOTPRINT FROM TRANSPORTATION BY 56% (BUILDING GREEN TOGETHER, 2024).

TAKT – CROSS CHAIR

The chair is designed for easy repair and replacement of parts. Customers assemble the chair themselves, which familiarizes them with the individual components. TAKT offers the possibility to purchase a new seat, backrest or set of screws, equivalent to the original. Furthermore, the chair comes with either a regular seat or an upholstered seat – which can be interchanged between.

Reflection: As the part is replaced with an equivalent, the modified aesthetics lies in going from a worn out or broken appearance, to a new-looking appearance. The only possible variation in aesthetics is changing between the seat being upholstered or not, however this interchangement requires purchase of a separate new seat.

ILLUSTRATION 27: TAKT CROSS CHAIR

NENDO – TWIG CHAIR

The Nendo Twig Chair is a two-part construction consisting of a fixed base made from aluminum onto which different wooden top-parts (back- and armrest) can be attached. This makes it possible to change the overall appearance of the chair just by changing the top part, while the base and seat remain the same.

Reflection: The base is only offered in one color and one configuration. Due to the construction, where the legs rise above the seat, it is mandatory to have armrests. Also, it appears as if it is not possible to change the top part, once the chair is assembled.

ILLUSTRATION 28: NENDO TWIG CHAIR

MONTANA – PANTONOVA SOFA MODULES

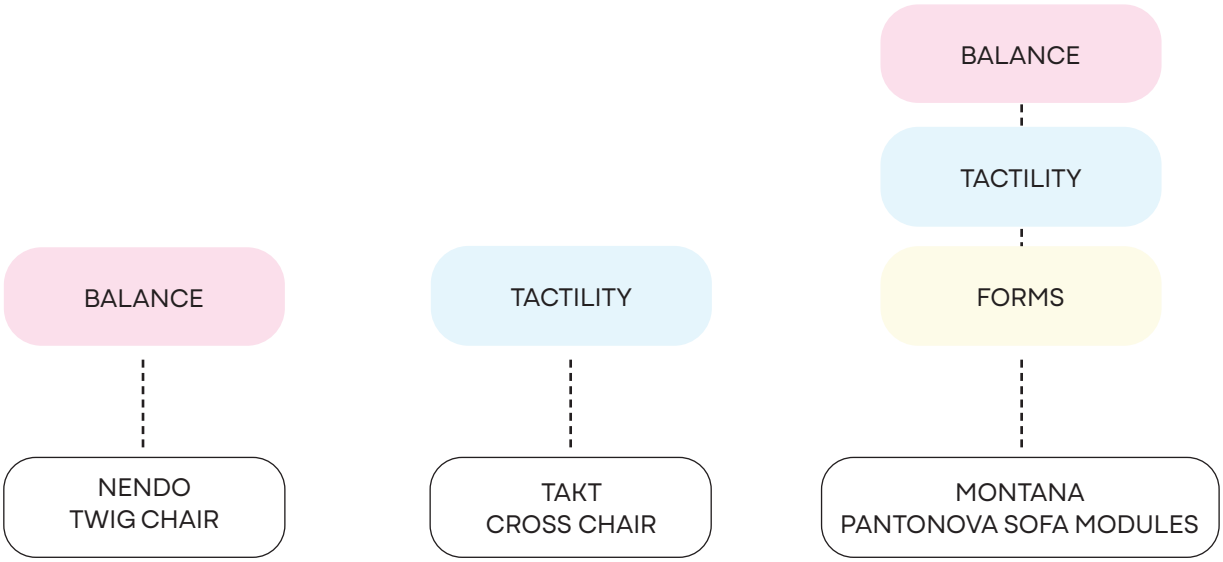
The sofa-series consists of three different seating modules: Linear, Concave, and Convex. These modules can be combined in various ways to create unique formations and aesthetics. The system also offers interchangeable cushions in different materials and colors.

Reflection: The aesthetic variance lies within the way you combine the modules, which is completely up to the consumer to determine. The modules are made from the same aesthetic principles, making the appearance of every possible configuration equally aesthetic. However, it is not possible to change the appearance of the chair without also changing the size of it.

ILLUSTRATION 29: MONTANA PANTONOVA SOFA MODULES

EVALUATION

Evaluating these concepts using the design parameters outlined in 'Trends Over Time', the following aesthetic modifications are observed:



Notably, no examples of seating furniture were found that allow for aesthetic modification across more than three of the design parameters. Therefore, it is considered unnecessary for the interchangeable parts of the proposed chair to accommodate all parameters. Instead, future research should focus on identifying which design parameters have the greatest impact on aesthetic obsolescence.

ARCHETYPES OF DINING CHAIRS

Following the market review, a mapping of various types of dining chairs was made. The objective of the research was to identify different archetypes of dining chairs and determine which archetype allows for most modularity and thereby the highest aesthetic variety. The full investigation can be found in Appendix 6.

REFLECTION

Some of the archetypes, such as the Windsor or the Monolithic are limited in terms of variation due to their rigid construction. Similarly, woven chairs are constrained by the fact that the weaving is done directly onto the frame, making replacement complex and limiting the form possibilities to the frame itself. In contrast, the Classic Dining Chair and the Cantilever Chair show the greatest potential for modularity. Their more segmented construction opens up a much larger solution space for variation in both the seat and the backrest. While both can support timeless designs, the material used in the Cantilever chair is more niche-oriented and appeals to a narrower consumer group than a classic wooden frame. As such, the Classic Dining Chair is seen as the most suitable foundation for further development.

ILLUSTRATION 30:
CANTILEVER CHAIR

ILLUSTRATION 31:
WOVEN CHAIR

ILLUSTRATION 32:
WINDSOR CHAIR

ILLUSTRATION 33:
CLASSIC DINING CHAIR

VALUE PROPOSITION

Considering the aim of entering a major red market of dining chairs, the chair must differentiate itself from other chairs on the market by the value it provides for customers. The Value Proposition Map was used to identify how the chair should create value by relieving pains and creating gains for customers (see App. 7).
By positioning the product on the market around such customer needs, a strategic product-market fit can be achieved, which constitutes one aspect of strategic durability (Haase & Laursen, 2023). A strong fit is achieved by creating a clear connection between what matters to customers and how the products, services and features ease pain and create gains (Strategyzer, 2024).

AESTHETICALLY DRIVEN

WHAT VALUE?
Express your aesthetic preferences through the easily adaptable design of the chair. Impress your network with an interior that is kept up to date with current trends.

FOR WHOM?
Fashion-conscious consumers, who enjoy keeping up with the newest trends in their life in their interior design within the home.

HOW?
A long-lasting, high quality chair frame that allows for interchangeability of elements, that provides the ability of changing the aesthetic appearance of the chair to reflect the current and future interiors.

MAINTENANCE DRIVEN

WHAT VALUE?
Maintain your timeless, long-lasting interior by the maintainable design of the chair. Make sure that your interior always appears decent and well-maintained.

FOR WHOM?
Quality-conscious consumers, who take pride in preserving a well-maintained and lasting appearance of the interior design within the home.

HOW?
A long-lasting, high quality chair frame that allows for interchangeability of timeless elements, that provides the ability of replacing worn parts of the chair to ensure a maintained and enduring interior.

VARIETY TESTING

To clarify how much aesthetic variety the seat and backrest should be able to provide for the overall appearance of the chair in order to satisfy the need for aesthetic renewal, a testing of the degree of aesthetic variance was conducted (See App. 8). It was conducted by reinterviewing several of the previous interviewees based on material displaying three degrees of aesthetic variance of a generic dining chair. The interviewees were presented the material from low to high degree of aesthetic variance, as shown in Illustration 34.

LOW DEGREE OF VARIANCE
When presented with the material of low degree of variance, the interviewees stated that the possibility of changing the fabric is valuable if the upholstery gets worn or stained. It is further stated that changing the color of the fabric can change the dominance of the overall appearance. However, it is emphasized that it is still considered the same chair, just with a different type of fabric.

MEDIUM DEGREE OF VARIANCE
When presented the material with the medium degree of variance, it is stated that this degree of variation gives the chair a design-related change, making its appearance look different. One interviewee states: "I would feel like getting a whole new chair by simply changing the backrest." (Interviewee #2)

HIGH DEGREE OF VARIANCE
When presented with the highest degree of variance, it is generally stated that the possibility of having armrests on the chair is considered highly valuable in terms of providing more comfort and accommodating different ergonomic preferences of more people. Furthermore, this degree of variance is considered enough to provide possibilities for significant change, as one interviewee states: "I don't need more options to feel assured about buying the chair." (Interviewee #3)

LOW DEGREE OF VARIANCE

MEDIUM DEGREE OF VARIANCE

HIGH DEGREE OF VARIANCE

ILLUSTRATION 34: DEGREES OF VARIANCE

THE MORE OPTIONS, THE BETTER!

Despite these statements, it remains difficult to determine exactly when the degree of aesthetic variation is sufficient to satisfy the desire for renewal. Several interviewees preferred the material with the highest degree of variation when presented with it, as it offered more options. As a result, there was a general sentiment that 'the more options, the better', which does not clearly clarify the threshold for a satisfying degree of aesthetic variation.
However, it was indicated that the maintenance-driven interviewees were more satisfied with the lowest degree of variation, as it allowed for maintaining the upholstery if it became worn or stained. The aesthetically driven interviewees appeared to desire a higher degree of variation than that and therefore valued the variants with a more significant change in form and appearance.
Ultimately it is considered that this study contains a source of error in the way the threshold is examined, as 'more will often want more' when the option is available – making it difficult to draw any definitive conclusions from it. However, several general insights were derived, as shown below.

! The chair frame is expected to have high durability and quality to endure a lifetime of several interchangements

! Life phases with kids tear and wear more on upholstery. Therefore, the option of both upholstered and non-upholstered seat and backrest is valued

! The change of interior will most likely happen in relation to moving

! Interchanging larger parts does not compromise the sustainable perception of the concept

! Armrests are considered highly valuable in terms of providing more comfort and accommodating different ergonomic preferences of more people

! Some variants raise ergonomic concerns due to differences in backrest form

! A visual mismatch between old and new wood due to the interchangement raises concerns about the perceived 'newness' of the chair

! Preferable to have different lacquer, oil or stain options for the chair frame - to have the possibility of matching it with existing furniture

! The price of the interchangement is expected to be proportional to the degree of variance and quality of the materials used

+ The salesprice of interchangement must not exceed 1/3 of the initial sales price.
→ The sales price of seat and backrest must not exceed 1150 DKK

DESIGN BRIEF 2.0

INTRODUCTION
This project focuses on designing a dining chair, that can evolve with the changing trends within interior design. The chair should be able to adapt to current trends and aesthetic preferences, while being able to be maintained and renewed in terms of wear and tear, to eliminate the premature replacement due to aesthetic obsolescence.

AIM
To address the premature disposal of furniture due to aesthetic obsolescence, where furniture is replaced due to changing trends and aesthetic preferences or wear and tear. Instead, consumers should be investing in furniture that is aesthetically adaptable for the future in terms of both trends and wear, to extend its' lifetime and minimize risks of aesthetic obsolescence.

TARGET GROUP
Aesthetically-driven: Quality-conscious consumers, who tend to buy into medium-investment designs to be able to reflect current trends within their interior.
Maintenance-driven: Quality-conscious consumers, who tend to buy into medium-investment designs to be able to reflect a timelessly maintained appearance within their interior.

VALUE PROPOSITION
Designed for change – a dining chair with replaceable seat and backrest that evolves with your style and stands the test of time.

CONTEXT
- Consumer retail market, private homes
- Mid-range furniture design stores

PROBLEM STATEMENT
How to design a dining chair that addresses aesthetic obsolescence in terms of both changing trends, aesthetic preferences and physical wear of the product, while also constituting a viable business case?

REQUIREMENTS
No elements of different materials should be glued (p.23)
The chair frame must have a timeless appearance (p.26)
The chair frame must allow for maintenance (p.27)
The chair must be developed as part of a well-established, known brand (p.28)
The chair must have easy percieved interchangeability (p.28)
The chair must have easy practical interchangeability (p.28)
The interfaces must interfaces must have a high degree of feedback and feedforward (p.28)
The chair must be positioned in a mid price point (p.28)
The sales price of the chair must not exceed 3500 DKK (p.31)
The sales price of seat and backrest must not exceed 1150 DKK (p.39)
Seat and backrest must be able to reflect both a trend-based and timeless appearance (p.34)
Fasteners and similar components must be standard parts (p.35)

PHASE 03
SOLUTION SPACE

Frame material
How to upholster?
Upholstery principles
Integration of upholstery
Feedback Milestone III
Strategies for change in aesthetics
Customizability offered in the mid segment
Construction principles - Frame, seat and backrest
Form variety on seaat and backrest
Configuration - Degrees of freedom
Designbrief 3.0

FRAME MATERIAL

As the frame of the chair constitutes the permanent part of the design proposal, the expression and material of the frame must reflect a timeless design. Furthermore, as derived from the user research, the frame is expected to have a high degree of durability and quality, to endure a lifetime of several interchangements and various contexts. Finally, it is considered that the frame must be maintainable in order for the chair to be long-lasting.
Some of the materials previously identified as timeless are wood and metal. Based on research on furniture retaining habits, it is identified that most long-lasting, retained furniture is made of wood (Skovdam et al., 2024; Frahm et al., 2022).
Being a natural material, wood is imperfect by its naturally heterogeneous surface, which is the reason for its graceful aging. Additionally, the material of a long-lasting piece of furniture should be honest, meaning that its surface does not mimic something else than it is (Frahm et al., 2022).

Considering these aspects, and the fact that the frame of the chair should be maintainable, it is decided that the frame of the chair must be made from solid wood.

+ The chair frame must be made of solid wood

HOW TO UPHOLSTER

Based on the conducted user research it is considered that the seat and backrest of the chair should be offered in an upholstered version as well as a non-upholstered version. To gain insights on current methods of upholstery and reupholstery AP Møbelpolstring in Nørresundby was visited. The full interview with CEO, Henrik Holm can be found in Appendix 9, while the essential insights are described below.

An upholstered seat is typically composed of a wooden board, a layer of foam with a polyester wadding on top, all covered up by an upholstery cover.

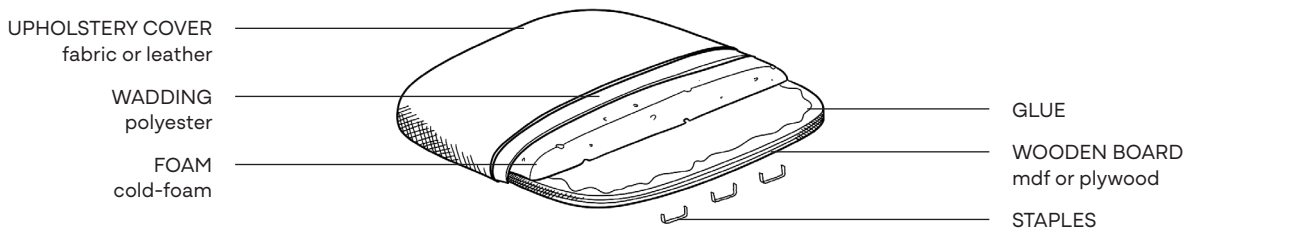
Customer segments at AP Møbelpolstring:
20% privates, 80% contract

Typical upholstery assignments:
Reupholstery of cover and/or foam due to wear
Mostly expensive 'design classics' - customers request the same appearance as original upholstery

Prices for reupholstery (including new cover and foam):
450 DKK (fabric cover)
650 DKK (leather cover)

Costs of upholstery: 50% materials, 50% man hours

ILLUSTRATION 35: SEAT CONSTRUCTION



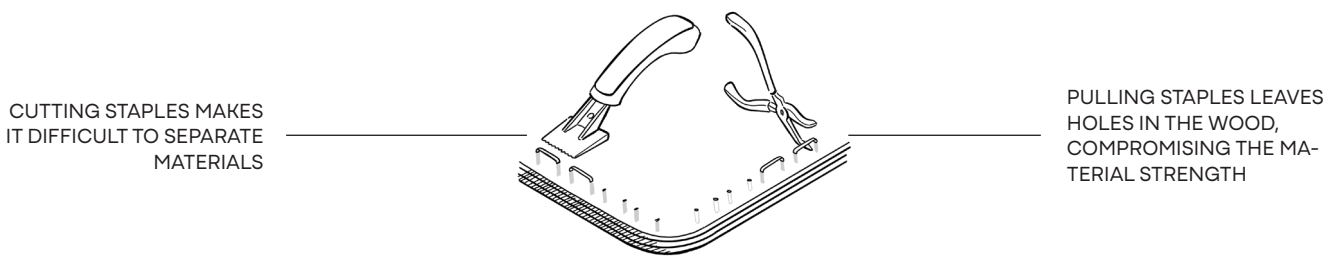


ILLUSTRATION 36: CUTTING VS. PULLING STAPLES

Generally, it is hard to separate all the materials completely when reupholstering. The foam is glued to the wooden board, and the upholstery cover is typically stapled to the bottom of the board. When reupholstering, the staples are cut as this is easier and gentler for the structure of the wooden board, instead of pulling them out which can weaken the wood due to the holes from the staple legs. Alternatively, the upholstery can be attached with sewn-on Velcro strips, which also must be manually ripped up to separate it. The matching Velcro strips are attached to the furniture with adhesive and further stapled to secure it fully.

An alternative way of securing the foam to the wooden board is to mold the foam to fit around the board eliminating the need for glue, thereby easing the disassembly of these materials. However, such tool for molding cost approximately half a million DKK, hence it is only a viable solution when dealing with larger volumes of the same.

It is noted that current methods for upholstery make complete disassembly of different materials challenging. Therefore, the primary focus of future research should be finding an alternative method to securely fasten the upholstery elements, while still allowing full separation and avoid compromising the integrity and reuse-value of the materials.

> The upholstery covers are cut by a laser cutter to increase precision, save manual man hours, and minimize the waste generated in terms of cut-offs.
>
> The majority of their cut-offs are preferably disposed to local partners, such as 'Ornli', who repurpose it for other products like pillowcases, aprons etc. (Ornli, 2025).

\+ It must be possible to seperate all materials
→ Staples must not be used for upholstery

UPHOLSTERY PRINCIPLES

Following the visit to AP Møbelpolstring, an idea generation on alternative upholstery methods was carried out. The aim was to explore ways of upholstering without relying on glue or staples with the central challenge being: *How do you upholster in a way that the upholstered element is securely attached and appear integrated with the chair, while still allowing for complete disassembly of the individual materials?*

Various concepts were discussed and sketched. To further explore the potential of the different ideas a series of prototypes were made. The full investigation can be found in Appendix 10.

CONCEPT 01: PILLOWCASE
Principle: Upholstered plate and foam inside a cover.
Evaluation: To fit snug, tolerances must be low. Attachment must penetrate the textile as the upholstery plate is fully covered.

CONCEPT 02: OPEN UNDERSIDE PILLOWCASE
Principle: Upholstered plate and foam inside a cover. Cover has a cutout on the bottom for attachment of seat on chair frame.
Evaluation: Tightness of the cover is compromised – stretches once pressure is applied on top. Cutout must be fixed in place to avoid stretching.

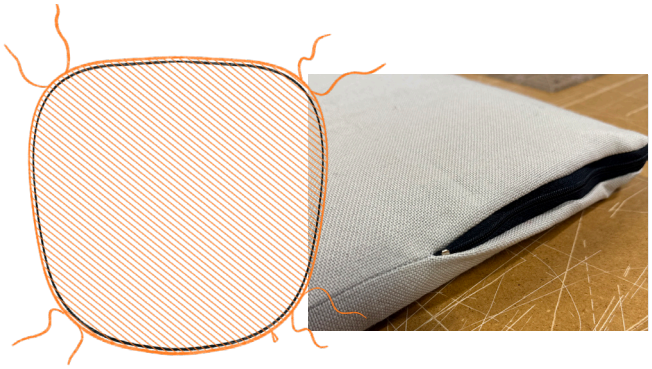


ILLUSTRATION 37: PILLOWCASE

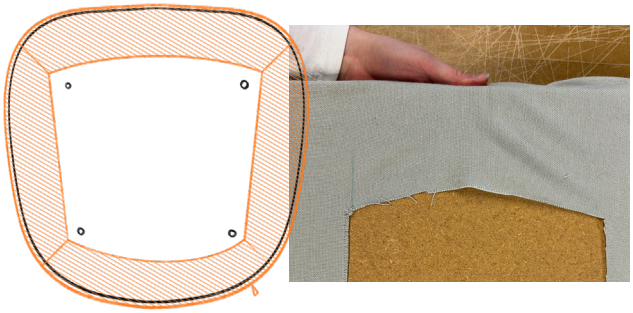


ILLUSTRATION 38: OPEN UNDERSIDE PILLOWCASE

CONCEPT 03: SEAT CUSHION - VISIBLE STRAPS
Principle: Separate, detachable cushion – allowing the same seat to be used with or without upholstery. Visible attachment.
Evaluation: Cushion and attachment method appear poorly integrated with the chair. Solution seems too obvious.

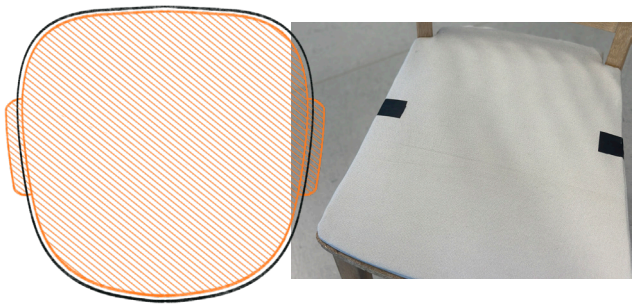


ILLUSTRATION 39: SEAT CUSHION - VISIBLE STRAPS

CONCEPT 05: SEAT CUSHION - CUTOUTS:
Principle: Separate, detachable cushion – allowing the same seat to be used with or without upholstery. Carveout on the sides or corners of the seat allowing attachment straps to be wrapped around less visibly.
Evaluation: The straps are better integrated compared to concept 04, however the cutouts pose a challenge in creating an elegant shape of the seat.

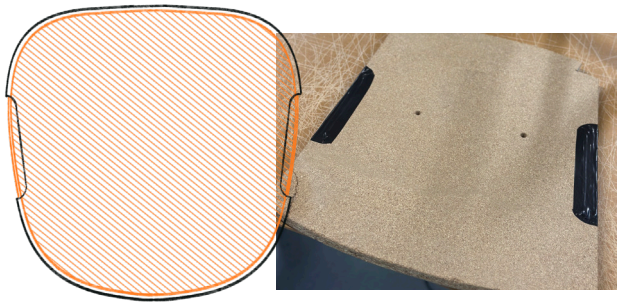


ILLUSTRATION 40: SEAT CUSHION - CUT-OUTS

CONCEPT 04: SEAT CUSHION - INVISIBLE STRAPS:
Principle: Separate, detachable cushion – allowing the same seat to be used with or without upholstery. Attachment straps hidden underneath the cushion.
Evaluation: Cutouts or lanes must be carved in the wooden seat, making it less appealing to use without a cushion.

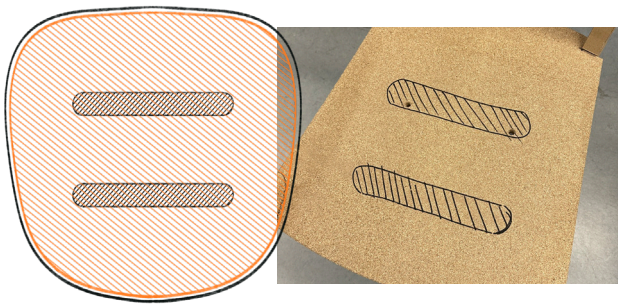


ILLUSTRATION 41: SEAT CUSHION - INVISIBLE STRAPS

CONCEPT 06: SEAT CUSHION - BUTTONS:
Principle: Separate, detachable cushion – allowing the same seat to be used with or without upholstery. Cushion attached in each corner with buttons, acting as a design detail.
Evaluation: Button solution leaves a hole or bottom part of the button on the seat, making it less appealing to use independently.

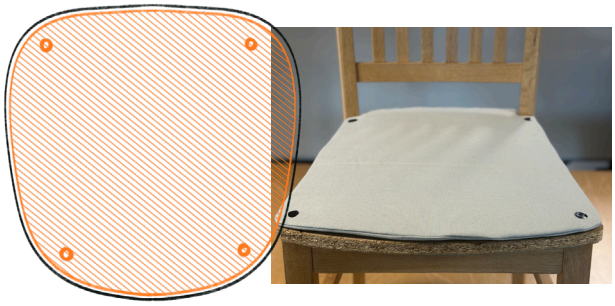


ILLUSTRATION 42: SEAT CUSHION - BUTTONS

CONCEPT 07: SEAT CUSHION - CORD ALONG EDGE
Principle: Cord sewn into the cover along the edge and then tightened on the back or bottom of the seat.
Evaluation: Better integrated compared to remaining seat cushion concepts, however fixation of cord must be explored.

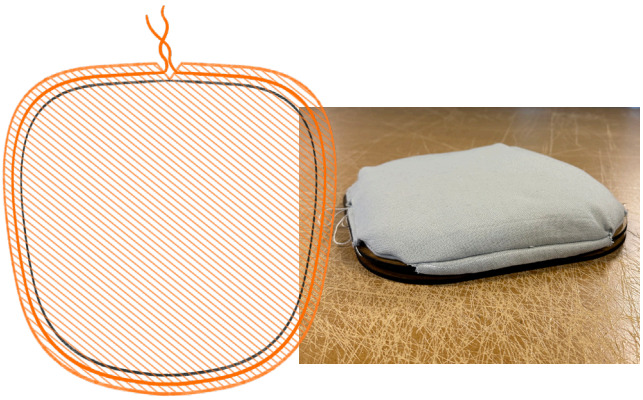


ILLUSTRATION 43: SEAT CUSHION - CORD ALONG EDGE

CONCEPT 08: SANDWICH
Principle: Textile fixated between the upholstery plate and an additional plate.
Evaluation: Not possible without some fixation of the fabric before attachment of additional plate.

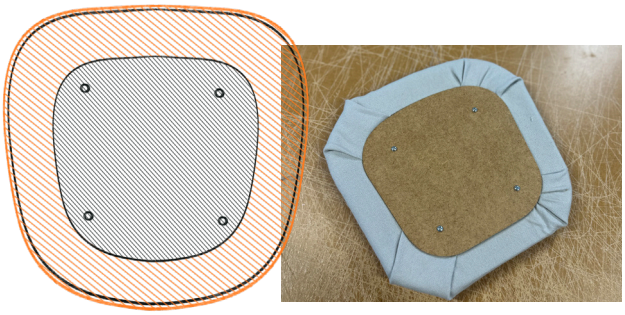


ILLUSTRATION 45: SANDWICH CONSTRUCTION

CONCEPT 09: VELCRO
Principle: Regular upholstery principle using velcro strips instead of staples.
Evaluation: Easy attachment and detachment. Velcro may not be strong enough to keep upholstery in place and may wear over time.

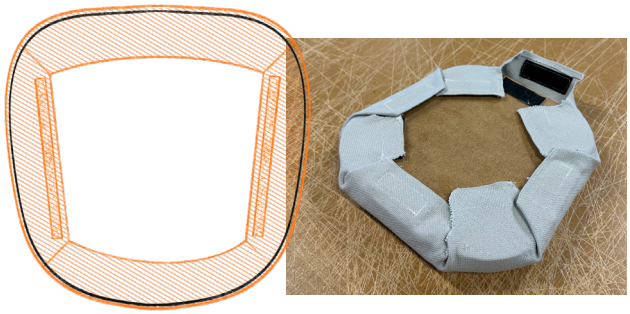


ILLUSTRATION 44: VELCRO

REFLECTION
While prototyping revealed certain potential and challenges tied to the different concepts, it remains difficult to fully assess which solutions are best suited for the design proposal. As a result, it is decided that further dialogue with an upholsterer or someone experienced in chair upholstery techniques is necessary. Additionally, the degree to which the upholstered element is visually and functionally integrated remains a concern across several of the explored concepts.

INTEGRATION OF UPHOLSTERY

To better understand how to integrate upholstered elements into the design, a mapping of various upholstery principles was carried out. Each principle was positioned along a span ranging from 'Low Degree of Integration' to 'High Degree of Integration'. The principles were assessed based on two criteria: the visual integration - how seamlessly the upholstery blends with the overall design - and the functional integration - how securely the upholstered element is attached. A selection of the principles is shown below, while the full investigation can be found in Appendix 11.

REFLECTION

To create the experience that the upholstered element feels more integrated, it should follow the contours of the seat/backrest as closely as possible. The mounting should appear secure and firm to enhance the sense of integration. Minimizing the distance between the seat/backrest and the upholstered element makes the chair appear as a more cohesive whole. Finally, the shape of the upholstered element must stylistically match the rest of the chair to achieve a higher level of integration.

ILLUSTRATION 46: SCALE OF HIGH TO LOW DEGREE OF INTEGRATION OF UPHOLSTERY

FEEDBACK MILESTONE III

While the overall vision for the project was acknowledged at the previous Milestone, questions are still raised regarding the framing of the project. In particular, there appears to be a mismatch in the problem-solution fit, which must be addressed. How will this concept genuinely encourage users to keep their dining chairs when they grow tired of them, rather than simply replacing them? What value does it truly offer to the target audience? Maybe it could be relevant to look into how needs for a dining chair changes during different life stages, since the object is to keep the design proposal relevant over an extended period of time.

Additionally, too much emphasis has been placed on the upholstery aspect, leading to the perception that the project is primarily about designing a cushion. It is pointed out that although the problem statement focuses on aesthetic obsolescence, the proposed solution appears to lean solely on maintenance related issues.

REFLECTION

In the Milestone presentation, too much emphasis was placed on the work around upholstery principles. With the feedback it is evident that the upholstery dilemma presents just a single subproblem within the overall fuzzy problem, and it may have taken up a larger focus than necessary. As a result, it is decided to set it aside for now in order to identify the remaining challenges and explore possible solutions for those. Furthermore, the project framing needs to be revisited again. The current value proposition obviously isn't convincing why more research must be done on existing market solutions and how the design proposal can differ.

"I FEEL LIKE YOU ARE JUST DESIGNING A CUSHION RIGHT NOW"

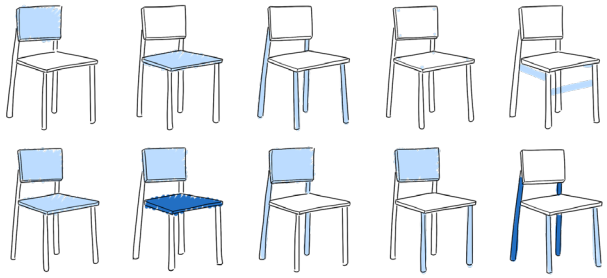
LINDA NHU LARSEN, MAIN SUPERVISOR FOR OTHER GROUPS

STRATEGIES FOR CHANGE IN AESTHETICS

Addressing the feedback from Milestone 3, the focus returns to the aesthetic aspects of the problem. However, while several approaches have been attempted, uncertainty remains regarding how to approach the concept of variety and how to define its extent. As a result, it is decided to take a step back and conduct a thorough mapping of the different ways the aesthetics of a dining chair can be altered. The goal is to explore which specific parameters can be adjusted to change the chair's appearance and to evaluate each one individually. The parameters in the mapping are based on the design parameters for trendy design, however they have been adapted to better suit the design of a dining chair.

From the mapping five distinct strategies for altering the appearance of a dining chair are found: changing the Colors, Materials and Tactility, Proportions, Forms and Lines, or Complexity. Each strategy is explored through a round of quick idea generation (10 minutes a round), where modifications are limited to the chosen parameter. The full investigation can be found in Appendix 12, while reflections on the different parameters can be found in the following.

ILLUSTRATION 47: VARIANCE IN COLOR

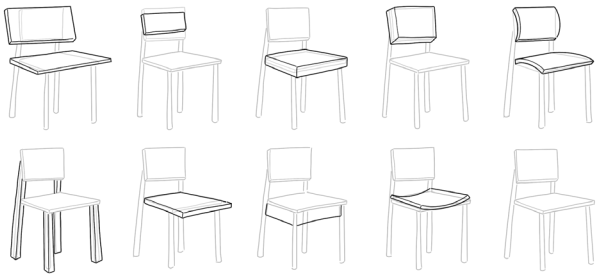


COLOURS

The aesthetical modification is primarily happening in the sense of how "loud" the chair is, but without being particularly different from one another. Meaning that certain colors or color combinations can set a certain mood, but when putting two chairs next to each other, you will still have the feeling that it is the same chair. However, colors can be used to draw attention to specific details – maybe indicating joints or what parts of the chair are permanent/interchangeable.

It is considered that it is not sufficient to only vary in color. The aesthetical variance must be supported by at least one other parameter.

ILLUSTRATION 48: VARIANCE IN PROPORTIONS



PROPORTIONS

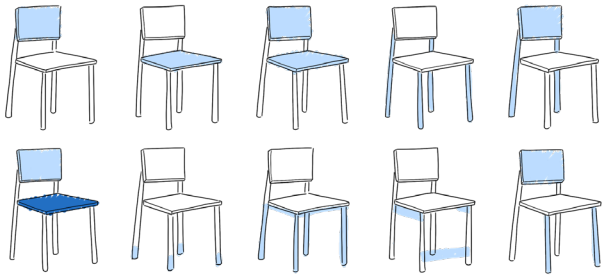
The proportions seem to determine how visually dominant the particular element is, hence establishing a visual hierarchy of the different components. Likewise, the proportions of the elements can vary dependently on each other and create more coherency and equivalence.

It is considered that this parameter has significant impact on the visual and aesthetic appearance of the chair and can act as a singular parameter for the overall aesthetic variance. However, it is noted that ergonomic considerations may limit the aesthetic freedom established with this parameter.

MATERIALS AND TACTILITY

The combination of more than two materials can appear messy, while the combination of one or two materials appears more balanced. Differing in material within the same or corresponding components also appear more noisy. The tactility of different materials affects the overall appearance; e.g. leather and wood appear warmer and more welcoming than e.g. steel and leather. While the tactility and number of different materials affect the mood of the chair, it is considered that the overall aesthetics remain somewhat the same, hence the variance must be supported by at least one other parameter.

ILLUSTRATION 49: VARIANCE IN MATERIALS

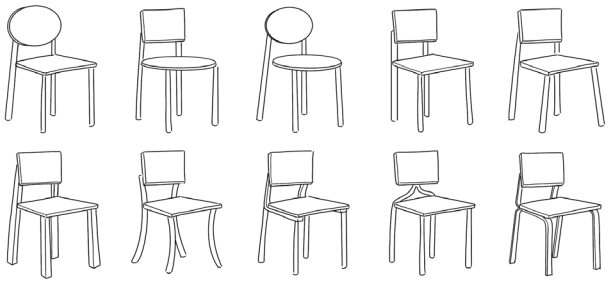


FORM AND LINES

Altering the shapes of different elements of the chair has significant impact on the aesthetic appearance. This is also the case if only a single component is altered, e.g. the backrest being modified from being square to being round has a substantial impact on the language and mood of the chair.

It is considered that Form and Lines can act as a singular parameter for the overall aesthetical variance. However, it is noted that when altering the form of one or more elements it can be challenging to ensure continued harmony in the chair as a whole.

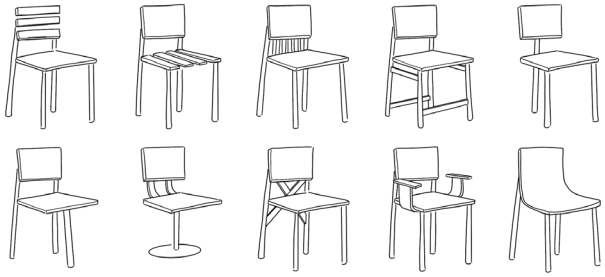
ILLUSTRATION 50: VARIANCE IN FORM AND LINES



COMPLEXITY

The overall appearance can vary a lot by changing the complexity and number of elements in the chair, to a degree that is considered sufficient to act as a singular parameter for the variance. However, construction principles may limit the aesthetic freedom significantly.

ILLUSTRATION 51: VARIANCE IN COMPLEXITY



CUSTOMIZABILITY OFFERED IN THE MID SEGMENT

Another aspect of the feedback from Milestone 3 focused on the perceived value for the target consumers of the design proposal compared to existing market alternatives. Therefore, a new market review was conducted. The purpose of the research was to understand the extent of customizability available to the intended target group – the mid segment - while also identifying what is economically viable to offer at this price point. The companies examined include HAY, FDB and Normann Copenhagen. The full research can be found in Appendix 13.

ILLUSTRATION 52: SELECTION OF HAY CHAIRS

MODEL: X-LINE CHAIR
PRICE: 1499 DKK
NO. OF SEAT AND BACKRESTS: 8
NO. OF FRAMES: 9

MODEL: SOFT EDGE 40
PRICE: 2249 DKK
NO. OF SEAT AND BACKRESTS: 7
NO. OF UPHOLSTERIES: 2
NO. OF FRAMES: 4

MODEL: ABOUT A CHAIR AAC 222
PRICE: 2299 DKK
NO. OF SEATS: 18
NO. OF UPHOLSTERIES: 1
NO. OF FRAMES: 3

HAY

HAY offers a high variety of customizability across different materials and production techniques, such as injection molded plastic, powder coating and wood lacquering. It is assumed that the extensive variety assortment is possible based on the production volume and company size.

ILLUSTRATION 53: SELECTION OF FDB CHAIRS

MODEL: J46
PRICE: 2299 DKK
NO. OF OPTIONS: 14

MODEL: J80
PRICE: 3299 DKK
NO. OF OPTIONS: 8

MODEL: J48
PRICE: 4499 DKK
VARIETY: 4 FRAME FINISHES, 3 UPHOLSTERY COLORS

FDB

The customizability offered by FDB is largely limited to variations in wood finishes - only one dining chair model is available with upholstery. This limited offering may be attributed to the high cost of materials (oak, leather, wicker etc.) as well as the craftsmanship required in their production.

ILLUSTRATION 54: SELECTION OF NORMANN COPENHAGEN CHAIRS

MODEL: TIMB CHAIR
PRICE: 3499 DKK
NO. OF SEAT AND BACKRESTS: 2 (TEXTILES)
NO. OF FRAMES: 2

MODEL: ALLEZ CHAIR
PRICE: 3199 DKK
NO. OF SEAT AND BACKRESTS: 4

MODEL: MAT CHAIR
PRICE: 2499 – 6299 DKK
VARIETY: MTO
NO. OF SEATS: 3
NO. OF FRAMES: 2
NO. OF UPHOLSTERIES: 207

NORMANN COPENHAGEN

Normann Copenhagen offers a more limited range of variety compared to some of the other brands explored. This could be due to smaller production volumes and company size relative to HAY and FDB. However, they do provide a different form of customizability by offering certain models made to order. For these MTO models, the retail price increases noticeably, suggesting that this production approach comes with significantly higher costs — something that may not align strategically with aim for the design proposal.

! The customizability currently offered includes variety in color, shape, materials and tactility

! Variety in materials resulting in additional manufacturing processes is considered too costly

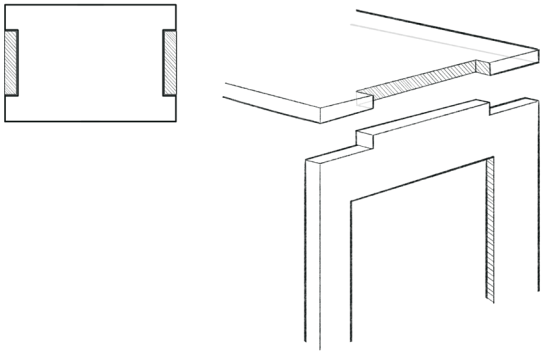
! It appears that it is financially feasible to offer variety in color, coating and finish

! MTO production approach is considered costly

CONSTRUCTION PRINCIPLES - FRAME, SEAT AND BACKREST

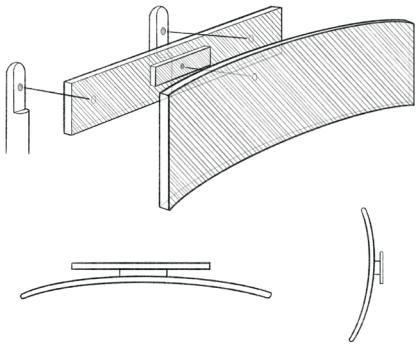
The limitations in terms of aesthetic variation as well as the user experience related to the replacement of the interchangeable components are dependent on the design of the frame.
To investigate the frame, an idea generation was conducted, focusing on structural principles and the attachment of the seat and backrest. The objective of this was to ensure that the interfaces for mounting would accommodate the greatest possible variability in seat and backrest. Moreover, it is considered that a criterion for the replacement of the interchangeable components is that the process is both perceived and practically straightforward.
The complete investigation is available in Appendix 14, while selected concepts and associated reflections are presented below:

ILLUSTRATION 55: CONSTRUCTION PRINCIPLES



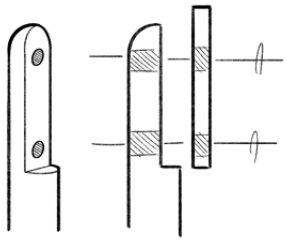
CUT-OUT-CONCEPT
Recesses in the seat and backrest with corresponding protrusions in the frame, allowing the parts to fit together like puzzle pieces.

+ High affordance for assembly between the chair frame and seat/backrest element
+ Hidden screws for assembly underneath
+ Simple construction (affordable manufacturing)
+ Easy assembly and disassembly
– Limited formal freedom in the design of the seat and backrest
– Can be difficult in relation to upholstery



TWO-PART CONSTRUCTION
Additional module between interchangeable part and the frame

+ High aesthetic variety as the outer part is partly separate from the inner part
+ Full ergonomic freedom in terms of angles and curvatures of the backrest
– Extra use of resources for the additional part
– Higher complexity in visual expression and construction
– Cost price will be higher

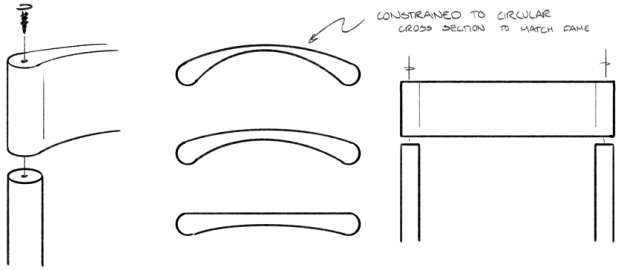


RECESS-PRINCIPLE
Recess in frame to accommodate backrest

+ High affordance for assembly
+ High aesthetic freedom
+ Easy assembly and disassembly
+ Medium cost price
– The height of the backrest can only be prolonged upwards
– Low degree of innovation
– Visible screws for attachment

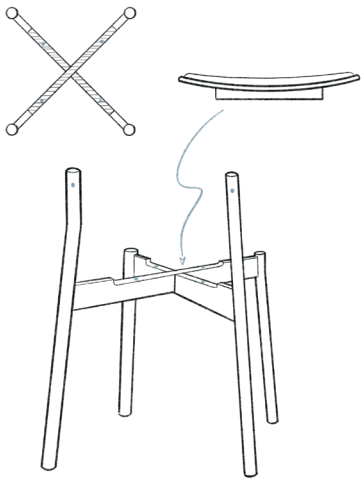
While it is possible to identify certain advantages and disadvantages, it is considered premature to derive any definitive conclusions regarding the design of the frame design at this stage. Consequently, the insights generated from the investigation are temporarily set aside and will be revisited later in the process (Frame Construction, p. 70)

REFLECTION
The ideation material suggests that the investigation may have lacked sufficient structure. A more effective approach might have been problem slicing, in which the construction of the frame and the mounting of the seat and backrest would have been examined separately.



TOP MOUNTED
Backrest mounted from above

+ Aesthetical freedom in terms of curvature
+ Easy assembly and disassembly
– The height variance of the backrest will be limited (can only be prolonged upwards)
– Limited by the length of screws (the screws should be standard and may not accommodate such length of screws for furniture)
– Thickness of backrest must match the thickness of the frame (which can be costly due to material and processing)
– Difficult to attach upholstery with hidden screws



CROSS CONSTRUCTION W. RECESS
Cross construction with a recess matching a protrusion on the seat

+ High aesthetic variety due to the seat laying on top of cross with centered attachment points
+ Stable frame construction
– Extra use of resources for the milled recess and second material plate. It would make more sense to create an elevation in the cross construction in the frame instead
– May be wobbly in attachment if the attachment points are placed too closely

FORM VARIETY ON SEAT AND BACKREST

To explore the potential for aesthetic variation in the seat and backrest of the chair, a brief idea generation was conducted based on a fixed chair frame. This exploration revealed that significant aesthetic difference can be achieved by modifying the backrest alone. However, some variations offer a better visual balance with the overall chair compared to others, underlining the importance of approaching the chair as a cohesive whole, when designing the various parts. It is also noted that the angle of the interface between the backrest and the frame poses a challenge in achieving a continuous curvature of the backrest. Furthermore, it appears challenging to achieve high aesthetic variety in the seat, as the front legs of the chair almost act as a structural boundary for the form and dimensions of the seat. The latter point will be further explored in the following section.

! All variants of seat and backrest should achieve an integrated, cohesive appearance with the frame

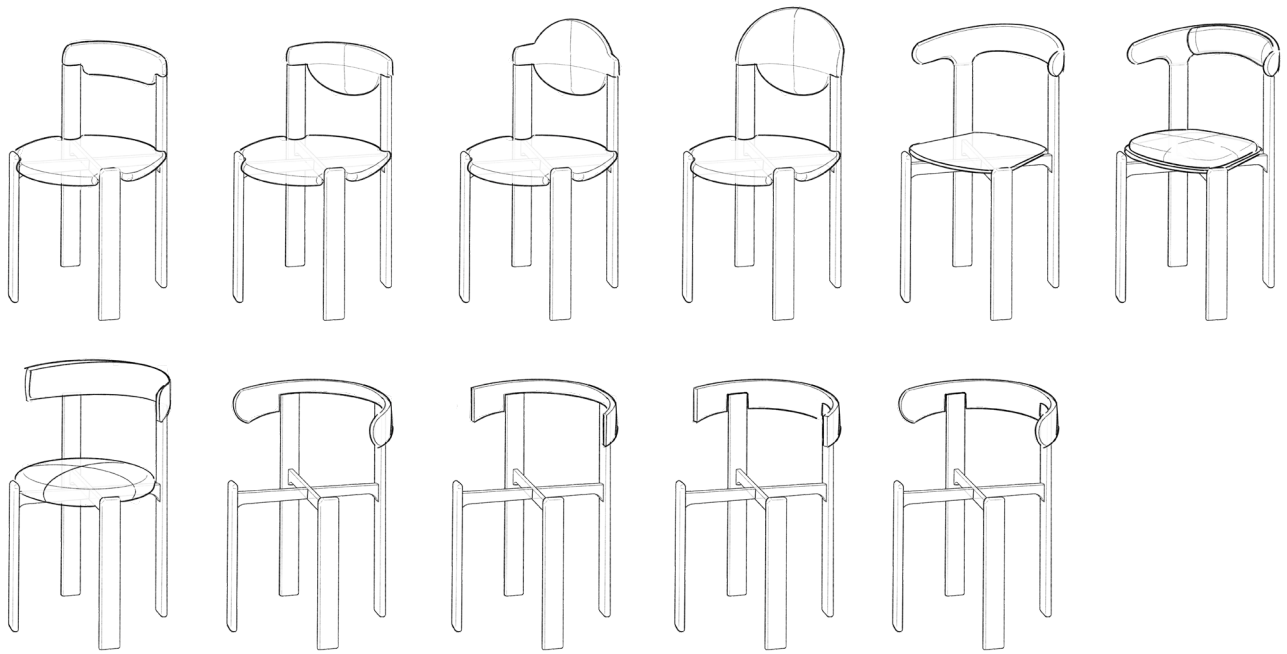


ILLUSTRATION 56: IDEA GENERATION ON FORM VARIANCE

CONFIGURATION – DEGREES OF FREEDOM

To explore the aesthetic degrees of freedom by having the seat and backrest either inside or outside the frame of the chair, an analysis of the constraints and possibilities of each configuration was conducted (see Appendix 15).

INSIDE CHAIR FRAME - SEAT

+ The curvature of the seat can be varied
+ The interface between the chair frame and seat are rather simple
– The form and dimensions of the seat can only vary within the frame of the chair

INSIDE CHAIR FRAME - BACKREST

+ The curvature of the backrest can be varied
+ The interface between the chair frame and backrest are rather simple
– The form and dimensions of the backrest can only vary within the frame of the chair

OUTSIDE CHAIR FRAME - SEAT

+ The form and dimensions of the seat can vary in several directions
+ The interface between the chair frame and the seat can be rather simple and modular
– The freedom of curvature in the seat can be limited by the attachment point with the frame

OUTSIDE CHAIR FRAME - BACKREST

+ The form and dimensions of the backrest can vary in several directions
– The curvature of the backrest can be limited by fixed angles and curvatures of the interface between the backrest and frame

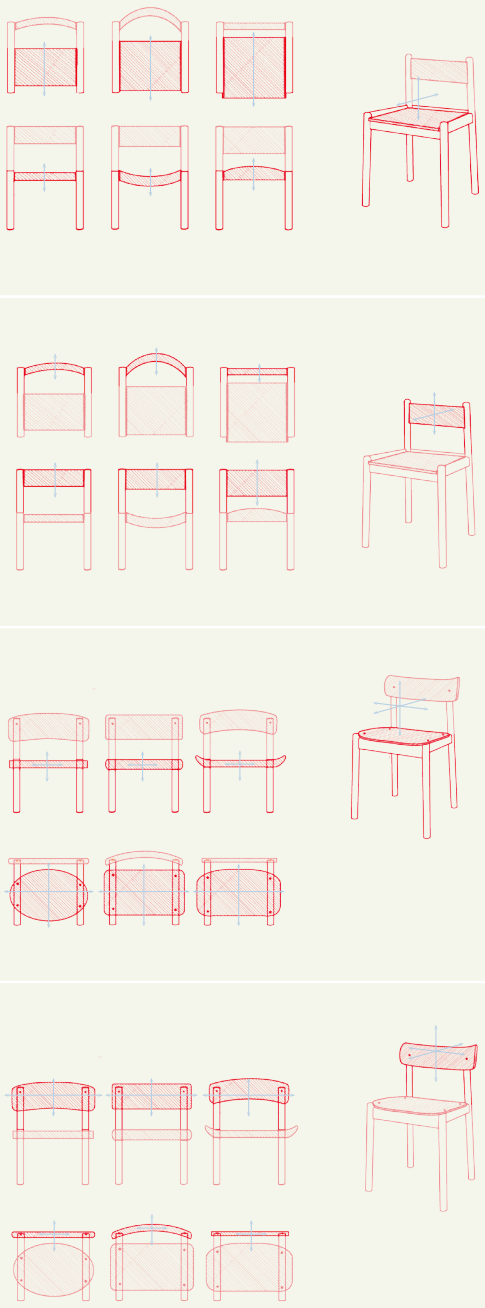


ILLUSTRATION 57: DEGREES OF FREEDOM

Based on the possibilities and constraints for the aesthetic degree of freedom of the different configurations, most potential was considered in the configurations outside the chair frame, as those allowed for the most aesthetical freedom. However, these configurations yielded some attention points in relation to the curvatures and angles of the interfaces arising from such construction, that has to be accounted for in the design.

! The highest degree of aesthetic variety can be achieved by having the seat and backrest outside the chair frame

DESIGN BRIEF 3.0

INTRODUCTION
This project focuses on designing a dining chair, that can evolve with the changing trends within interior design. The chair should be able to adapt to current trends and aesthetic preferences, while being able to be maintained and renewed in terms of wear and tear, to eliminate the premature replacement due to aesthetic obsolescence.

PROBLEM STATEMENT
How to design a dining chair that addresses aesthetic obsolescence in terms of both changing trends, aesthetic preferences and physical wear of the product, while also constituting a viable business case?

AIM
To address the premature disposal of furniture due to aesthetic obsolescence, where furniture is replaced due to changing trends and aesthetic preferences or wear and tear. Instead, consumers should be investing in furniture that is aesthetically adaptable for the future in terms of both trends and wear, to extend its lifetime and minimize risks of aesthetic obsolescence.

TARGET GROUP
Aesthetically-driven: Quality-conscious consumers, who tend to buy into medium-investment designs to be able to reflect current trends within their interior.
Maintenance-driven: Quality-conscious consumers, who tend to buy into medium-investment designs to be able to reflect a timelessly maintained appearance within their interior.

VALUEP ROPOSITION
Designed for change – a dining chair with replaceable seat and backrest that evolves with your style and stands the test of time.

CONTEXT
- Consumer retail market, private homes
- Mid-range furniture design stores

REQUIREMENTS
No elements of different materials should be glued (p.23)
Staples must not be used for upholstery (p.43)
The chair frame must have a timeless appearance (p.26)
The chair frame must allow for maintenance (p.27)
The chair frame must be made of solid wood (p.42)
The chair must be developed as part of a well-established, known brand (p.28)
The chair must have easy percieved interchangeability (p.28)
The chair must have easy practical interchangeability (p.28)
The interfaces must interfaces must have a high degree of feedback and feedforward (p.28)
The chair must be positioned in a mid price point (p.28)
The sales price of the chair must not exceed 3500 DKK (p.31)
The sales price of seat and backrest must not exceed 1150 DKK (p.39)
Seat and backrest must be able to reflect both a trend-based and timeless appearance (p.34)
Fasteners and similar components must be standard parts (p.35)

PHASE 04
NARROWING

Rethinking the way forward
The five walls
Brand decision and analysis – HAY
Ergonomics research 1.0
Two working principles
Expert interviews
Expansion to the contract market
Idea generation on the two principles
Wood tones and colors
Injection molded parts vs. bent veneer
The concept: 1 frame, 2 seats and 3 backrests
Designbrief 4.0

RETHINKING THE WAY FORWARD

Still struggling to find proper foothold after the latest Milestone a discussion is initiated with the primary supervisor. The main headache throughout the project has been figuring out how to work tangibly with aesthetic variation – and more specifically, how much variation is actually needed to satisfy the user's need for renewal. During the supervision a question is raised:

"MAYBE IT IS NOT ABOUT HOW MUCH VARIATION IS NEEDED, BUT HOW MUCH VARIATION IS POSSIBLE?"

While certain limitations to the solutions space have been defined through the conducted investigations and user research, it remains unclear which boundaries are yet to be established. Going forward, it is necessary to identify which aspects of the context and the design proposal require further exploration in order to narrow the solution space and steer the remainder of the design process.

THE FIVE WALLS

As a result of the supervision, the first step is to map out the limitations of the solution space. These boundaries are referred to as "walls" and are defined based on aims and insights established throughout the project so far. In total, five walls are identified: Price, Aesthetics, Ergonomics, Sustainability, and Construction.
From the mapping it is noted that the vast majority of limitations regarding the aesthetics and the ergonomics of the chair are yet to be determined, why these aspects will be further explored in the following sections.

SUSTAINABILITY

Material separation: Full
Reuse value of materials: High
Recycle value of materials: Full

CONSTRUCTION

Disassembly option: Full
Reparability degree: High
Interfaces: Modular
Fasteners: Standard components

ERGONOMICS

Seat height
Seat dimensions
Seat angle
Seat curvature
Backrest height
Backrest dimension
Backrest angle
Backrest curvature
(Armrest height)
(Armrest dimensions)
(Armrest angle)

PRICE

Purchase price: 1000 – 3500 dkk
Purchase price of aesthetic update:
¼ of the original price
Cost price: Brand specific markup

AESTHETICS

Permanent parts: Timeless appearance
Interchangeable parts: Timeless and trendy appearance
Frame material: Solid wood
Remaining materials: Brand specific
Form language: Brand specific
Tactility: Brand specific
Colours: Brand specific

Determined
Yet to be determined

! The markup and cost price of the chair will be brand specific

\+ The aesthetics (colors, materials, form language, tactility) of the chair must match the portfolio of the particular brand

\+ The chair should be ergonomically designed

BRAND DECISION AND ANALYSIS

As the walls are established it becomes evident that several aspects – the aesthetic considerations in particular – are brand dependent. Based on this, it is decided to select a case company to guide future design decisions.

Thinking of HAY
Various mid segment companies are explored, but ultimately the Danish design brand HAY is selected based on the resemblance between their design philosophy and the principles of this project. This alignment presents a plausible context in which the design proposal could be implemented.

ILLUSTRATION 58: HAY DESIGN DNA

ABOUT
HAY is a Danish design company founded in 2002 by Mette and Rolf Hay. The brand is built on the idea of creating contemporary, functional and accessible furniture and accessories available to a broad audience. HAY believes in the individual and offers a high degree of customization of their products, to suit the independent preferences and needs. HAY is positioned in the high end of the mid-segment to the low end of the premium segment, appealing to design-conscious consumers. Their target group typically presents urban, aesthetically aware consumers aged 25 – 45 years. Today HAY operates 25 stores across 9 countries, and retails in over 70 countries worldwide.

"The goal is to create high-quality, affordable products made for the evolving needs of everyday life" - HAY

DESIGN DNA
HAY's visual identity is a cornerstone of its brand appeal. Unlike the traditional monochrome Scandinavian minimalism, HAY utilizes a playful and unexpected color palette, including soft pastels and bold, saturated tones. The colors are either combined tone-on-tone, or in pairs of complementary colors, creating a strong visual impact. The form language of the products is typically defined by simple, clean lines. The shapes are often geometric inspired, such as circles, rectangles, cylinders etc., however the edges are rounded or curved for a softer appearance. Typically used materials in their furniture line are wood, powder-coated steel, molded plastic, glass, aluminum and a variety of textiles. The overall design language is guided by playful minimalism, with functional clarity and democratic design as principal themes. Many of the products offered by HAY are furthermore multi-use designs that are either stackable, modular or adaptable.

+ The aesthetics (colors, materials, form language, tactility) of the chair must match the portfolio of the particular brand
  - → *The colors must either be combined tone on tone or in pairs of complementary colors*
  - → *The form language must be geometrically inspired and defined by simple, clean lines*
  - → *The edges must be rounded or curved*
  - → *The materials must either be wood, powder coated steel, molded plastic, glass aluminum, textiles*

Brand specific requirements

+ *The cost of one chair must not exceed 875 DKK (4 x markup)*

+ *The cost of one seat of seat and backrest must not exceed 575 DKK (2 x markup)*

The stated markup has not been confirmed by HAY but presents an estimate, based on the common practice in the furniture industry of applying a markup between 2 and 7, depending on production volume and target segment. Given that HAY operates in the mid-market segment, a markup of 4 is considered plausible. Regarding the cost price of the replaceable parts, a lower markup is considered reasonable, as customer loyalty and a continuous revenue stream have already been established.

ERGONOMICS RESEARCH 1.0

To investigate the ergonomic boundaries of the design proposal a study of the general ergonomics for dining chairs was conducted (See Appendix 16). The following dimensions are recommended for chairs used for domestic seating (Ill. 59).

To further explore these ergonomic dimensions, an ergonomic test of the position and dimension of the backrest was conducted (see Appendix 16). The test was conducted with a mockup chair that allowed for the backrest to vary in height position and height dimension, as shown on Ill. 60. The ergonomic comfort experience by each configuration of position and dimension was evaluated from 1–5 by three different individuals of different heights.

As seen in Illustration 61-63, the most ergonomically comfortable height position of the backrest was determined as 36-42 cm above the seat (measured to the top of the backrest). Specifically, the position between 38-40 cm above the seat scored highest in regard to ergonomic comfort. Within this height range, the height dimension of the backrest could vary from 7-17 cm without signific compromising the experienced ergonomic comfort.

Considering the limitations of this test, the most ergonomically comfortable position identified was influenced by the fixed curvature and angle of the mockup backrest. Especially the curvature is considered to impact the ergonomic experience of different height positions, as the curvature of a human back increases down the upper body. Therefore, a more curved backrest would assumably have felt more comfortable in lower height positions. Furthermore, the test subjects only sat in the different configurations for short durations, which does not reflect the comfort of sitting in the chair for longer durations as intended.

	RECOMMENDED DIMENSIONS
SEAT HEIGHT	40-48 cm
SEAT DEPTH	38-46 cm
SEAT WIDTH	40-51 cm
SEAT ANGLE	5-8°
BACKREST ANGLE	95-105°
BACKREST HEIGHT	30-40 cm (50 cm for formal chair)

ILLUSTRATION 59: RECOMMENDED DIMENSIONS FOR DOMESTIC CHAIRS

HEIGHT POSITION

HEIGHT DIMENSION CM	32	34	36	38	40	42	44	46
7	3	3	4	5	5	4	1	1
12	4	3	5	5	5	4	2	2
17	3	3	4	5	5	4	3	2

ILLUSTRATION 61: SCOREBOARD FOR TEST-PERSON 1 (HEIGHT 163 CM)

HEIGHT POSITION

HEIGHT DIMENSION CM	32	34	36	38	40	42	44	46
7	2	3	4	5	5	4	2	1
12	3	3	4	5	5	4	3	2
17	3	3	4	5	5	4	3	2

ILLUSTRATION 62: SCOREBOARD FOR TEST-PERSON 2 (HEIGHT 175 CM)

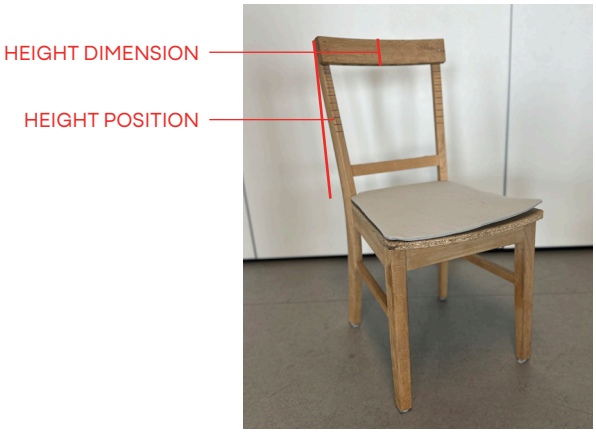


ILLUSTRATION 60: VARIABLES TESTED IN ERGONOMIC STUDY 1.0

HEIGHT POSITION

HEIGHT DIMENSION CM	32	34	36	38	40	42	44	46
7	1	2	3	4	4	3	1	1
12	2	3	4	4	5	4	2	2
17	2	3	4	5	5	5	3	3

ILLUSTRATION 63: SCOREBOARD FOR TEST-PERSON 3 (HEIGHT 177 CM)

ADDITIONAL ERGONOMIC STUDY

Based on these considerations, an additional study of the backrest position and curvature of existing dining and office chairs (both physical and online), including the chair from the previous test, was conducted (See Appendix 16).

ILLUSTRATION 64: STUDY OF BACKREST CURVATURE AND HEIGHT POSITION

CHAIR 1
Height position: 32 cm
Curvature: radius 103 cm

CHAIR 2
Height position: 33,5 cm
Curvature: radius 59 cm

CHAIR 3
Height position: 36 cm
Curvature: radius 35,5 cm

CHAIR 4
Height position: 34,5 cm
Curvature: radius 30 cm

Conclusion

Based on this study, it was found that the backrests positions varied from 28-36 cm above the seat, while the curvature radius ranged from approximately 30-103 cm. By evaluating the ergonomic comfort of the chairs seen on Ill. 64, three different parameters were identified to influence the experienced comfort:

(1) Whether the backrest is upholstered or not
(2) The flexibility of the backrest material
(3) The curvature of the backrest

From these, it was derived that the curvature presents the most significant parameter. It was identified that the higher the curvature (the lower radius), the more comfort is experienced in this position range.
In conclusion the design proposal must allow for the variants of the backrests to be positioned 30-34 cm from the seat with a curvature of 25-75 cm radius. The investigation of the height dimension of the backrest was however inconclusive.

+ The furniture must be ergonomically designed
- → *The backrest must be positioned 28-34 cm above the seat of the chair*
- → *The curvature of the backrest must be 25-75 cm in radius*
- → *The angle of the backrest must be 95-105°*
- → *The seat must be positioned 40-48 cm above the ground*
- → *The depth of the seat must be 38-46 cm*
- → *The width of the seat must be 40-51 cm*
- → *The angle of the seat must be 5-8°*

TWO WORKING PRINCIPLES

The aesthetic boundaries of the design proposal are highly dependent on the other boundaries of Price, Construction, Sustainability and Ergonomics. With the intend of further exploring the boundaries of Price, Construction, and Sustainability, two concepts were developed to serve as working design principles materializing the aspects of these walls. One of the concepts is based on the 'Classic Dining Chair'-archetype, while the other draws on the configuration of aesthetic variance discovered in the Twig Chair (p. 36). Thereby, the two concepts served as concrete examples, enabling further exploration and more targeted discussions around pricing, construction-related possibilities and challenges, and sustainable aspects.

CLASSIC DINING CHAIR

NEMO

ILLUSTRATION 65: CLASSIC DINING CHAIR WITHOUT ARMRESTS

A classic dining chair with interchangeable seat and backrest. The backrest is mounted on the backrest support either from the front or the back using screws. The seat is mounted directly on the frame with screws attached from below.
As the seat is mounted on top of the frame, altering the dimensions (or to some extent the shape/curvature) in the variants is fairly unrestricted. The backrest support has a milled recess in which the backrest rests, thus this represents a limitation for the curvature of the backrest variants.

TWO PART DINING CHAIR

LUNA

ILLUSTRATION 66: DINING CHAIR DIVIDED INTO A TOP AND BOTTOM PART

A dining chair with armrests, divided in a top and bottom part – the top being the interchangeable part. It is not determined how the top part attaches to the frame, but a simple 'plug'-solution is considered. The seat is mounted with four screws attached from below through the cross joint in the frame. As the seat is placed inside the frame, the concept does present a limit to the dimensional possibilities for the seat variants. The top part is restricted by the four joint points of the four legs. However, besides these, the form and curvature of the top part is completely unrestricted.

EXPERT INTERVIEWS

To further explore the limiting boundaries based on these concepts, interviews with different companies producing furniture were conducted. The aim of these interviews was to discuss the pricing, constructive and sustainable aspects of the two concepts on the foundation of the companies' expertise and experience with the production of furniture, and in particular upholstered furniture.
The following companies; VELA, RUMAS and Cabinetmaker Mads Høgsted, were interviewed and the full summary of insights from these interviews can be found in Appendix 17.

The interviews revealed several insights that either established a requirement for the proposal or required further investigation.

ILLUSTRATION 67: INTERVIEW WITH JENS HØJER, CEO AT RUMAS AND HØJER MØBLER

ILLUSTRATION 68: INTERVIEW WITH CABINETMAKER, MADS HØGSTED JENSEN

ILLUSTRATION 69: INTERVIEW WITH ANDERS HAUERBERG HANSEN, VELA

EXPANSION TO CONTRACT MARKET?

- There is an increasing demand for refurbishing furniture within the contract market - exploration of contract market expansion
- The possibility of having armrests would be relevant to offer within the contract market

VIABILITY OF INTERCHANGEABLE PARTS

- Interchangeable parts of 'Luna'-concept were deemed complex and costly - other materials and productions methods should be considered
- Interchangeable parts of 'Nemo'-concept can be made from layered veneer instead of solid wood to reduce costs
- Interchangeable parts must be cheap and simple to produce

CONSTRUCTIVE DURABILITY OF THE CHAIR FRAME

- The wooden elements assembled with dowel joints must be accompanied by glue to ensure durability
- Threaded bushings must be used in assembly joints between the interchangeable parts and the chair frame to eliminate wear towards the wood.

MATERIAL SEPARATION OF UPHOLSTERY

! The upholstery foam can be attached with water-based glue that is water-solvable for separation

! The upholstery cover can be securely attached by the method of drawstring upholstery (see Ill. 70) to allow for easy and gentle disassembly

! Drawstring upholstery is only considered viable for the seat of the chair, as the underside will be hidden

! Alternatives to leather such as artificial leather or bio-based leather should be considered

ILLUSTRATION 70:
DRAWSTRING UPHOLSTERY METHOD AT VELA

UPHOLSTERY METHOD AT VELA

The method utilizes a drawstring to attach the upholstery cover. The drawstring is sewn to the perimeter of the cover, and then accurately tensioned by a machine to wrap the cover tightly around the cushion. The ends of the strings are secured with two staples.

INTRODUCTION OF 'NEW WOOD'

! It is deemed impossible to completely match new wooden parts to an old, patinaed chair frame - consider making it part of the storytelling or make a contrasting feature for the wood

\+ Threaded bushings must be used in assembly joints between the permanent and interchangeable parts
→ *Threaded bushings must be used in assembly joints between the frame, seat and backrest*

EXPANSION TO THE CONTRACT MARKET?

Based on the increasing demand for refurbishing furniture in the contract market, the possibility of introducing the design proposal to the contract market is explored.
In comparison to the lifetime of dining chairs, the estimated lifetime of contract furniture is 5-10 years reflecting frequent replacement. But is it even possible to design the chair for both the private and contract market?
A study of conference chairs was conducted to compare the identified features and ergonomics of conference chairs with classic dining chairs (Appendix 18). By this comparison, it was found that conference chairs and dining chairs are ergonomically compatible. However, the aesthetic appearance of conference chairs is misaligned with the aesthetic appearance sought for the design proposal, as presented below. Due to these aesthetic differences, it was decided not to focus on expanding the design proposal to the contract market.

Conference chair (contract market)

Visual expression:
Industrial, formal, professional

Function-driven design:
Visible functions

Primary materials:
Steel, plastic, fabric

Primary colors:
Black, chrome, grey (steel/ brushed steel)

Primary archetypes:
Swivel chair, shell chair

Classic dining chair (private market)

Visual expression:
Cozy, grounded, natural

Aesthetical-driven design:
Integrated functions

Primary materials:
Wood, fabric

Primary colors:
Neutral earthy colors (wood)

Archetype of proposal:
Classic dining chair

ILLUSTRATION 71: DINING CHAIRS VS CONFERENCE CHAIRS

IDEA GENERATION ON THE TWO PRINCIPLES

While the interviews with Cabinetmaker Mads Høgsted, VELA and Rumas, provided certain construction and production related insights, it remains unclear which of the two working principles present the most potential. As a result, both are further investigated through a round of idea generation, with the focus being to explore possibilities for aesthetic variation. Following, each principle was evaluated independently.

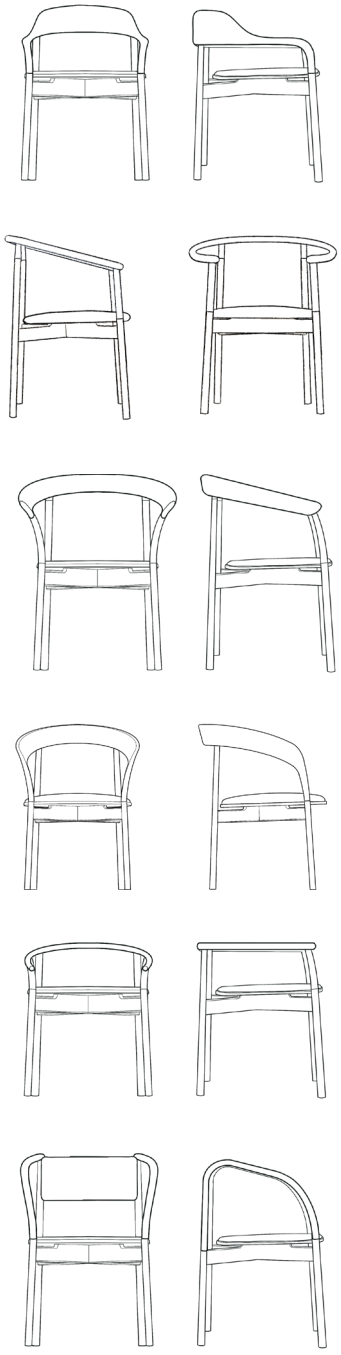


ILLUSTRATION 72: IDEA GENERATION UPON DINING CHAIR USING THE TWO-PART-PRINCIPLE

LUNA
TWO PART PRINCIPLE

- It is possible to make visually very different appearances of the top part and thereby of the chair as a whole.
- It is possible to make visually very interesting chairs in terms of form and curvature.
- Including armrests presents some ergonomical potential
- In some of the variants, the backrest part entails a bigger part of the overall chair, which entails a greater use of material and processing of that material.
- The interchangeable parts are to either be molded in materials such as plastic, paper pulp etc. or alternatively, or made from steam bent wood.
- Some of the backrests involve high complexity in form and curvatures – thus assumably a high complexity and cost if these parts are to be molded, which could be problematic in relation to keeping the cost of the interchangeable parts low.
- The recirculation possibilities of these variants if molded, will presumably be to granulate/recycle the material – being a more resource consuming process than refurbishing the parts.

ATTENTION POINTS

- How are the ergonomics of this construction and the different variants?
- How costly is a mold for such parts?
- Which materials would make sense to do the top-parts in?
- How is the top and bottom part assembled?

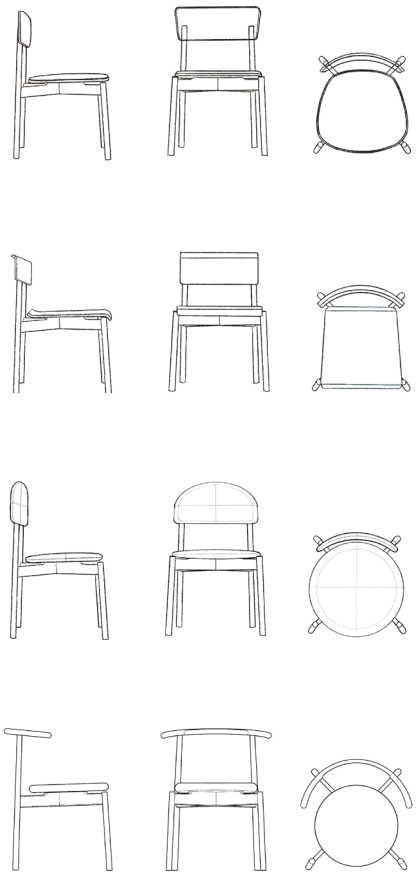


ILLUSTRATION 73: IDEA GENERATION UPON CLASSIC DINING CHAIR PRINCIPLE

NEMO
CLASSIC DINING CHAIR

- The interchangeable parts entail a smaller part of the overall chair, which is desirable in terms of minimizing the use of materials.
- Upholstered interchangeable parts present a high potential for refurbishment.
- The complexity of form and curvatures of the interchangeable parts are relatively low, thus the cost of the processing of the parts will assumably be lower
- The aesthetic variation is lower, than in the 'Luna'-concept

  Reflection: This observation seems a bit counter-intuitive, as this concept has fewer constraints/ limitations comparative to the 'Luna'-concept. However, reflecting upon this combined with the insights from 'Form variety on seat and backrest' p. 52, it appears that it is difficult to establish a significant feeling of a new appearance while staying within the archetype "Classic Dining Chair". Based on this it is considered that it may be necessary to challenge the initial archetype of the chair, in order to give the user a sense of renewed appearance.
- The proposals do not include any armrest, which is less desirable in terms of increasing the ergonomic comfort of the chair

ATTENTION POINTS

- Incorporation of armrest may need to be explored
- How are the ergonomics of this construction and the different variants?
- If the new interchangeable parts are not upholstered but made of wood, there will be a visual difference between these and the "old" wooden frame. How is this solved?
- How is the backrest mounted on the frame in the case where it is fully upholstered?

ILLUSTRATION 74: COMBINATION OF DIFFERENT WOOD TONES AND COLORS

WOOD TONES AND COLORS

During the interview with cabinetmaker Mads Høgsted, it was pointed out that it is not possible to process a piece of wood that has been surface treated or has naturally yellowed over time to such an extent that it can be combined with a raw piece of wood without noticeable difference.
Therefore, considerations are made about actively using this issue in the design process and intentionally combining wood of different tones or surface treatments as a deliberate design decision. In this context, existing concepts that make use of this principle have been examined and evaluated (App. 19).

NUMBER OF CONTRASTS

In furniture that combines wooden elements in different colors, it is noted that introducing more than one contrast often leads to a cluttered look. Therefore, it is considered that more than two different colors in the design proposal should be avoided. This implies that if a contrasting color is used for the backrest, the seat should either match the backrest or the frame to maintain visual coherence.
Furniture featuring mixed wood tones is harder to find, which may indicate limited consumer demand. A possible explanation for this is that consumers typically prefer either light or dark wood in their interiors and tend to maintain consistency in their choices. Based on these observations, if the principle of contrasting wood tones is to be applied in the design, it should be done in a discrete manner - preferably in smaller elements such as joints or detailing.

! More than two contrasting colors in the design proposal should be avoided to ensure visual coherence

! Contrasting wood tones can be applied to joints or details of the design proposal in a discrete manner

INJECTION MOLDED PARTS VS. BENT VENEER

Due to concerns regarding the economic viability of molding the interchangeable parts of the 'Luna'-concept, an interview with Hans Høgh from Podovo was conducted. The full summary of insights can be found in Appendix 20.

Due to the size of the interchangeable parts, the molding tools for injection molding are estimated to be a costly investment of a minimum of 200.000 DKK for each mold, depending on the exact shape, size and complexity.

The variants of the design proposal are intended to be produced as a serial production of low to medium volumes to align with the continuous change of the variants offered (see Appendix 21). Therefore, the solution of injection molding the interchangeable parts is deemed economically unviable.

THE CONCEPT: 1 FRAME, 2 SEATS AND 3 BACKRESTS

From the explorations conducted in terms of determining the constructive, economic, sustainable and aesthetic viability of the two concepts, it was decided to narrow the solution space for the design proposal down to one concept.
The design proposal will be based on the constructive principle of the 'Nemo'-concept due to following main reasons:

- The interchangeable parts constitute a smaller part of the entire chair, which allows for the use of fewer resources in these parts
- The complexity of the interchangeable parts is low, thus the processing of these parts will be economically viable in low to medium production volumes
- The materials used for the interchangeable parts presents reuse value in terms of recycling, thus a high integrity of the materials can be maintained

The aesthetic variation of the design proposal will be based on the 'Luna'-concept, as it presented the potential for significant aesthetic variation in the overall appearance of the chair by introducing form variation in the backrest and possibly armrests of the chair. Therefore, the following concept development and detailing is focused on creating conscious form variance in backrest, targeting different aesthetical preferences. The concept of the design proposal can be summed up as shown on Ill. 75.

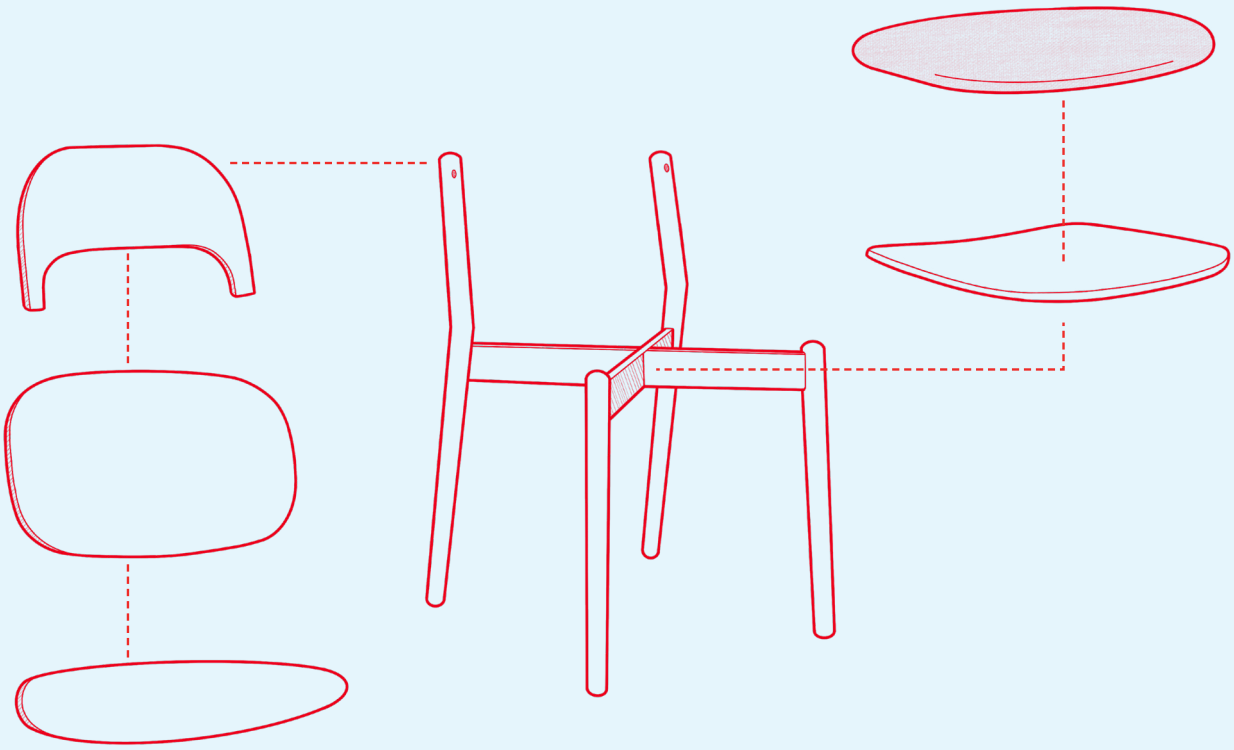


ILLUSTRATION 75: 1 FRAME, 2 SEATS AND 3 BACKRESTS

DESIGN BRIEF 4.0

AIM

To address the premature disposal of furniture due to aesthetic obsolescence, where furniture is replaced due to changing trends and aesthetic preferences or wear and tear. Instead, consumers should be investing in furniture that is aesthetically adaptable for the future in terms of both trends and wear, to extend its lifetime and minimize risks of aesthetic obsolescence.

TARGET GROUP

Aesthetically-driven: Quality-conscious consumers, who tend to buy into medium-investment designs to be able to reflect current trends within their interior.
Maintenance-driven: Quality-conscious consumers, who tend to buy into medium-investment designs to be able to reflect a timelessly maintained appearance within their interior.

VALUE PROPOSITION

Designed for change – a dining chair with replaceable seat and backrest that evolves with your style and stands the test of time.

REQUIREMENTS

No elements of different materials should be glued (p.23)
Staples must not be used for upholstery (p.43)
The chair frame must have a timeless appearance (p.26)
The chair frame must allow for maintenance (p.27)
The chair frame must be made of solid wood (p.42)
The chair must be developed as part of a well-established, known brand (p.28)
The chair must have easy percieved interchangeability (p.28)
The chair must have easy practical interchangeability (p.28)
The interfaces must interfaces must have a high degree of feedback and feedforward (p.28)
The chair must be positioned in a mid price point (p.28)
The sales price of the chair must not exceed 3500 DKK (p.31)
The sales price of seat and backrest must not exceed 1150 DKK (p.39)
*The cost of one chair must not exceed 875 DKK (4 x markup)** (p.57)
*The cost of one set of seat and backrest must not exceed 575 DKK (2 x markup)** (p.57)
Seat and backrest must be able to reflect both a trend-based and timeless appearance (p.34)
*The colors must either be combined tone on tone or in pairs of complementary colors** (p.57)
*The form language must be geometrically inspired and defined by simple, clean lines** (p.57)
*The edges must be rounded or curved** (p.57)
*The materials must either be wood, powder coated steel, molded plastic, glass, aluminum, textiles** (p.57)
Fasteners and similar components must be standard parts (p.35)
The backrest must be positioned 28-34 cm above the seat of the chair (p.59)
The curvature of the backrest must be 25-75 cm in radius (p.59)
The angle of the backrest must be 95-105° (p.59)
The seat must be positioned 40-48 cm above the ground (p.59)
The depth of the seat must be 38-46 cm (p.59)
The width of the seat must be 40-51 cm (p.59)
The angle of the seat must be 5-8° (p.59)
Threaded bushings must be used in assembly joints between the frame, seat and backrest (p.62)

**Brand specific requirements*

PHASE 05
DETAILING

Ergonomics research 2.0
Frame construction
Backrest ideation
There must be a better solution
Armrest development
3D ideation
FEA of backrest with armrests
Selection of backrest with armrest
Variants without armrest
Test and detailing on user interaction
Chair assembly considerations
Degree of customizability
Refurbishment of seat and backrest
Selected colors and textiles
Designbrief 5.0

ERGONOMICS RESEARCH 2.0

To define the ergonomic boundaries of the design proposal further, economic tests regarding the backrest and armrest was conducted based on the recommended ergonomic ranges identified in 'Ergonomics research 1.0'.

BACKREST ANGLE

The angle of the backrest was tested with the aim of determining the most ergonomically comfortable angle for a dining chair (see Appendix 22).

The test was conducted with the previously used mock-up chair with the backrest positioned 32 cm from the seat. The tested angles of the backrest varied with 2° ranging from 94-108°. The ergonomic comfort experience by each angle was evaluated from 1–5 by three different individuals of different heights.
As seen in Illustration 76, the most ergonomically comfortable angle of the backrest was determined as 102-106°.

Although, the attention points drawn from this test is that the curvature of the backrest resembles a source of error in terms of evaluating the actual comfort of the chair – in comparison to the desired curvature of the backrest. Additionally, the short durations of sitting in the chair to evaluate the angle resemble a source of error in terms of evaluating whether the angle is comfortable for longer durations (60-90 min).
However, it is concluded that the angle of the backrest (measured from the seat) should be between 102-106°.

	94°	96°	98°	100°	102°	104°	106°	108°
TESTER 1	2	3	4	4	5	5	5	3
TESTER 2	2	3	3	3	4	5	5	3
TESTER 3	2	2	3	4	5	5	4	3

ILLUSTRATION 76: ERGONOMIC BACKREST ANGLE

ARMREST LENGTH

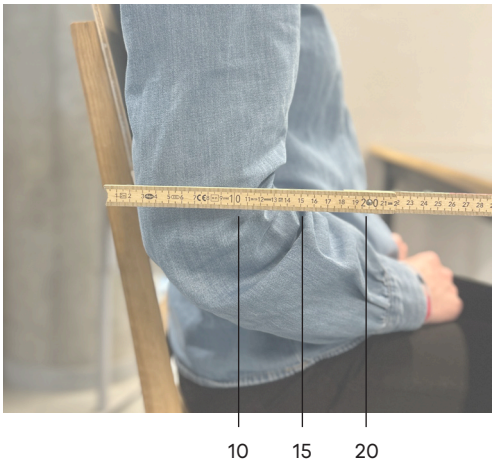
The length of the possible armrests was tested with the aim of determining the most ergonomically comfortable length for dining chairs (see Appendix 22).
The test was conducted by measuring the required length of the armrest to support the arms in two different simulated sitting positions of the arms applicable for dining.

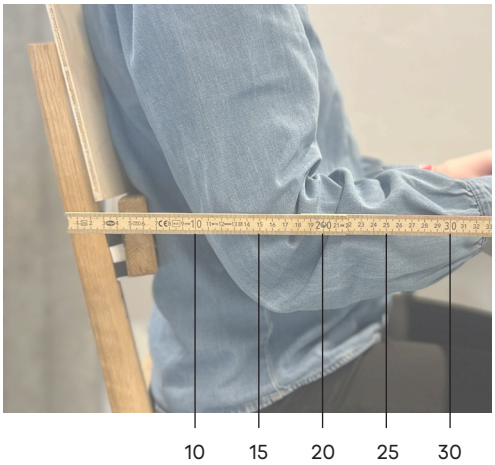
Based on this test, it was concluded that the length of the armrests (from the backrest) should be 25-30 cm to provide support for the arms while dining.

+ The angles of the backrest must be 102-106°

+ The lenght of the armrest must be 25-30 cm

ILLUSTRATION 77: ARMREST LENGTH





FRAME CONSTRUCTION

With several design parameters now defined the insights from Construction Principles: Frame, Seat, and Backrest p. 50, are revisited to navigate the development of the frame.

X or Square

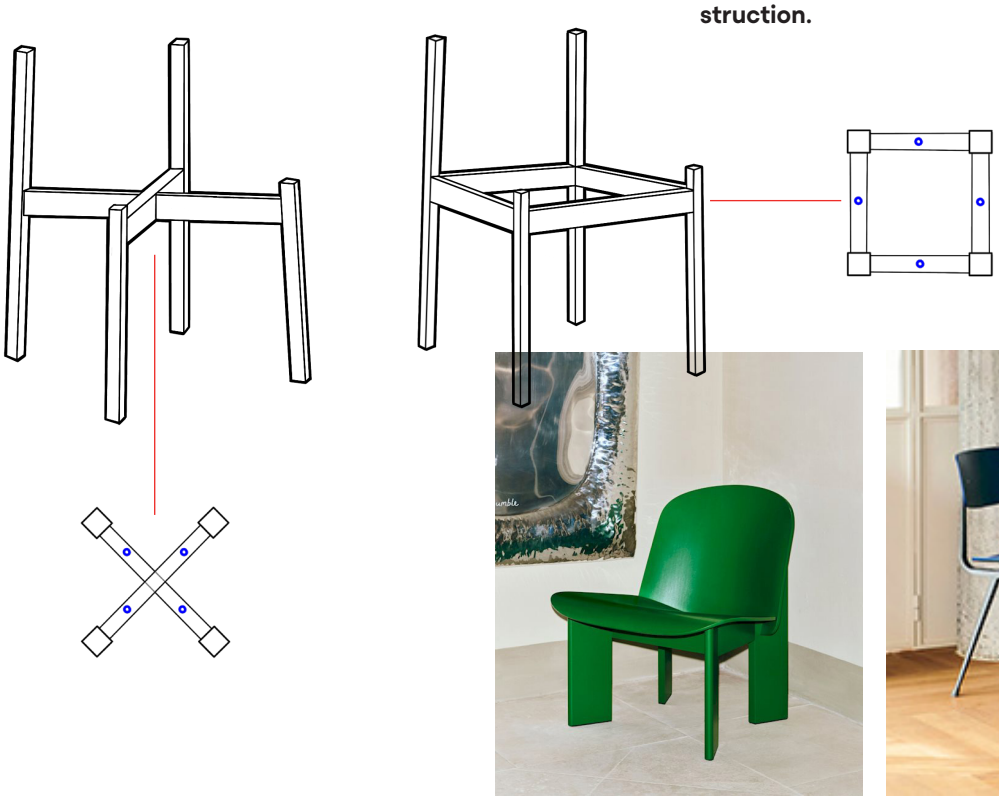
In general, two primary types of frame constructions were identified during the market research (Market Research - Construction Principles, p. 35): A cross-frame construction and a square-frame construction (including variations hereof), see Illustration 78.

Comparing these configurations reveals that the cross-frame construction allows for a centered mounting of the seat, which can be advantageous in terms of enabling greater aesthetic freedom in the design of the seat. In contrast, square-frame constructions typically require a more peripheral seat mounting, which may limit formal variation.

Moreover, the cross-frame configuration allows the frame to be composed of only two modules that can be assembled in a single joint. This is favorable in relation to simplifying the user experience of the assembly process. Additionally, it is advantageous with regard to flat-packing, which is beneficial for optimizing shipping space and handling, thereby reducing both transportation costs and environmental impact (Mercer, 2024). Certain variations of the square-frame design may also support flat-packing; however, such versions would inevitably consist of more components, thus complicating the assembly process for the end user.

Based on these considerations, it is concluded that the frame design should be based on a cross-frame construction.

ILLUSTRATION 78: X OR SQUARE-FRAME



A CHAIR FRAME FOR HAY

The aesthetic considerations regarding the frame are based on the design principles and formal language of HAY. An analysis of HAY's portfolio of seating furniture reveals a consistent use of bold colors and strong geometries. Furthermore, it is noted that unconventional frame profiles are often used (Illustration 79). Based on this observation, the idea of employing conventional round-dowels for the frame is rejected and alternative geometric forms are explored. Another key principle of HAY is the intentional and charismatic use of form and configuration. Therefore, it is considered how to develop a frame that is both visually assertive, while also timeless, ensuring that the backrest remains the focal point of the composition.

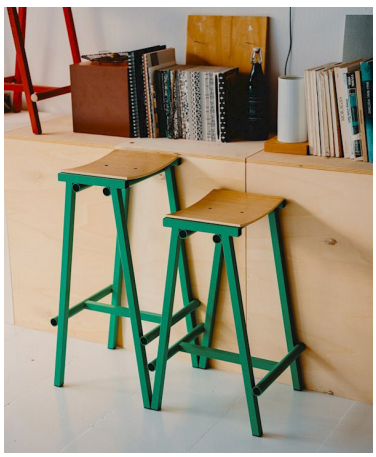
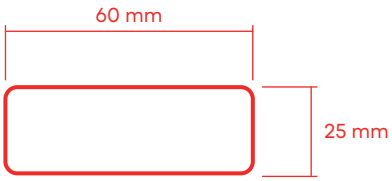


ILLUSTRATION 79: HAY FRAME PROFILES

Considerations regarding production and cost were also included. In order to maintain cost-efficiency, it is deemed unfeasible to work with profiles or components requiring custom fabrication.
Ultimately, the following proposal for the frame was developed. The frame consists of rectangular profiles, standard measurements 25 x 60 mm.



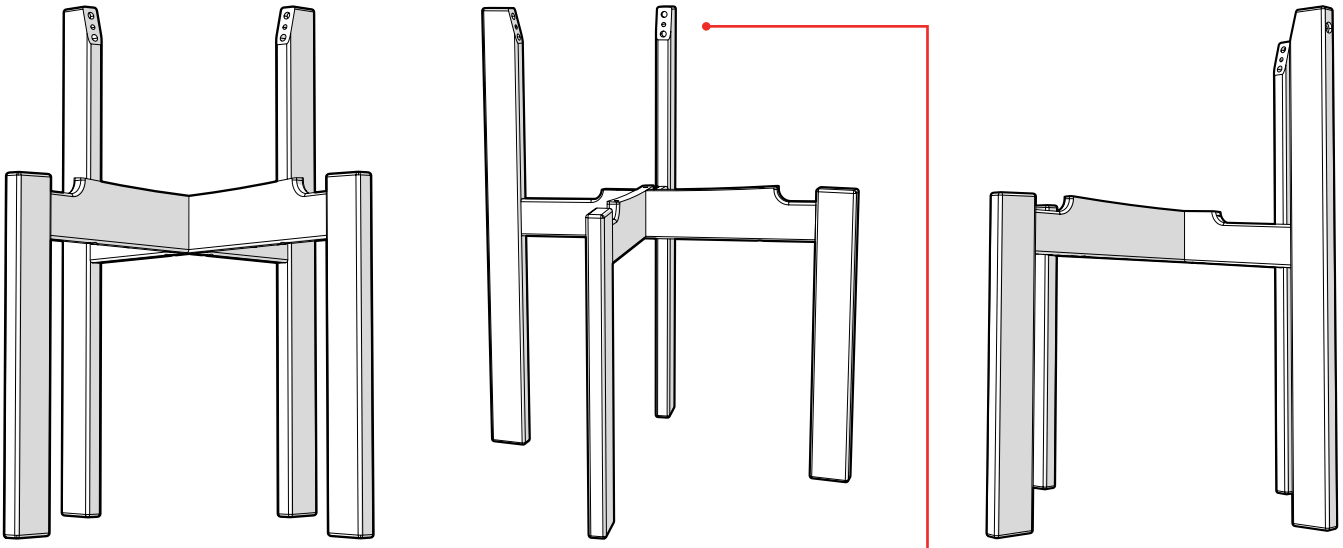


ILLUSTRATION 80:
CHAIR FRAME WITH RECTANGULAR PROFILES

INTERFACE
During the initial round of ideation on construction principles (Construction Principles – Frame, Seat and Backrest, p. 50), several concepts for mounting the backrest to the frame were explored. These included, among others, the possibility of mounting the backrest from above, as well as integrating a recess into the frame to accommodate the backrest.
While the top-down mounting approach offers a degree of design freedom - particularly in terms of backrest curvature and, to some extent, overall form - it was ultimately deemed too uncertain. Concerns were raised regarding limitations in vertical dimensions and the screws required for this solution. In contrast, the recess-based concept is more commonly used within chair design and is therefore considered a more validated and reliable direction for further development. This solution furthermore reflects high affordance in terms of assembly and allows for easy practical assembly and disassembly. Moreover, this interface will accommodate high aesthetic variance. However, the exact angle and curvature of the recess must be further determined in relation to the development of the backrest variants.

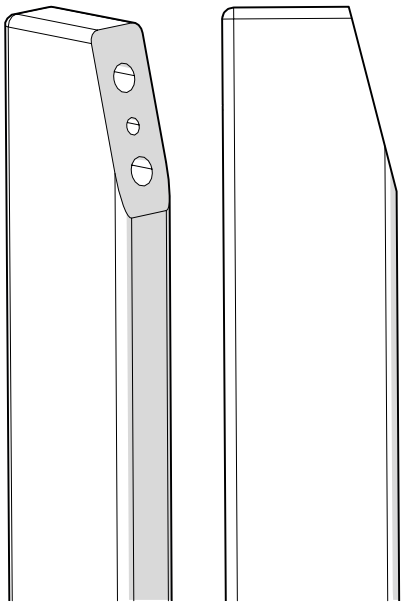


ILLUSTRATION 81: INTERFACE FOR BACKREST

SEAT
As it is decided that the variation in form should be limited to the variants of backrests and the developed chair frame presents a strong visual presence independently, it is considered necessary for the seat to maintain a simple and understated expression. The role of the seat is to support the integration between the different backrest variants and the frame, meaning the seat must formally and stylistically align with all the variants of backrest as well as the frame. Furthermore, it is considered that the shape of the seat must accommodate easy upholstering, why complex shapes should not be considered, as these will complicate the upholstery process, hence increase production and refurbishment cost.

Given the time constraints of the project, it is decided to not invest substantial time and work in the development of the seat. This decision is based on the assessment, that the design and configuration of the backrest variants and the frame is of greater importance for the overall expression of the chair, as well as determining the feasibility of the interchangement of components. With the considerations above in mind, existing solutions for seats were explored. During this exploration it was found that a rectangular shape, with slightly rounded corners, accommodates various formal and stylistic expressions for the remaining elements of the chair. With inspiration from these existing solutions, the following seat was developed, illustration 82.

ILLUSTRATION 82: SHAPE OF THE SEAT

BACKREST IDEATION

With the construction principle and overall frame aesthetics defined, the focus shifts onto developing the different backrest variations. Initially, a range of shapes was explored through sketching. The various concepts were evaluated collectively within the group, based on their coherence with the frame and alignment with HAY's design language.
It quickly became evident that a better spatial understanding of the concepts was needed to properly evaluate their aesthetic qualities. Therefore, the most promising concepts were selected for further exploration through 3D modelling.
As the concepts are modelled according to the actual dimensional constraints, a number of challenges begin to emerge.

INTERFACE
As previously mentioned, the interfaces between the backrest and the frame consists of a recess made in the top part of each of the rear legs. This recess is influenced by the angle of the rear legs, the angle of the backrest, and the curvature of the backrest. If the angle of the legs change, the size of the interface changes as well (see illustration 83).

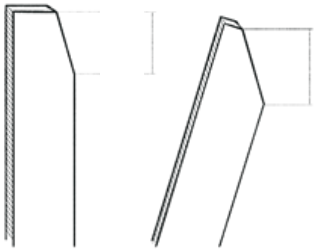


ILLUSTRATION 83: INTERFACE RESTRICTIONS

IDEATION ON ALL KINDS OF
DIFFERENT SHAPES

SELECTED SHAPES WITH AND
WITHOUT ARMRESTS

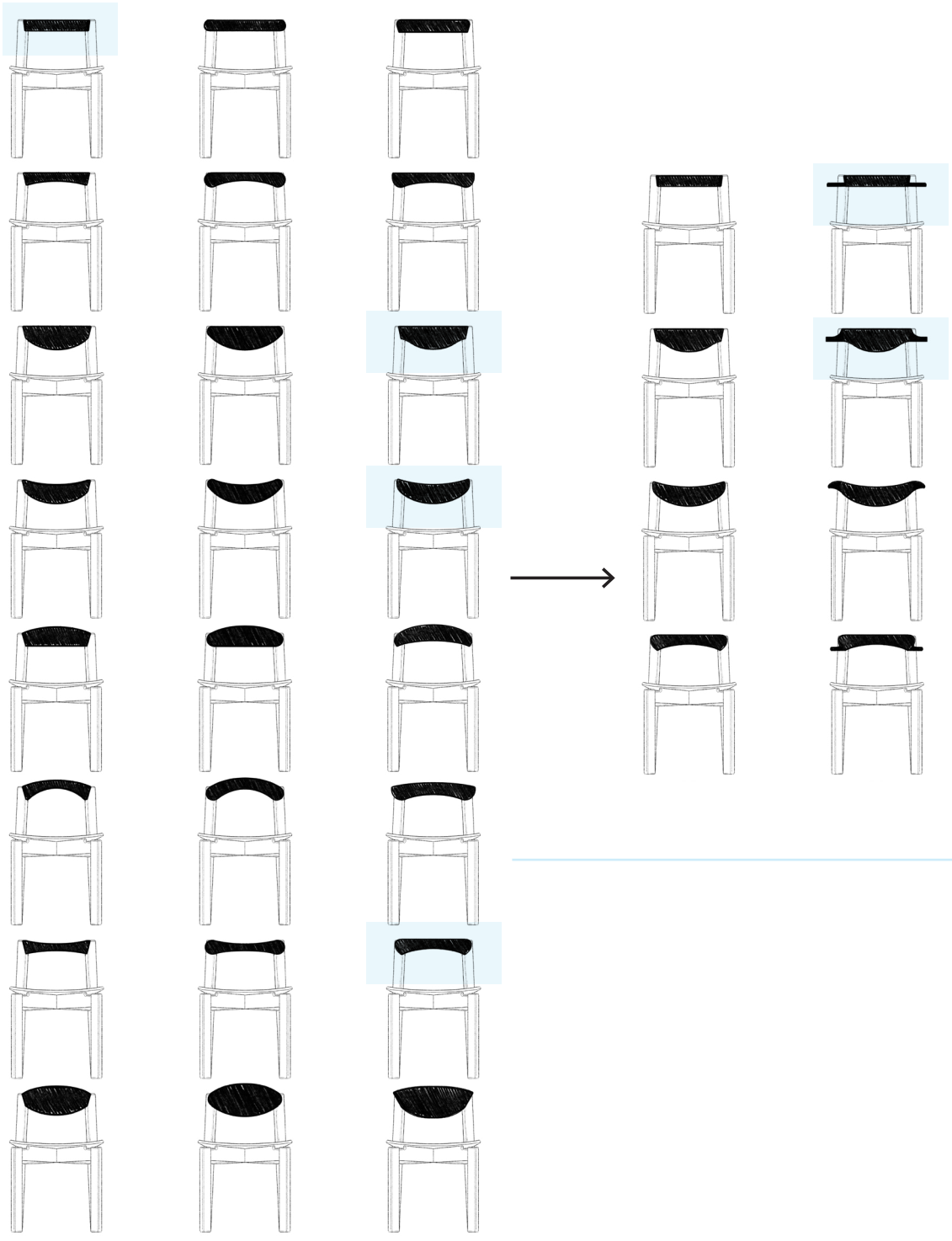


ILLUSTRATION 84: BACKREST IDEATION
- MOST INTERESTING SHAPES HIGHLIGHTED IN BLUE

BACKREST DIMENSIONS

If the height dimension of the backrest is smaller than the interface itself, parts of the recess will be visible when the backrest is mounted. Depending on the angle of the rear legs, there will be a minimum required height dimension for the backrest.

Example: The backrest is modelled based on the minimum height dimension value defined by the rear leg angle. In the three versions, the angle of the legs is determined by shifting the top of the central axis gradually by 5 mm from the bottom (illustration 85).

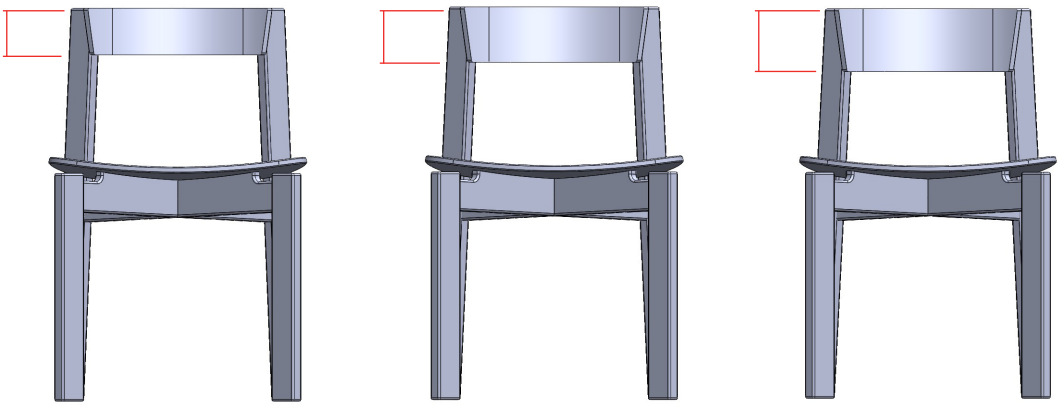


ILLUSTRATION 85: BACKREST DIMENSIONS

REAR LEGS ANGLE

The angle of the rear legs is also dependent on the curvature of the backrest. In order to maintain the same seat depth - 48 cm from the front edge of the seat to the center of the backrest (Ergonomic Study 1.0) - it is necessary to adjust the angle of the legs when the curvature of the backrest is changed. The greater the curvature of the backrest, the further forward the backrest must be positioned, meaning the legs need to be angled more.

BACKREST CURVATURE

In Ergonomic Study 1.0, it was derived that a comfortable span for the curvature would be R250mm – R750mm, assuming the backrest is positioned 28 – 34 cm above the seat. However, as backrest iterations with armrests are modeled, it is noted that curvatures tighter than R55cm result in a visually abrupt bend where the backrest transitions into the armrest. Therefore, it is assessed that an acceptable curvature range for backrest variants with armrests is R25–55 cm.

When the same curvature is applied to variants without armrests, it becomes more difficult to work with the design language. On the following page is an example of the same backrest modeled with two different curves - one based on the same curve used in the variant with armrest and the other a circular arc with a radius of 600 mm. The curvature for variants with armrests must be constructed as a spline, since the armrests cannot continue along the same trajectory as the backrest. When variants without armrests are modeled with the same curvature, the geometry appears warped and disproportional. Conversely, when modelled with a circular arc, it is possible to achieve a cleaner and more aesthetically pleasing geometry. However, as the two curvature types differ, the two backrests cannot be identical at the interface with the frame, even if they are modelled using the same radius.

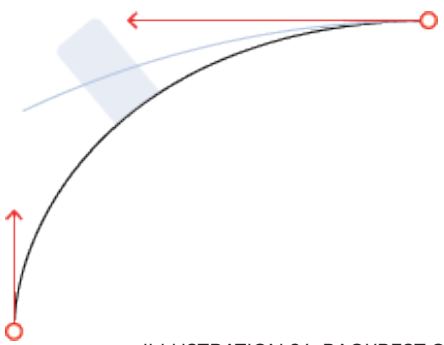


ILLUSTRATION 86: BACKREST CURVATURE

Same curvature as backrest w. armrests

New curvature (R600mm)

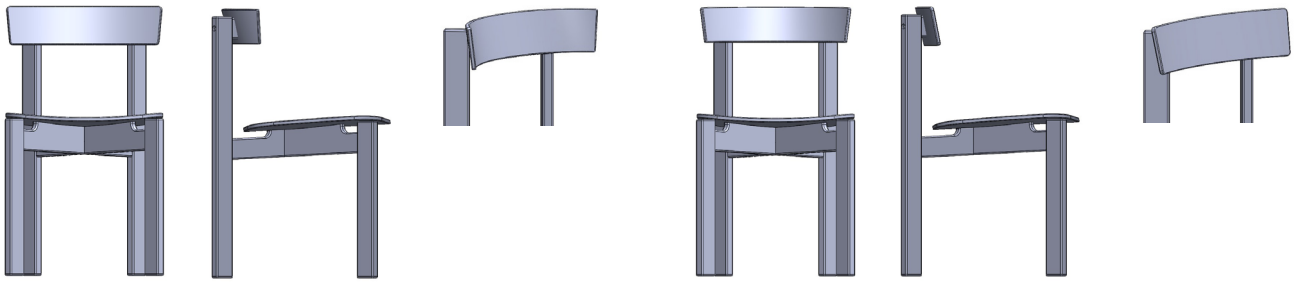


ILLUSTRATION 87:
EXPLORATION OF BACKREST CURVATURE

THERE MUST BE A BETTER SOLUTION

The initial development of the backrest variants leaves behind frustration and confusion. The iterations appear overly complicated with new problems occurring every time one issue is addressed. There must be a better way to solve it.

INTERFACE

The challenge lies in the interface between the rear legs and the backrest. The surface where the backrest and the frame meet must be identical across the different backrests variants for the interchangeability to be possible, which limits the formal and aesthetic variation that is possible to achieve.

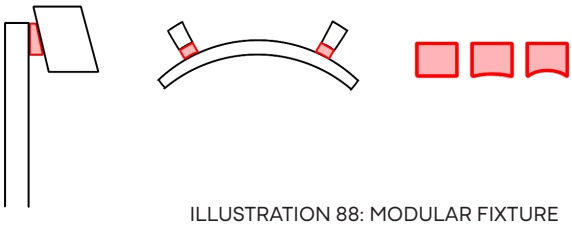


ILLUSTRATION 88: MODULAR FIXTURE

HOW ABOUT A FIXTURE?

Consulting with the technical supervisor on the project, various solutions to the problem are discussed. One of which resembling the 'Two-part concept' from the initial ideation on construction principles (Construction principles – Frame, Seat and Backrest, p. 50). This solution consists of placing a module – a fixture – between the backrest and the frame. This way, all variations in the backrest, such as dimensions, angle, and curvature, can be absorbed by the intermediate piece instead of the frame. Each backrest would then come with its own dedicated fixture, eliminating the need for a recess in the frame.

The proposal is evaluated collectively in the group (App. 23). It is discussed whether this would present a better solution, or if it simply overcomplicates the problem by introducing an additional component. So far in the concept development, it has been proven that it is possible to make the interface of the different variants identical, however it imposes some significant limitations to the solution space. Below are the considerations for and against the fixture solution.

WITH MODULAR FIXTURE

+ Harmony between aesthetics and strength (as the screws between the backrest and the modular fixture can be hidden behind, when attached to the chair frame)
+ Freedom regarding curvatures, angles and the height dimension of the backrest
+ Better possibilities of scalability
– Constitute an extra part (+ extra screws etc.)
– Need of a new bending tool each time a new curvature of the backrest is introduced

WITHOUT MODULAR FIXTURE

+ Fewer components
+ All backrest variants have the same curvature, thus uses the same bending tool
– The backrests are limited to one curvature and one angle
– It is necessary to attach the backrest with a minimum of two visible screws from the back, or one visible screw from the front (not aesthetically pleasing)

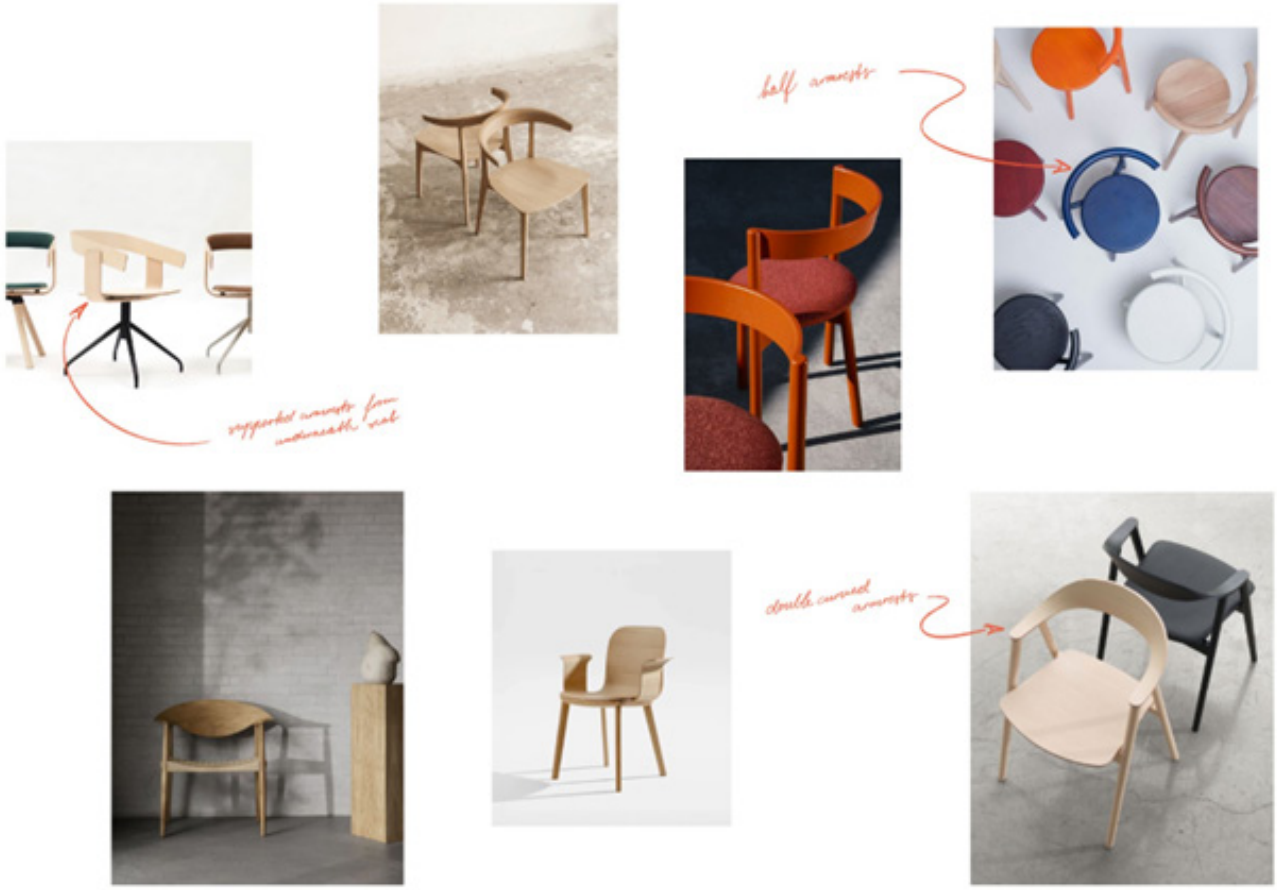
Ultimately it is decided to proceed with the fixture solution based on the aesthetic freedom.

ARMREST DEVELOPMENT

In the initial backrest ideation three overall formal directions were explored – a geometric, an organic, and a curved expression. Based on each of these, proposals were made for a backrest variant with armrests. However, it is agreed that none of the variants manage to integrate the armrests in an aesthetically satisfying way, why a new round of iterations is necessary.

Inspiration was sought from existing solutions and a moodboard was created exploring construction principles that align with the intended aesthetic identity.

ILLUSTRATION 89:
MOODBOARD OF DINING CHAIRS WITH ARMREST



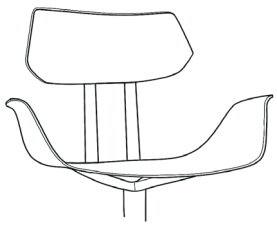
KEY TAKEAWAYS

- Half armrests go a long way – maybe the feeling of having armrests is enough?
- Armrests with 'full length' has supports from either chair frame or from underneath the seat.
- Double curved backrests open up the possibility of broader armrests and a more complex appearance which could be interesting to explore, if the cost allows it.

6 STRATEGIES FOR THE ARMRESTS

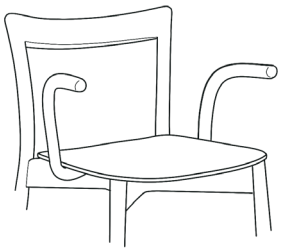
Based on the insights from existing designs, various approaches to adding armrests to the design proposal are discussed. From the discussion, six strategies are identified:

ILLUSTRATION 90: STRATEGIES FOR ARMREST



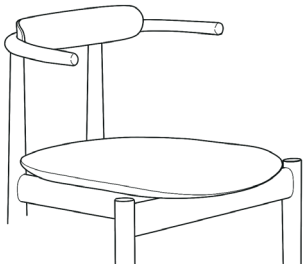
1. ARMREST AS PART OF AN UPWARD BEND SEAT

- The seat must align clearly in form and appearance with the backrest for the chair to look cohesive. This limits the aesthetic freedom.
- It would require two different variants of the seat, which would result in the need for an additional bending tool for laminated veneer
- Aesthetics resemble those of a conference chair more than of a dining chair (lacks coziness)



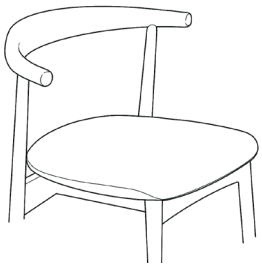
2. INDEPENDENT ARMREST ATTACHED TO THE BOTTOM OF THE SEAT OR FRAME

- Appears less integrated
- Aesthetics resemble those of a conference chair more than of a dining chair (lacks coziness)
- It would be challenging to produce in laminated veneer, why the introduction of an additional material may be required



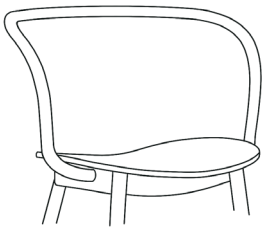
3. ARMREST MOUNTED IN BETWEEN THE FRAME AND THE BACKREST

- If produced from metal tubes increased strength would be present, however introduction of additional material may compromise the cost price
- Possible to produce in laminated veneer, however if so, this variant is similar to (4), just more complicated
- Due to structural limitations, it is not possible to do full length armrest



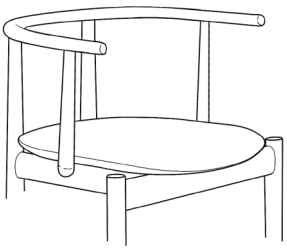
4. ARMREST AS PART OF THE BACKREST

- Appears cohesive and well-integrated
- Possible to produce in laminated veneer
- Due to structural limitations, it is not possible to do full length armrest



5. ARMREST AS PART OF BACKREST – STRUCTURAL SUPPORT, CONTINUATION

- High cost due to complexity if produced in veneer
- Introduction of an additional material if produced in metal
- Possible with full length armrest



6. ARMREST AS PART OF THE BACKREST – STRUCTURAL SUPPORT, INDEPENDENT

- Possible with full length armrest
- More expensive solution than (4) due to the increased number of elements
- Possible aesthetic value in the structural support

During the mapping and evaluation of the different approaches, the advantages and disadvantages of integrated versus independent armrests are discussed. Below is an overview of these considerations. Based on the evaluation it is decided to proceed with integrated armrest. However, it remains uncertain how far the armrest can extend in principle (4) before requiring additional structural support. Therefore, both principles (4) and (6) must be explored further to assess their feasibility.

ILLUSTRATION 91: INTEGRATED VS. INDEPENDENT ARMRESTS

INTEGRATED ARMRESTS

+ It is an integrated part of the chair, which makes the aesthetics appear more cohesive.
+ Requires no additional components.
+ Less replacement effort for the consumer.
– Due to structural limitations it is not possible to do full length armrest.
– Not all variants can have integrated armrests, why those who wish to have armrest will be limited in their choice range.

INDEPENDENT ARMRESTS

+ Those who wish to add armrests are not limited in their choice of backrest – they can access the full range.
+ Can be positioned slightly further forward than integrated armrests, thereby adding more support.
– Adds an extra component that must be produced and assembled (increases cost).
– The design of the armrest must match the expression of all backrest variants.
– In known examples of this solution, it appears less integrated.
– Requires a greater degree of replacement effort for the consumer.

3D IDEATION ON FINAL CONCEPT

Based on principles four and six, a series of armrest iterations were 3D-modeled. In the iterations featuring full-length armrests, supports are added to absorb the torsion that would otherwise occur at the joint between the backrest and the frame. The supporters are mounted below the seat.

EVALUATION

The iterations with full length armrests appear busy and unrefined in comparison to the iterations with half-length armrests. Revisiting the moodboard – where similar constructions appeared more aesthetically pleasing – it is observed that the more refined expression is largely due to different positioning and construction principles of the rear legs. Based on this, it is decided to discard the idea of full-length armrests that require additional structural support. In addition to their aesthetic advantages, the alternative armrest designs without extra support are also more cost-effective to produce due to having fewer components.

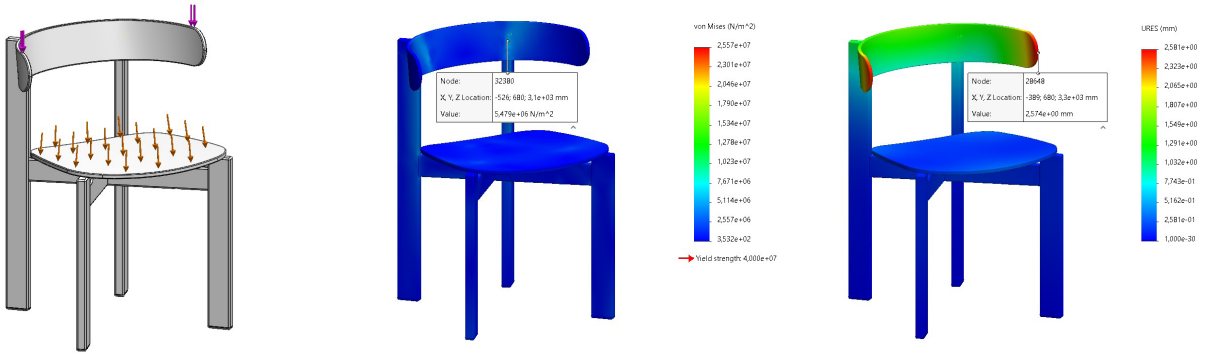
ILLUSTRATION 92: 3D IDEATION

FEA OF BACKREST WITH HALF LENGHT ARMRESTS

To determine whether the modelled backrests with half-length armrests can withstand the expected load applied by a person using them for support, while getting up from the chair, a Finite Element Analysis (FEA) was conducted in SolidWorks (see Appendix 24).

For the conduction of this study, one arbitrary backrest from the previous 3D-modelling is used to simulate the situation. By applying a load of approximately 100 kg to the tip of the armrests, it was found that the largest stresses are located around the bolted joints in the backrest. However, these stresses are well below the yield strength of the material. Furthermore, in terms of displacement, the tip of the armrests displaces approximately 2,6 mm, which is considered acceptable both in terms of functionality and comfort. Therefore, it was considered that these types of backrests are structurally viable in the current construction of the chair.

ILLUSTRATION 93: FEA



SELECTION OF BACKREST WITH ARMREST

To properly evaluate the modelled variants with half-length armrests by their spatial dimensions and interplay with the rest of the chair, these were 3D-printed along with the chair frame at a scale of 1:5. Each of the backrests was attached to the frame to evaluate their appearance in relation to the frame and seat of the chair, and their alignment with the design language of HAY (App. 25).
The following two backrests were selected for further assessment due to their potential in terms of proportional balance, harmony and clearly intentional forms.

As the appearance of the backrest with rounded ends are more clearly reflecting the appearance of HAY, that variant is deemed to have the most potential. However, as the concept is further inspected, it is noted that the armrests are positioned 8 cm higher than what was indicated as a comfortable height in the ergonomic study. Therefore, another ergonomic study, investigating armrest positioning, was conducted.

Better aligned with HAY form language and design principles

no. 11 no. 3

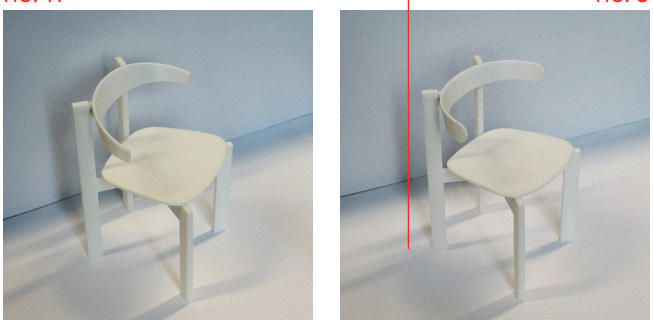


ILLUSTRATION 94: SELECTED 3D PRINTED BACKRESTS

ERGONOMIC STUDY ON ARMREST HEIGHT

During this test (App. 26), it became evident that the current height of the rear legs on the design proposal was lower (70 cm) compared to the chair used for the testing (75 cm), which is considered a 'low' chair. Therefore, it was decided to extend the rear legs of the chair frame on the design proposal by 5 cm. With the adjustment, armrest positioned 30 cm above the seat – equivalent with those of the considered backrest – were tested on a mockup chair. For this height of the armrest, it was deemed ergonomically comfortable and specifically intentional for resting the elbows, thus this height was deemed viable for the armrest.

REVISED EVALUATION OF BACKRESTS WITH ARMREST

Based on the extension of the rear legs of the chair frame and repositioning of backrests, it was deemed necessary to make an additional evaluation of the two highlighted backrests, to ensure their proportional balance and harmony in relation to the extended chair frame. A new frame was 3D-printed, and the backrests were evaluated again. **From the evaluation it was concluded that both backrest variants were still presenting proportional and formal cohesiveness with the frame, and backrest no. 3 was selected for further development based on its' alignment with HAY's design language.**

ILLUSTRATION 95: ARMREST HEIGHT

VARIANTS WITHOUT ARMREST

With the intention of targeting different aesthetic preferences, two distinct stylistic and formal directions were developed for the two backrest variants without armrests. One direction is based on a linear, geometric design language, and the other on rounded, organic forms. For each direction, a mood board is created to serve as an aesthetic guide for the subsequent concept development.

A series of concepts were 3D modeled and subsequently evaluated in plenary (App. 27). The concepts were assessed based on overall form language, interaction with seat and frame, as well as the form language and design principles identified in HAY. Of these concepts, those considered to have the most potential were 3D printed at a 1:5 scale.

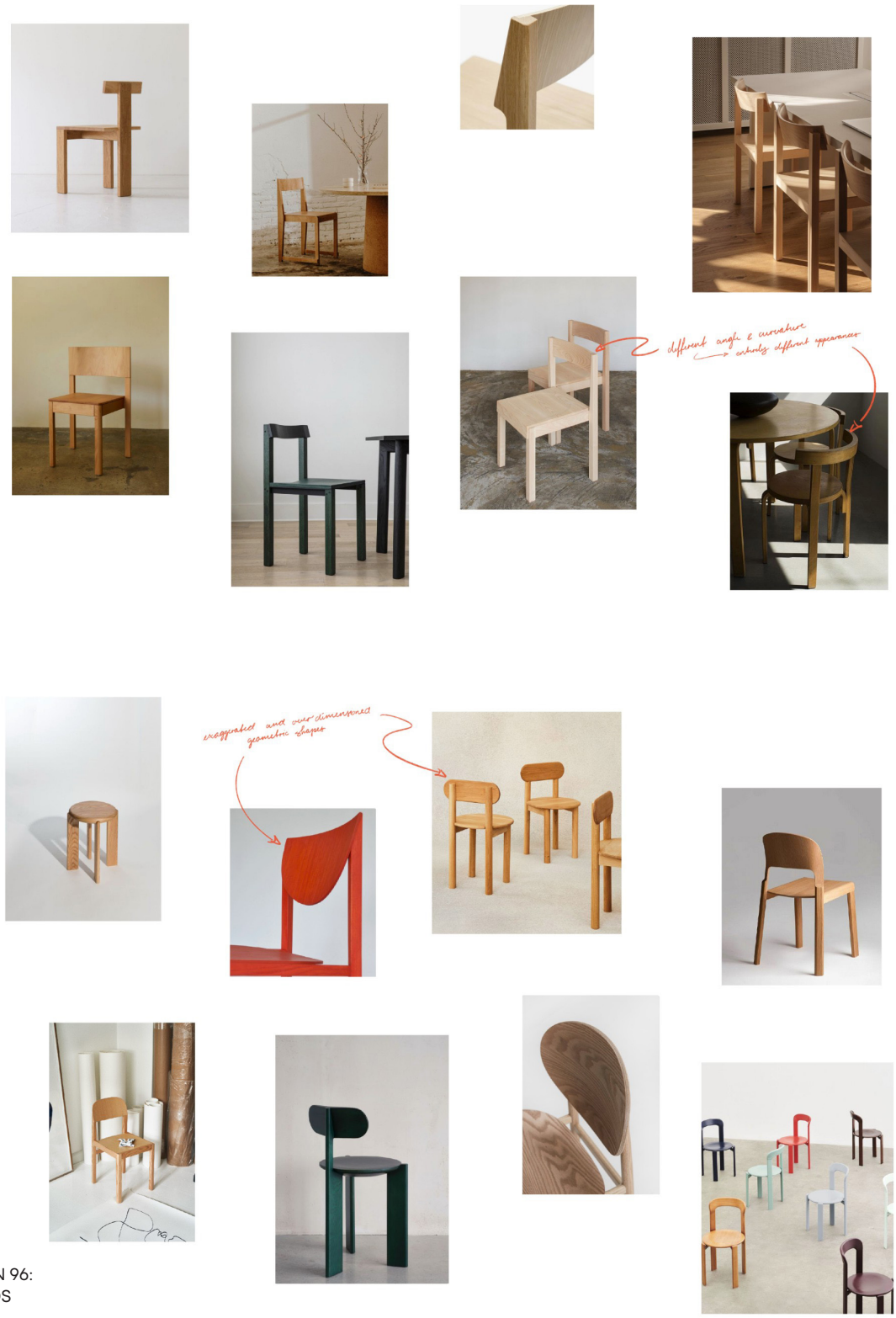
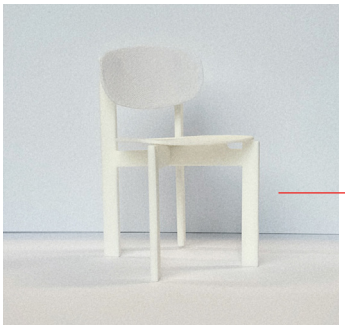


ILLUSTRATION 96:
MOODBOARDS

SELECTION OF VARIANTS
For each of the two stylistic directions, five concepts were selected for further exploration and 3D printed. With the 3D printed models, it was possible to consider the formal and spatial dimensions of the selected concepts, as well as the overall interplay with the frame (Appendix 28). Based on the assessment, the two following concepts were chosen as the backrest variations without armrest. The concepts were chosen, based on their independent potential, as well as their interplay with each other – including the armrest variant – as a series.

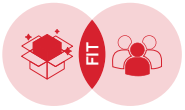


"Good formal interplay between the seat and the backrest. It offers something different compared to the other variants. It's chunky without being too heavy or overpowering"

"Interesting formal contrast between the seat and the backrest. This variant has character and personality. It makes a bit of a statement"

ILLUSTRATION 97:
SELECTED VARIANTS WITHOUT ARMREST

TEST AND DETAILING ON USER INTERACTION



As one of the requirements for the chair is the high degree of feedforward and feedback – both in terms of assembling the chair frame and attaching and detaching the seat and backrest, it is explored how to ensure this. A test of attaching the backrest to the chair frame is conducted in order to identify possible pitfalls, that must be addressed in the design proposal (App. 29).
The main insights from this test were that the subjects had trouble aligning the holes in the backrest with the holes in the frame, and figuring out which way is top and bottom of the backrest. Therefore, the following factors have been considered:

ASSEMBLY OF FRAME
An indicator should be integrated into the cross structure of the frame to clearly show when the assembly is correct, preventing incorrect orientation of the modules.

ATTACHMENT OF INTERCHANGEABLE PARTS
Clear alignment guides should be provided for both the seat and backrest to ensure easy positioning and correct orientation, while preventing difficulties in aligning the screw holes correctly.

ILLUSTRATION 98: USER TEST

USER INTERACTION

Difficulty aligning the holes in the backrest with the holes in the frame, and figuring out which way is top and bottom of the backrest.

To achieve these considerations in the simplest way possible, it is decided to clearly indicate when the leg modules of the frame are assembled correctly, by a small recess made between the modules, as shown in Ill. 99. In terms of attaching and detaching the seat and backrest easily, with correct orientations and alignment with the screw holes, it is decided to use dowels as visible and tactile guides for positioning the seat and backrest, as seen on Ill. 99-100.

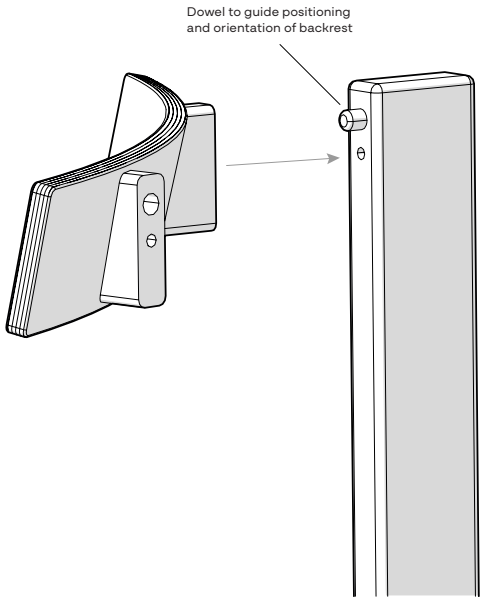


ILLUSTRATION 100: DOWELS
FOR BACKREST

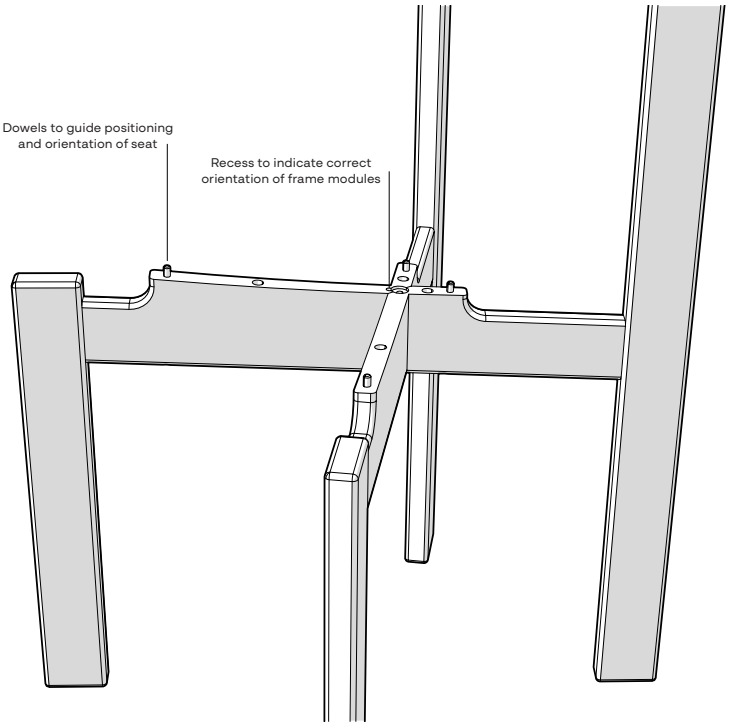


ILLUSTRATION 99:
DOWELS IN FRAME MODULES

CHAIR ASSEMBLY CONSIDERATIONS

In the following section, the assembly methods for the main elements of the design proposal are determined.

Chair frame

To determine the assembly method for the frame of the chair, different solutions were explored, including different fasteners and glued wood joints (see Appendix 30). As required for the design proposal, all different materials must be separatable for reuse or recycling, thus the assembly method should not compromise the reuse or recyclability value of the materials.

In terms of fasteners, that would allow for a hidden assembly, it was found either too expensive or not durable for a long product lifetime. Therefore, it was explored whether assembling the frame with glued wood joints would be a viable solution for not compromising the recycling value of the wood. By consulting with Marius Pedersen, it was found that wood from furniture is categorized as A2-wood, which will be fractioned and processed into new wooden MDF-boards (Marius Pedersen A/S, 2015a). For this category, the wood can contain glue, lacquer, stain or paint without obstructing its recyclability (Marius Pedersen, 2015b; Miljøstyrelsen, 2018).

Consequently, it was decided that assembling the frame using glued wood joints represented the most cost-effective and durable solution.

Fixtures (to the backrest)

As the fixtures between the chair frame and backrest are to be attached to the backrest, making a recess in the backrest in combination with glue will be the method for assembling these parts (Ill. 101).

Attachment of interchangeable parts

The interchangeable parts, constituting seat and backrests, will be assembled with bolts, that are screwed into threaded bushings in the support beams of the frame and the spacers of the backrests, as illustrated on Ill. 102

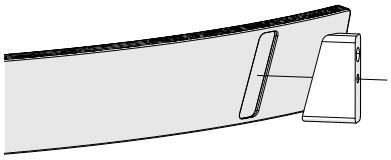


ILLUSTRATION 101: FIXTURES GLUED TO BACKREST

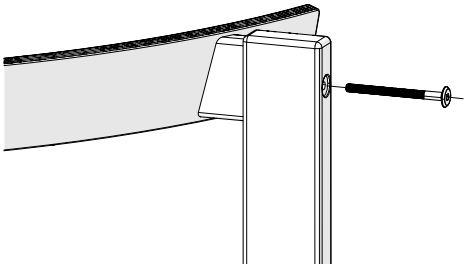


ILLUSTRATION 102: BACKREST MOUNTING

DEGREE OF CUSTOMIZABILITY

While the maintenance driven user prefers timeless, classic aesthetics, the aesthetically driven user gravitates more towards trend influenced design. To cater to both preferences, the design must offer a degree of customizability beyond the formal variation of the backrest options. To explore the appropriate level of customization, a series of renderings were made of a selected backrest variant in various colors and color combinations, after which different scenarios were mapped and evaluated. The color palette used is based on the REY Chair by HAY and its existing color offerings from which five colors have been selected.

Regarding the chair frame it is deemed reasonable to offer the frame in two finishes – one natural and one black-stained. Previous insights suggest that consumers often develop a preference for a specific wood tone, why it makes sense to offer a neutral alternative to the natural finish of the wood.

The following scenarios representing different degrees of customizability are established based on the exploration found in Appendix 31.

ILLUSTRATION 103: REY CHAIR COLORS

SCENARIO 01
Free customizability of frame, seat and backrest

- Frame: 5 colors
- Seat: 5 colors, 5 upholsteries
- Backrest: 3 variants in 5 colors

Total number of variants: 750

ILLUSTRATION 104: DEGREES OF CUSTOMIZABILITY


+ Uniform color is highly aligned with HAY's deliberate and consistent use of colors
+ High number of possible variants
+ High level of consumer customizability
+ Possible to change seat and backrest separately
+ High reuse value of seat and backrest
– Combining more than two colors tends to create a cluttered expression
– Combining more than two colors is less aligned with HAY's design principles
– If the frame is colored in a trend-influenced color, the chances of long-term appeal and longevity are significantly reduced

SCENARIO 02
Free customizability of seat and backrest

- Frame: 2 colors
- Seat: 5 colors, 5 upholsteries
- Backrest: 3 variants in 5 colors

Total number of variants: 300


+ High number of possible variants
+ High level of consumer customizability
+ Possible to change seat and backrest separately
+ High reuse value of seat and backrest
– Combining more than two colors tends to create a cluttered expression
– Combining more than two colors is less aligned with HAY's design principles

SCENARIO 03
Setwise customizability of seat and backrest

- Frame: 2 colors
- Backrest: 3 variants in 5 colors
- Seat: 2 options (colored or upholstered)

Total number of variants: 60


+ Medium number of possible variants
+ Medium level of consumer customizability
+ Control of color combinations: higher aesthetic value and brand alignment
+ High reuse value of seat and backrest
– Not possible to change seat and backrest separately

SCENARIO 04
Free customizability of seat

- Frame: 2 colors
- Backrest: 3 variants
- Seat: 5 colors, 5 upholsteries

Total number of variants: 60


+ Medium number of possible variants
+ Medium level of consumer customizability
+ High reuse value of seat
– Low reuse value of backrest

Overall, the most cohesive and aligned expression with HAY's deliberate and consistent use of color in the chair is achieved by offering the frame in the same colors as the seat and backrest.
However, it is assessed that if the frame is offered in the same colors as the seat and backrest, the chance of long-term appeal and product longevity is reduced, as the frame would then rely on trend-influenced colors. Therefore, this scenario is avoided.
The second most harmonious and balanced expression is achieved when colors are combined so that only one contrast is present. However, this requires that the seat and backrest are replaced as a set, which conflicts with the overall concept of reducing consumption, since the consumer would be forced to replace both elements even if only one needs replacement - either due to aesthetic preferences or wear.
In some cases, the seat and backrest are made of different materials that wear differently.
For instance, the upholstered seat may become dirty or worn before the wooden backrest, making it reasonable that these parts can be replaced separately - in order to reduce the extent of consumption during replacements.
By allowing different elements to be combined separately, greater variation can be achieved with fewer resources. However, introducing more than one contrast slightly deviates from HAY's typically consistent and deliberate approach to their carefully considered color combinations. With that said, strategic marketing could inspire and influence consumers to prefer curated combinations of seat and backrest colors.
Therefore, it is decided to offer the customizable options presented in the second scenario.

TREATMENT OF WOODEN ELEMENTS

Natural and black wood stains are determined as treatment for the frame to preserve a natural surface structure of the wood. Thereby, two of the colors offered for the seat and backrests are accordingly, natural and black stained. For the remaining colors offered, wood stain or paint are considered. If colored with stain, the surface structure of the remaining colored variants will be coherent with the frames. However, the stained colors will result in lower reuse value, as it is not possible to add stain on top of an already stained part, hence the original stain must be removed entirely before re-staining.
If colored with opaque paint, the surface structure will be smoother in contrast to the frame, however it is possible to repaint the parts in terms of changing trends for certain colors, thereby ensuring high reuse value.

EMBRACING IMPERFECTIONS

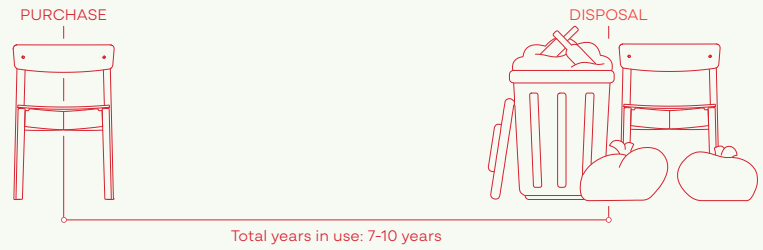
Presenting the option to combine a new natural-stained backrest with an old natural-stained frame, a slight color difference in the wood tones is inevitable (Expert interviews p. 61).

Therefore, this will be part of the storytelling for this concept – by embracing the 'Wabi Sabi' design philosophy, which appreciates the beauty in imperfection (Vind, 2024). It is central to this philosophy that imperfections are associated with positive value of honesty and natural beauty (Lobos, 2014).
Thus, the expected differences in wood tones between new and old elements are to be embraced and valued as natural beauty that supports the long-life and sustainable impact of the chair. Thereby, the difference becomes a visual reminder of the chair's history and continued life, intended to encourage a deeper emotional connection between the user and the chair.

REFURBISHMENT OF SEAT AND BACKREST

Considering the refurbishment processes initiated after an interchangement of either the seat, backrest, or both through the take-back system, several aspects are considered.

CURRENT PROCES



SUGGESTED PROCESS

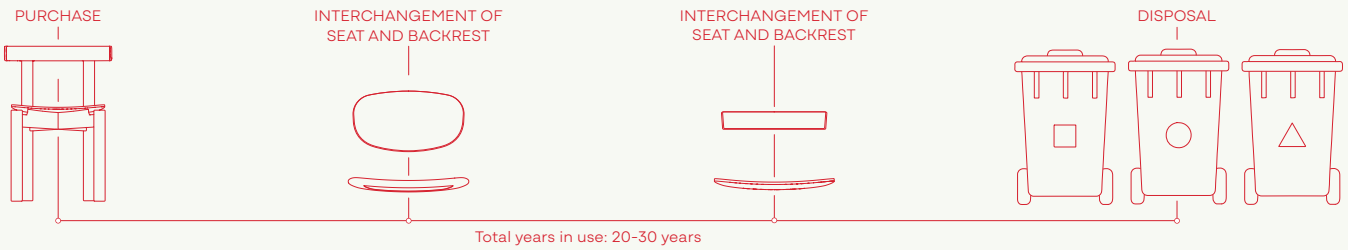
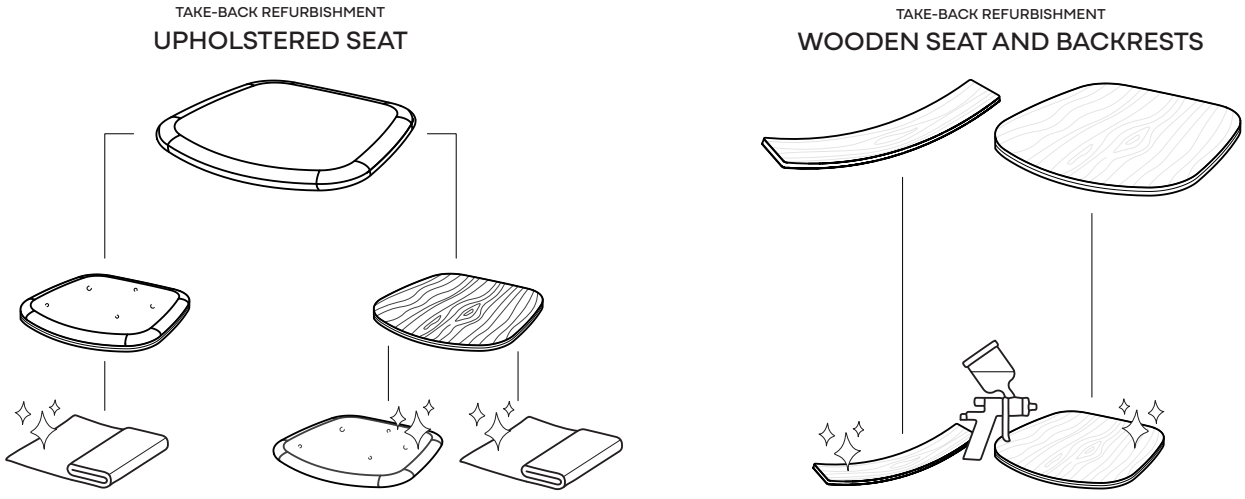


ILLUSTRATION 105:
TAKE-BACK REFURBISHMENT



REFURBISHMENT OF UPHOLSTERED SEAT

When an upholstered seat is to be refurbished there are two main scenarios (Ill. 105). In the first scenario the upholstery foam is in good condition, thus the refurbishment only requires attaching a new textile cover. In the second scenario the foam is in worn condition, thus the refurbishment requires attachment of new foam and textile. If the used textile from either scenario cannot be reused for another seat due to its condition, it will be considered as textile waste. Therefore, it is proposed to use textiles that can enter a circular recycling system, such as Gabriel LOOP.

MATERIAL SEPARATION

As all the materials of the upholstery must be separable in regards to refurbishment and end-of-life, the textile is attached with the drawstring-method (Expert interview, p. 61), while the foam is attached with a water-solvable glue, which allows for full separation of the materials.

ILLUSTRATION 106:
MATERIAL SEPERATION

GABRIEL LOOP

The Gabriel LOOP is a circular take-back system that collects used textiles, sorts them, and recycles or upcycles them into new products, aiming to reduce textile waste and promote sustainability (Gabriel, 2019).

ILLUSTRATION 107:
GABRIEL LOOP

REFURBISHMENT OF WOODEN SEAT AND BACKREST

The refurbishment of the wooden seats and backrest comprises repainting the elements in a different color. While the natural and black stained parts cannot be re-stained, it is possible to cover the stain with an opaque color.
When it is assessed that these parts are no longer in a condition in which refurbishment is viable, the threaded bushings in the seats and backrests can be removed to allow for recycling of each of the individual materials.

Layered veneer vs. solid wood

Researching this refurbishment proposal, it was noted that it may be necessary to sand off the old paint prior to repainting. It was considered whether this process would wear away the outer layers of the veneer lamination over repeated refurbishments. Therefore, the option of producing these parts in solid wood was explored. In this scenario, the parts would mainly be produced by CNC-machining, why JLA Byg was consulted. During the consultation, it became evident that producing the parts in solid wood would result in a substantial amount of material waste, high cost, and significant weakening of the wood structure. Further consultation with VLA Byg and Vermund (VELA), suggested that refurbishing layered veneer by the intended procedure is considered plausible, as a minimal amount of sanding is assessed to be required before repainting (App. 32).

RANGE OF OFFERED COLORS

In consultation with Anders Hauerberg Hansen from Vermund, it became evident that, due to the high level of customization, it would be advantageous to surface-treat the wooden seats and backrests on a MTO basis in order to avoid holding stock in colors not purchased by customers. However, running various colors through the painting system incurs a fee each time the color in the system must be changed. Therefore, it will be necessary both to limit the number of different colors and to define a minimum quantity of items required to initiate painting with a specific color, to reduce the costs of the painted parts.
Therefore, it is determined to offer 5 different surface options for the interchangeable parts, including natural and black stains and three painted colors.

SELECTED COLORS AND TEXTILES

When selecting the colors and textiles for the seat and backrests, the aim is to align with and take inspiration from HAY's current range of colors and textiles. To support this, an analysis of HAY's existing offerings was carried out, where most relevant colors and textiles were mapped in a moodboard to explore their potential interplay (App. 33). Additionally, the colors and textiles were evaluated on both variants of the chair frame, as seen in App. 33.
Based on this exploration, it was determined to offer the following colors for paint and textiles (Ill. X).

FRAME COLORS

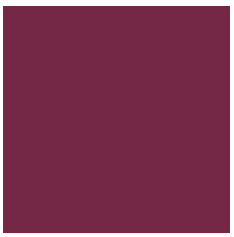

natural oak

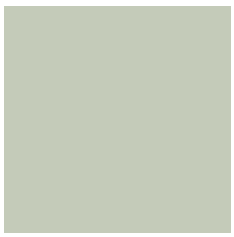

black stained oak

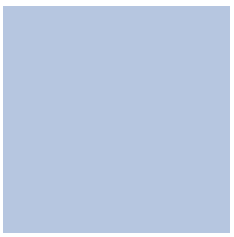
SEAT AND BACKREST COLORS


natural oak veneer

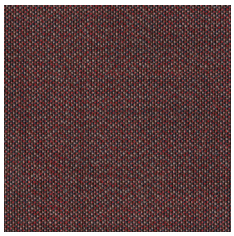

black stained oak veneer

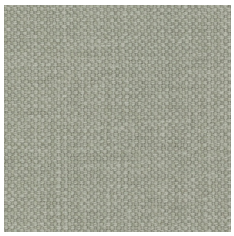

bordeaux
RAL 360 30 35


sage
RAL 130 80 10


dusty blue
RAL 270 80 15

UPHOLSTERY COLORS


bordeaux
Atlas 671 - Kvadrat


sage
Linara 529 - Romo

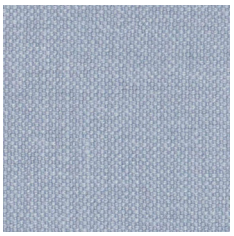

dusty blue
Linara 400 - Romo

ILLUSTRATION 108: CHOSEN COLORS AND TEXTILES

DESIGN BRIEF 5.0

AIM

To address the premature disposal of furniture due to aesthetic obsolescence, where furniture is replaced due to changing trends and aesthetic preferences or wear and tear. Instead, consumers should be investing in furniture that is aesthetically adaptable for the future in terms of both trends and wear, to extend its lifetime and minimize risks of aesthetic obsolescence.

TARGET GROUP

Aesthetically-driven: Quality-conscious consumers, who tend to buy into medium-investment designs to be able to reflect current trends within their interior.
Maintenance-driven: Quality-conscious consumers, who tend to buy into medium-investment designs to be able to reflect a timelessly maintained appearance within their interior.

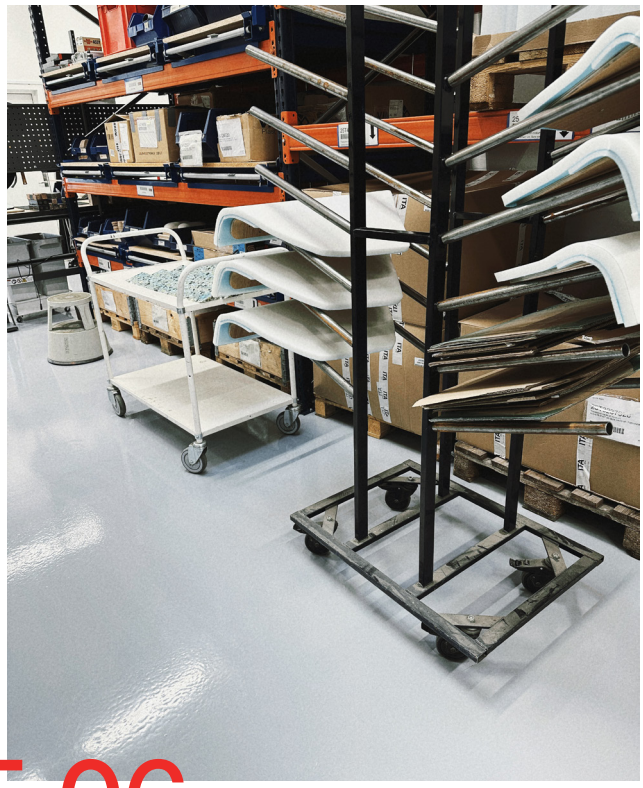
VALUE PROPOSITION

Designed for change – a dining chair with replaceable seat and backrest that evolves with your style and stands the test of time.

REQUIREMENTS

No elements of different materials should be glued (p.23)
Staples must not be used for upholstery (p.43)
The chair frame must have a timeless appearance (p.26)
The chair frame must allow for maintenance (p.27)
The chair frame must be made of solid wood (p.42)
The chair must be developed as part of a well-established, known brand (p.28)
The chair must have easy percieved interchangeability (p.28)
The chair must have easy practical interchangeability (p.28)
The interfaces must interfaces must have a high degree of feedback and feedforward (p.28)
The chair must be positioned in a mid price point (p.28)
The sales price of the chair must not exceed 3500 DKK (p.31)
The sales price of seat and backrest must not exceed 1150 DKK (p.39)
*The cost of one chair must not exceed 875 DKK (4 x markup)** (p.57)
*The cost of one set of seat and backrest must not exceed 575 DKK (2 x markup)** (p.57)
Seat and backrest must be able to reflect both a trend-based and timeless appearance (p.34)
*The colors must either be combined tone on tone or in pairs of complementary colors** (p.57)
*The form language must be geometrically inspired and defined by simple, clean lines** (p.57)
*The edges must be rounded or curved** (p.57)
*The materials must either be wood, powder coated steel, molded plastic, glass, aluminum, textiles** (p.57)
Fasteners and similar components must be standard parts (p.35)
The backrest must be positioned 28-34 cm above the seat of the chair (p.59)
The curvature of the backrest must be 25-75 cm in radius (p.59)
The angle of the backrest must be 102-106° (p.69)
The seat must be positioned 40-48 cm above the ground (p.59)
The depth of the seat must be 38-46 cm (p.59)
The width of the seat must be 40-51 cm (p.59)
The angle of the seat must be 5-8° (p.59)
Lenght of armrest must be 25-30 cm (p.69)
Threaded bushings must be used in assembly joints between the frame, seat and backrest (p.62)

*Brand specific requirements



PHASE 06
PRODUCTION

Product architecture
Chair frame
Fixtures
Backrest and seat
Cost
Supply chain and product journey

PRODUCT ARCHITECTURE

The following Bill of Materials outlines the components of the design proposal. Each part is specified by material and production method, which will be further elaborated in the coming chapter.

	BOM
1	1 x Backrest 01 – Veneer Oak & Beech, CNC milled
	(1 x Backrest 02 – Veneer Oak & Beech, CNC milled)
	(1 x Backrest 03 – Veneer Oak & Beech, CNC milled)
2	2 x Rear leg – Solid Oak, cut & CNC-milled (and glued)
3	2 x Front leg – Solid Oak, cut & CNC-milled (and glued)
4	2 x Aprons – CNC milled (and glued)
5	2 x Backrest fixtures - Solid Oak, cut & drilled
6	1 x Seat – CNC milled
	(1 x Polyurethane foam – Cut)
	(1 x Upholstery fabric – Cut, sewn)
7	6 x Dowels
8	3 x Threaded bushings, M6 x 17 mm
9	4 x Threaded bushings, M6 x 8 mm
10	7 x Fasteners, Ø6 x 65 mm
11	(4 x Replaceable gliders – Felt, Press fit)

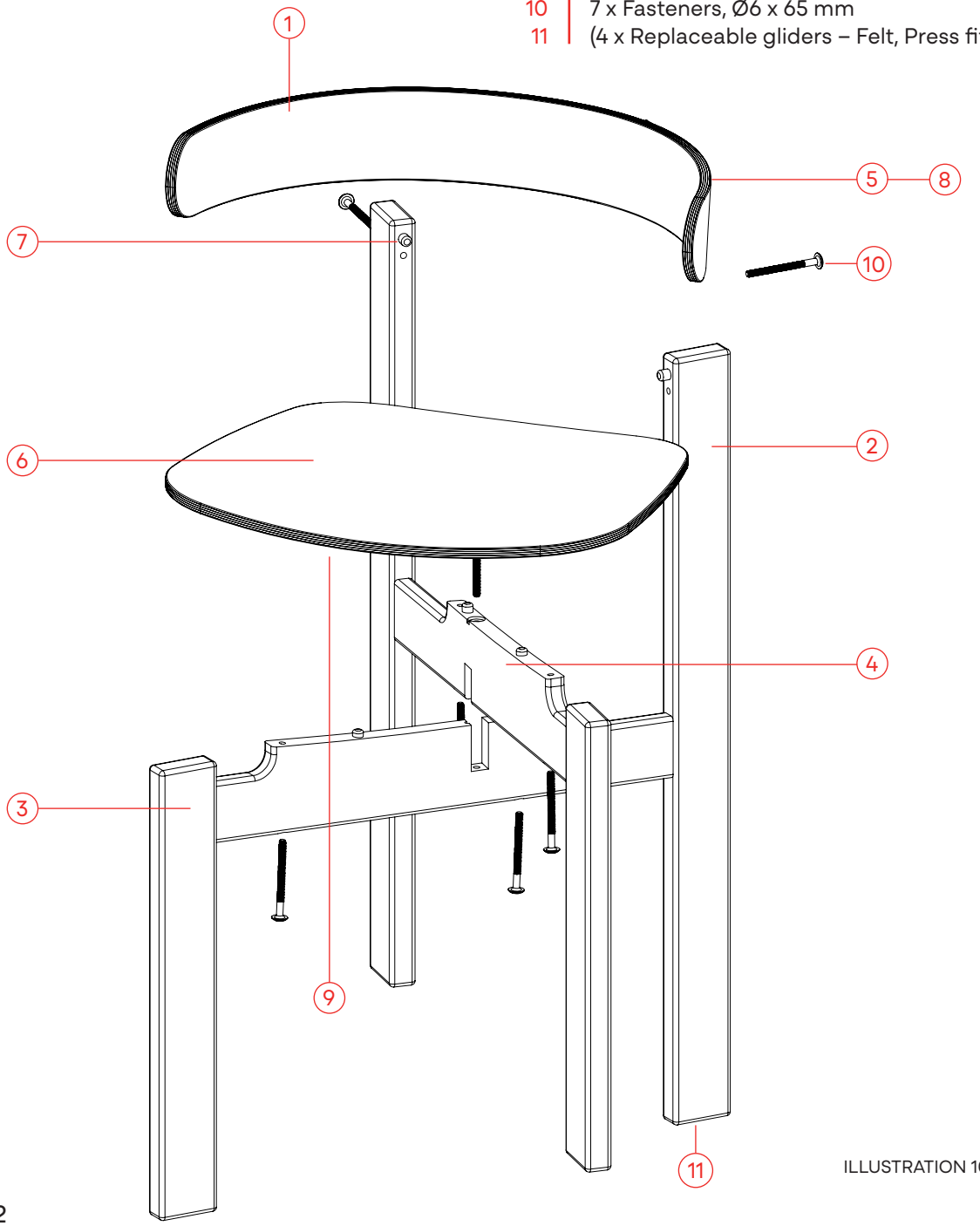


ILLUSTRATION 109: EXPLODED VIEW

CHAIR PRODUCTION

In the following section, the different manufacturing processes for the main elements of chair will be described. The processes are determined based on consultation with both VLA Byg and Vermund (VELA).

CHAIR FRAME

The chair frame consists of two main elements: the front and rear legs, and the support beams. These elements will be produced in solid oak wood, which is FSC-sourced for more sustainable foresting.

FRONT AND REAR LEGS
For manufacturing these parts, the wood is sourced in the desired dimensions in terms of cross-sections. The wood will then be cut into the desired length of the front and rear legs.
The recesses for the cross construction of support beams are manually milled with a handheld milling machine. Additionally, the screw holes in the rear legs are drilled manually. Lastly, the rounded edges are milled with an edge profiling router.

APRONS, SUPPORT BEAMS
The aprons are processed in a 5-axis CNC, as it is able to mill the contour, ends, recesses and holes in the beams in one collected process with its interchangeable tools available (Thompson, 2018).

The legs of the frame and aprons are then assembled with wood glued in two collective parts for the chair frame, as seen on Ill. 110. Lastly, these parts are lightly sanded before surface treatment is applied, in terms of either a natural or black stain.

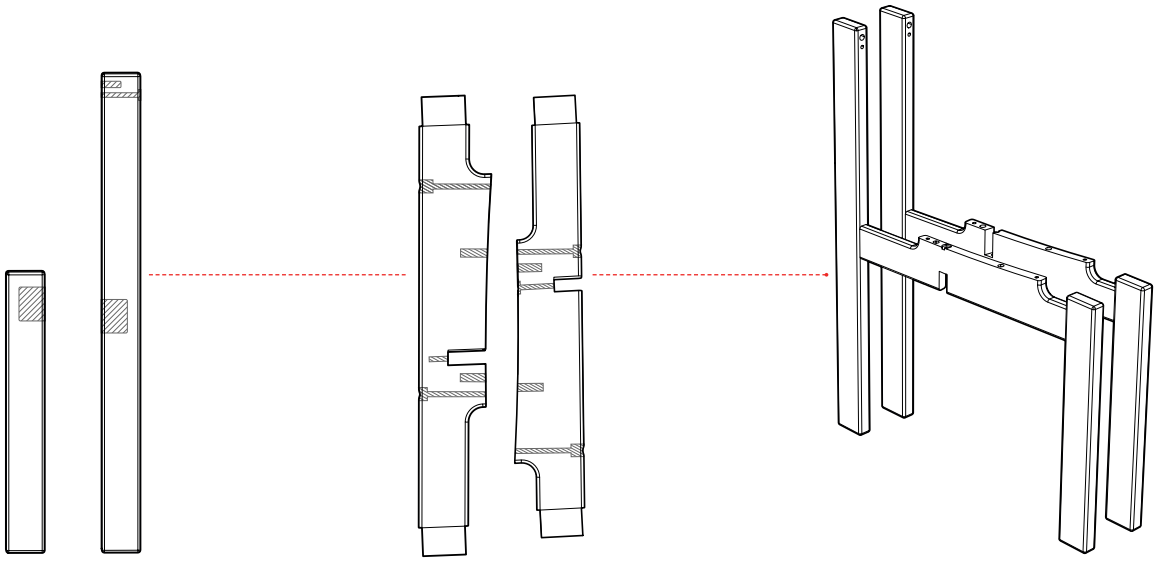


ILLUSTRATION 110: FRAME MODULES

FIXTURES

The fixtures between the backrests and the rear legs of the chair frame are produced in FSC-certified solid oak wood. For manufacturing this part, the wood is sourced in the desired dimensions in terms of cross-section. The dimensioned wood is then milled with an edge profiling router to obtain rounded edges. Subsequently, the wood is cut into the desired lengths of the fixtures, after which the holes for screws and dowels are manually drilled. Finally, the parts are cut by the desired angle.
The fixtures are then attached to the backside of the backrest with wood glue (see 'Production of backrests and seats').

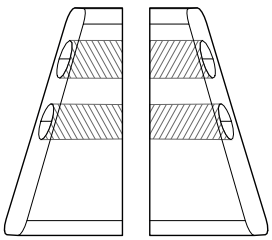


ILLUSTRATION 111: FIXTURES

BACKRESTS AND SEATS

The backrests and the wooden variant of the chair seat are produced from a lamination of FSC-sourced oak and beech veneer, as shown on ill. 112. This production method is particularly appropriate for reducing the unit costs of these parts, as it is a simple process with low molding costs, that fits the expected low to medium volume of these parts. Additionally, the lamination resembles a high quality, strong, light, and durable structure (Thompson, 2018).

For the production of these parts, the layers of veneer are bonded together with a strong adhesive while being placed inside of a press mold, as seen on ill. 113. The outer layers of the lamination will be oak wood veneer, while the inner layers will be beech wood veneer to reduce costs. The layers are then cured together by heating the mold. Different molds will be used respectively for the seat and the backrest variants, as they rely on different curvatures.

ILLUSTRATION 112: VENEER LAYERS

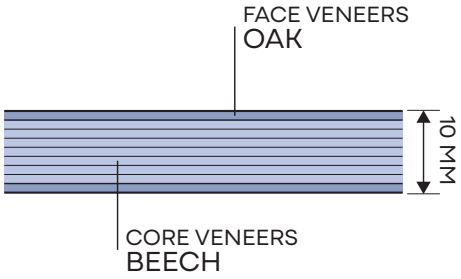
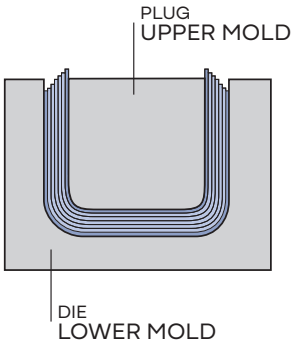


ILLUSTRATION 113: VENEER MOLDING



Afterwards, the curved veneer lamination will be processed in a 5-axis CNC, by milling out the contour and rounded edges of either the seat or backrest. The recesses in the backrests will be milled before the contour of the backrest is performed.

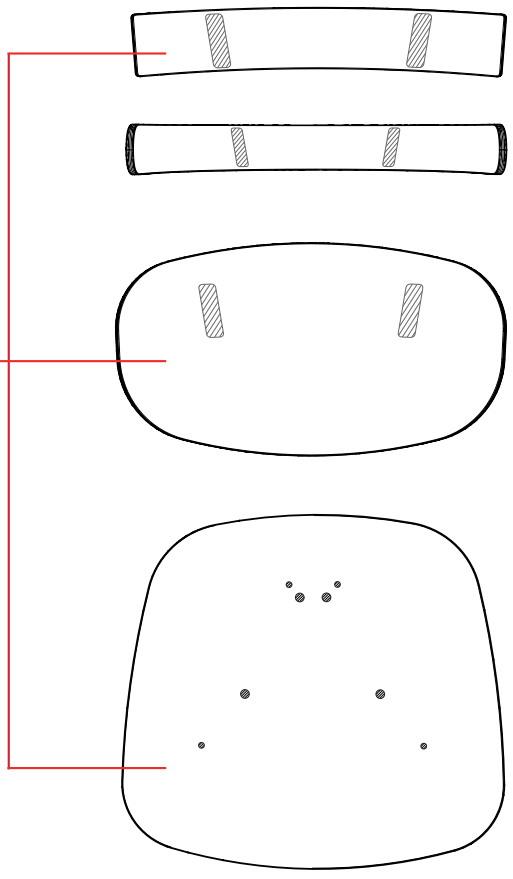


ILLUSTRATION 114: SEAT AND BACKRESTS

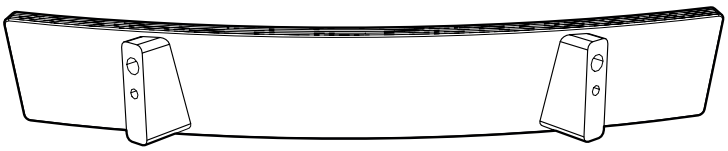


ILLUSTRATION 115: FIXTURE ATTACHMENT

For the backrests, the processed fixtures will then be attached in the milled recesses with wood glue to form the collected part of an interchangeable backrest (ill. 115). The backrests and seats are then lightly sanded before surface treatment is applied. The natural and black variants are treated with a natural or black stain, while the colored parts are painted with the respective color.

Lastly, threaded bushings will be inserted in the seat and the fixtures on the backrest.

UPHOLSTERED VARIANT OF THE SEAT

The upholstered variant of the seat is composed of a veneer laminated board, produced as described above, which is then upholstered. Although, this lamination is solely constructed from beech veneer (Ill. 116) to reduce costs of this board, as the board only will be partly visible from the underside.

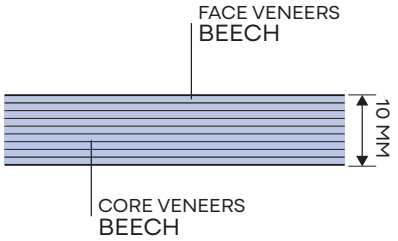


ILLUSTRATION 116: BEECH VENEER

A layer of cold foam will then be cut to match the contour of the seat and subsequently glued to the board (Ill. 117) with a water-based adhesive (Simalfa, 2025). The upholstery cover will be cut to match the dimensions of the board with foam and then sewn with a drawstring in the perimeter of the cover. The cover will then be placed around the board with foam, and the drawstrings will be tensioned in a machine to wrap the cover tightly around the upholstery (Ill. 118). Lastly, the ends of the drawstring are secured with two staples.

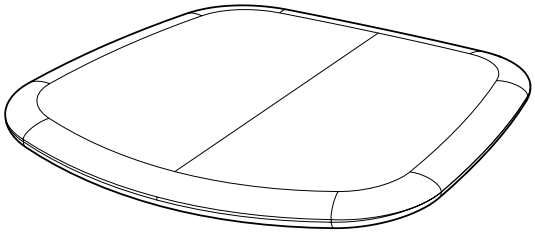


ILLUSTRATION 117: FOAM ON BOARD

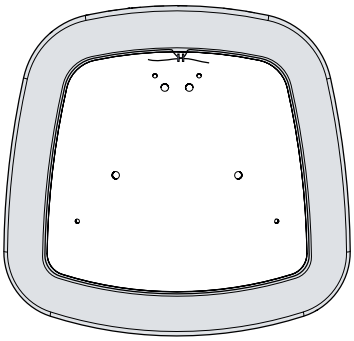


ILLUSTRATION 118: UPHOLSTERED SEAT

COST

In the following section, the estimated production costs of FORMA will be presented, along with some considerations regarding the cost sensitivity of certain elements in the design proposal. Furthermore, a suggested price point of FORMA will be introduced and compared to other similar products on the market.

PRODUCTION COSTS

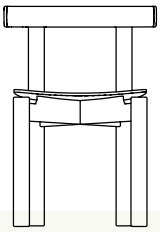
The production costs are estimated based on the following sources: a quote for the chair from a manufacturer in Poland, estimates from Anders Hauerberg Hansen for specific components, and production estimates from JLA Byg (App. 32 and App. 34)
The quote does not specify the cost of each individual element of the chair, which means that only some parts can be specified based on the secondary estimation inputs. In the table, the cost of the elements, depending on their offered options, is specified. Since the chair can be customized through these different options, the cost of four possible configurations is presented below. For one of these configurations, the estimated cost distribution is detailed on page 97, while the cost distribution of all parts can be found in App. 35.

According to the estimates, the cost of the chair exceeds the maximum cost of 875 DKK, which was determined as a requirement for the chair to be positioned within a mid-segment market, with an anticipated markup of 4.

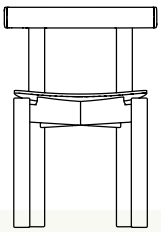
However, based on the estimates, the refurbishment cost for a set of arbitrary seat and backrest meets the requirement that the cost of such, must not exceed 575 DKK (2 x markup) in order to support a resale price of no more than 1/3 of the chair's total price.

REFURBISMENT	COST [EXCL. VAT]
Veneer seat	100 DKK
Veneer backrest	100 DKK
Surface treatment start-up fee	1000 DKK
Upholstered seat (new textile)	75 DKK
Upholstered seat (new foam and textile)	175 DKK

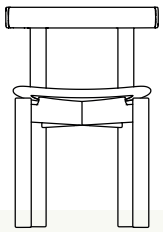
OPTIONAL CHAIR FRAMES	COST [EXCL. VAT]
Chair frame, natural stained	650 DKK
Chair frame, black stained	675 DKK
OPTIONAL SEATS	
Veneer seat, natural stained	225 DKK
Veneer seat, black stained	250 DKK
Veneer seat, painted	250 DKK
Upholstered seat (incl. veneer board, foam and textile)	375 DKK
OPTIONAL BACKRESTS	
Backrest variant (1), natural stained	200 DKK
Backrest variant (1), black stained	225 DKK
Backrest variant (1), painted	225 DKK
Backrest variant (2), natural stained	200 DKK
Backrest variant (2), black stained	225 DKK
Backrest variant (2), painted	225 DKK
Backrest variant (3), natural stained	200 DKK
Backrest variant (3), black stained	225 DKK
Backrest variant (3), painted	225 DKK
ADDITIONAL COMPONENTS	
Dowels (6 pcs)	16 DKK
Threaded bushings for seat (4 pcs)	8 DKK
Threaded bushings for backrest (2 pcs)	12 DKK
Threaded bushing for frame modules (1 pcs)	6 DKK
Fasteners (7 pcs)	42 DKK



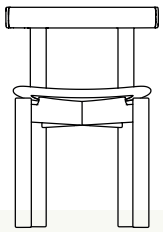
NATURAL STAINED, VENEER SEAT	
Chair frame, natural stained	650 DKK
Veneer seat, natural stained	225 DKK
Backrest variant (1), natural stained	200 DKK
Dowels	16 DKK
Threaded bushings for seat	8 DKK
Threaded bushings for backrest	12 DKK
Threaded bushing for frame modules	6 DKK
Fasteners	42 DKK
COST	**1160 DKK**



BLACK STAINED, VENEER SEAT	
Chair frame, black stained	675 DKK
Veneer seat, black stained	250 DKK
Backrest variant (1), black stained	225 DKK
Dowels	16 DKK
Threaded bushings for seat	8 DKK
Threaded bushings for backrest	12 DKK
Threaded bushing for frame modules	6 DKK
Fasteners	42 DKK
COST	**1235 DKK**



NATURAL STAINED, UPHOLSTERED SEAT	
Chair frame, natural stained	650 DKK
Upholstered seat	375 DKK
Backrest variant (1), natural stained	200 DKK
Dowels	16 DKK
Threaded bushings for seat	8 DKK
Threaded bushings for backrest	12 DKK
Threaded bushing for frame modules	6 DKK
Fasteners	42 DKK
COST	**1310 DKK**



BLACK STAINED, UPHOLSTERED SEAT	
Chair frame, black stained	675 DKK
Upholstered seat	375 DKK
Backrest variant (1), black stained	225 DKK
Dowels (6 pcs)	16 DKK
Threaded bushings for seat	8 DKK
Threaded bushings for backrest	12 DKK
Threaded bushing for frame modules	6 DKK
Fasteners	42 DKK
COST	**1360 DKK**

SENSITIVITY ANALYSIS

If it had been possible to specify the cost of all elements, a sensitivity analysis could have been conducted to determine which parts are most critical in terms of cost impact. Although this was not feasible based on the available estimates, certain elements are presumed to significantly increase the overall cost. Many of the components are processed using 5-axis CNC machining, which is generally more expensive than 3-axis CNC machining. It is assumed that Kvist Industries (HAY manufacturer) has access to this in their production, but if not available, costs may increase further - either due to the purchase of such machinery or because the parts would need to be produced more sequentially and manually.

The cost of the modular fixture for the backrests could not be specified, but it is expected to contribute significantly to the total cost, as it is produced through a variety of processes, some of which are manual. Therefore, it may be worth considering whether the same modular configuration can be achieved using a more cost-effective solution - or whether the component could be eliminated entirely to reduce costs.

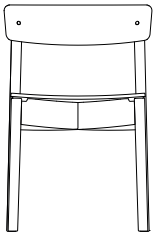
The main production of the chair will be handled by Kvist Industries in Latvia, while the MTO-processes will be carried out at their facility in Denmark. Therefore, the embedded cost of the MTO elements will presumably be higher if executed in Denmark, which should be reflected in the final price point of the chair.

Furthermore, it is being considered whether refurbishment might be a more economical option compared to producing new parts, especially when accounting for the costs associated with the take-back system. Although the estimated refurbishment costs appear to be lower than the cost of new components, the costs of logistics and handling within the take-back system have not been included. The extent of these costs may determine whether the concept is based on a viable business model for refurbishment.

COMPARISON TO THE MARKET

Comparing FORMA to other similar options on the market is challenging, as there are no products that offer exactly the same features. However, it has been chosen to compare it with Cross Chair from TAKT, which offers a similar concept in terms of interchangeability of parts.

CROSS CHAIR, TAKT

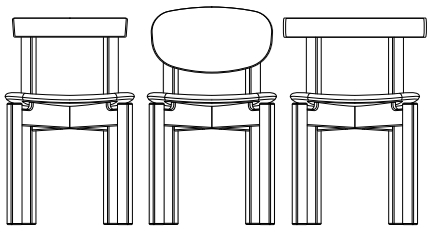


VALUE AND PRICE

+ TIMELESS DESIGN
+ MAINTAINABLE DESIGN
+ DESIGNED FOR EASY DISASSEMBLY
+ INTERCHANGEMENT OF WORN PARTS
– OFFERED OPTIONS FOR CHANGE IN AESTHETICS ARE LIMITED TO AN ATTACHABLE CUSHION
– UNABLE TO REFLECT TRENDS IN ITS APPEARANCE

3,795.00 DKK
(INCL. VAT)

FORMA COLLECTION



VALUE AND PRICE

+ ADAPTABLE FOR BOTH TRENDY AND TIMELESS DESIGN
+ MAINTAINABLE DESIGN
+ DESIGNED FOR EASY DISASSEMBLY
+ INTERCHANGEMENT OF WORN PARTS
+ WIDE RANGE OF INTERCHANGEABLE OPTIONS OFFERED FOR CHANGE IN AESTHETICS
– DOES NOT CURRENTLY OFFER INTERCHANGEMENT OF PERMANENT PARTS

5,800.00 DK
(COST PRICE X 4 MARKUP) + VAT

The price point is proposed based on an anticipated markup of 4. If HAY is able to offer the product with a lower markup, the price can be reduced, making the chair more economically competitive compared to other products in this segment.

MATERIAL COSTS (50%)	TOOL COSTS (2%)	CRAFTMANSHIP COSTS (28%)	PACKAGING COSTS (3%)	TRANSPORT COSTS (7%)	PAYMENT FEE (2%)	DESIGN ROYALTIES (8%)
338 DKK	14 DKK	189 DKK	20 DKK	47 DKK	14 DKK	54 DKK
188DKK	8 DKK	105 DKK	11 DKK	26 DKK	8 DKK	30 DKK
113 DKK	5 DKK	63 DKK	7 DKK	16 DKK	5 DKK	18 DKK
16 DKK						
8 DKK						
12 DKK						
6 DKK						
42 DKK						
722 DKK	**26 DKK**	**357 DKK**	**39 DKK**	**89 DKK**	**26 DKK**	**102 DKK**

SUPPLY CHAIN AND PRODUCT JOURNEY

HAY has suppliers all over Europe - and in terms of wooden furniture, their main supplier is Kvist Industries, which will be utilized for the production of the design proposal.

SUPPLIERS
Kvist Industries, Denmark
Specialized in customization, upholstery and surface treatment*
- Customization of MTO-parts (frames, backrests and seats)
- Refurbishment of take-back parts (backrests and seats)

Kvist Industries, Latvia
Specialized in veneer molding, solid wood production, and CNC-machining*
- Main production of chair frames

SELECTION OF RETAIL COUNTRIES
Denmark
Norway
Sweden
Netherlands
Germany
Belgium
Italy

MTO - A CURRENT PRACTICE IN HAY
HAY offers certain furniture on a Made to Order (MTO) basis to allow customers to select from a variety of upholstered fabrics, finished and configurations, while eliminating the risk of overproduction and unsold stock.

* (Q-SYSTEM, 2017; KVIST, 2019A; KVIST, 2019B; KVIST, 2019C)

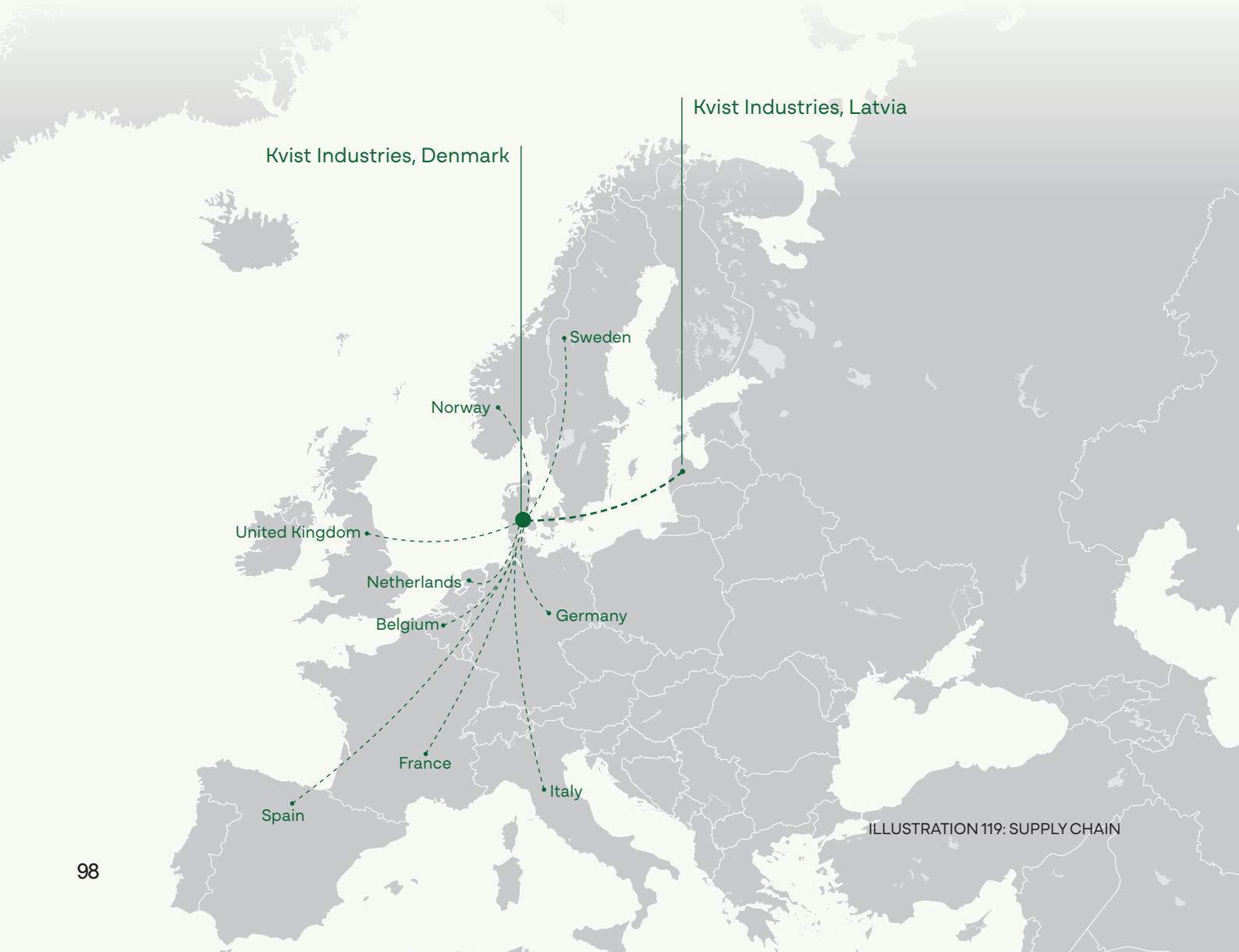


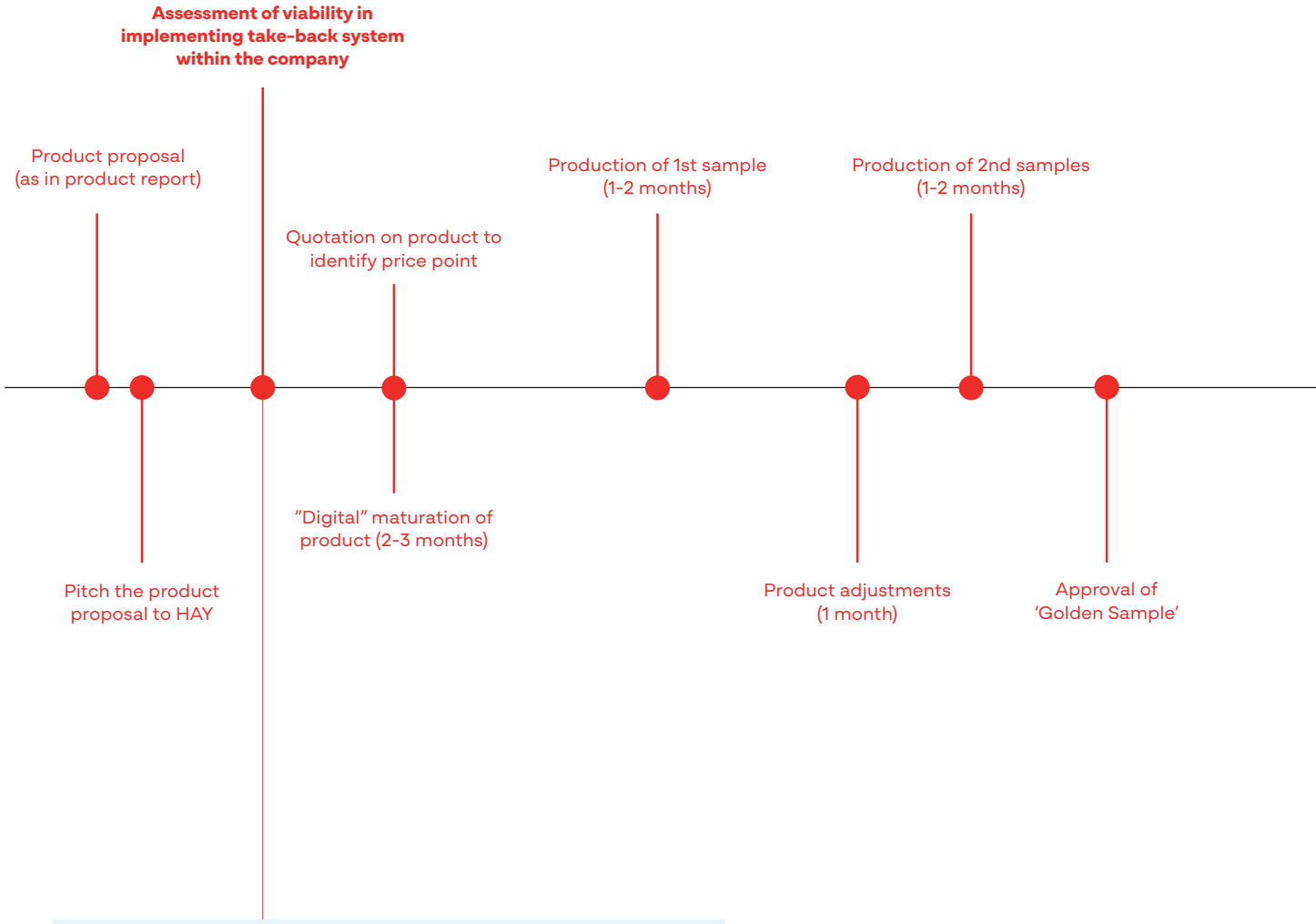
ILLUSTRATION 119: SUPPLY CHAIN

PHASE 07 MARKET IMPLEMENTATION

Roadmap
Timelime mapping of new variants
Strategic durability
Implementing the concept on a system basis

ROADMAP FOR IMPLEMENTATION

The following implementation plan for the product proposal is based on input from a sparring session with Nicolai Rytter from SACKit, in order to best represent the potential process and steps involved in releasing a product like this at HAY. If a collaboration had been established with HAY, a more detailed and accurate implementation plan, taking HAY's current business structures into account, could have been established.



If not a take-back system, then what?

If the take-back system cannot be implemented in the business structure of HAY, the product proposal will just represent a modular chair, where you can interchange the seat and backrest. The consumer will either keep or dispose the old seat and backrest - decreasing the sustainable value of the proposal, as the interchangeable parts will only be recycled on a material level of low integrity, instead of being refurbished into new parts with high product integrity. Thus, this scenario is not considered suitable as a foundation for maturing this concept.

ILLUSTRATION 120: ROADMAP

The DS/EN 12520:2024 is a furniture standard (safety, strength and durability) for domestic seating, which will apply for this product proposal.

Testing at Danish Technological Institute in relation to the DS/EN 12520:2024 standard (1-2 weeks)

Ordering 0-series - prototypes

"Go-to-Market"

Marketing presentation and implementation of product on market (2 months)

Start-up of serial production

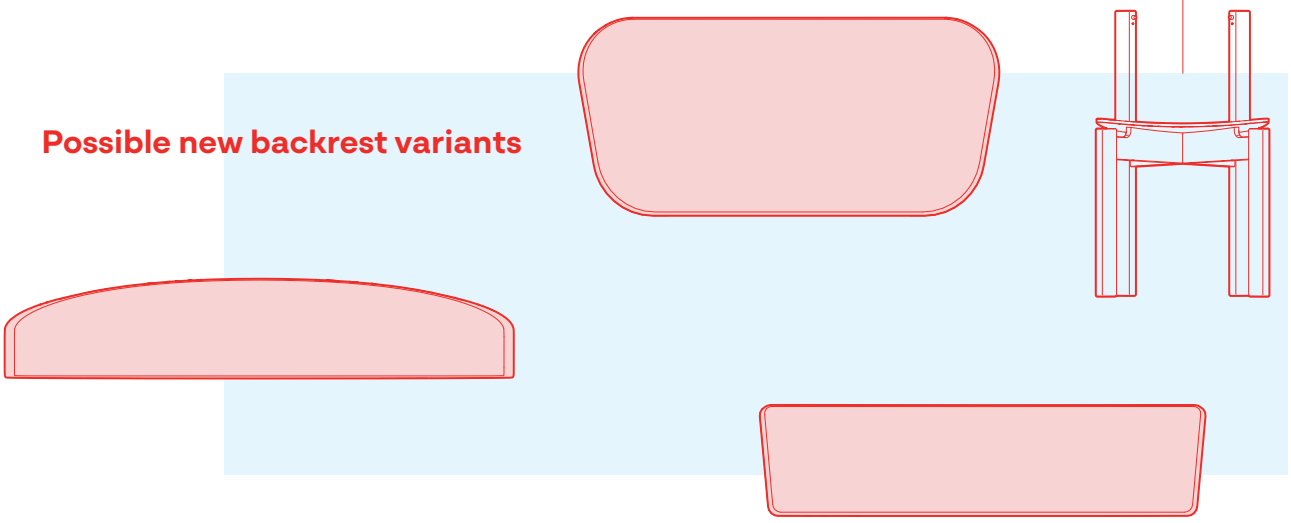
Product launch
Minimum 1 year from handover

Tracking product via PO-controls and customer complaints

Evaluation of procedures for TAKE-BACK system

Design and development of future variants

Possible new backrest variants



TIMELINE MAPPING FOR NEW VARIANTS

Based on the estimated lifespan of dining chairs (see 'Choosing a Product Category' p. 28), it is recommended that new variants are released before approaching the point at which replacement of the chair is considered. Therefore, it is proposed to launch three new backrest variants every 5 years after the initial launch of FORMA. Whether these variants should be released all at once or spread out over the 5-year period will depend on the company's specific business structures and launch procedures.
The following timeline represents the proposal for HAY's launch of new variants.

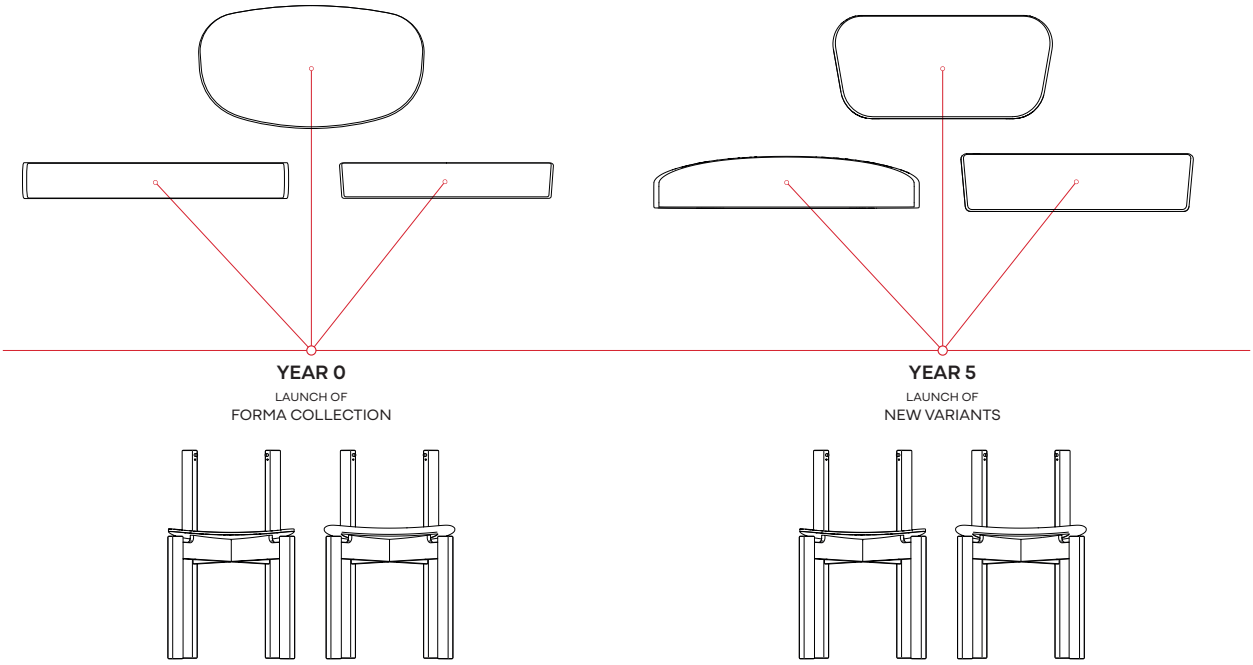


ILLUSTRATION 121: TIMELINE MAPPING

STRATEGIC DURABILITY

In the different phases of the project, different strategies have been applied to achieve long-lasting strategic fits. The development of FORMA has strived to create a strategic fit with both the user, the market and the company. In the following, it is summarized to what extent these fits are achieved in FORMA COLLECTION.

PRODUCT-USER FIT

To address the aspects of aesthetic obsolescence in FORMA, it has been essential to understand the users' needs and the factors that influence their attachment to the product, as they are ultimately the ones who determine when a product is considered obsolete.
Therefore, the main focus of the project has been to understand consumer behavior and reasoning in terms of disposing furniture due to aesthetic obsolescence of either wear or aesthetic trends. By that, two main target groups were identified, and their respective motivations, behaviors, and extend of needs for their aesthetic renewal were determined to address by the proposal for FORMA. Continuously, the ergonomic and functional needs of the users have been accommodated in the design.
Being a long-lasting, adaptable dining chair, FORMA strives to achieve a long-term strategic product-user fit - for both current and future needs, trends, and behaviors.

PRODUCT-MARKET FIT

As FORMA is a new product entering a red ocean market, it has been crucial to understand the value, the chair must provide for customers in order to differentiate on the market.
Hence, it has been explored which specific market this concept resonates with in terms of creating user value. Based on identified values of existing solutions and user needs, a value proposition was created to define the values FORMA must offer to differentiate itself and satisfy the customer-centric needs. The core value offered by FORMA is aesthetic adaptability in terms of either aesthetic change or preservation of timelessness.
By these means, FORMA strives to create a strategic product-market fit that utilizes HAY's existing credibility and current competitive position in the market. However, it is difficult to conclude in advance whether this value yields competitive advantage in the market if it was implemented by HAY.

PRODUCT-COMPANY FIT

To achieve a strategic product-company fit by FORMA, it was essential to identify which brand this concept aligns with in terms of being a long-term investment requiring trust and reliability in the brand. Aligning FORMA with the high quality and credibility of HAY, the core purpose and values of HAY provided the foundation for the design language, degree of customization to suit individual preferences, modularity and adaptability of FORMA. Thereby, the design strives to establish a strategic product-company fit by aligning with HAY's current portfolio, while relying on HAY's current MTO practices and core competencies within the production of high-quality furniture.
Whether the inherent take-back system for FORMA is considered a viable and realistic business for HAY to establish is uncertain. In terms of strengthening the product-company fit, it would have been more beneficial to discuss the design proposal of FORMA with HAY during the development to align with their business structures and competencies within the company. This is further elaborated and reflected on in 'Reflection' p. 107.

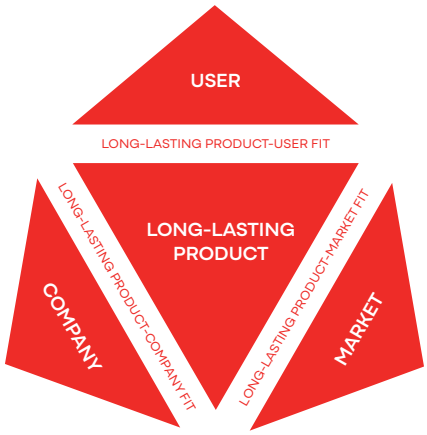


ILLUSTRATION 122: STRATEGIC DURABILITY

IMPLEMENTING THE CONCEPT ON A SYSTEM BASIS

As initially stated in the scope of the project, the overall aim was to develop a system or strategy for designing long-lasting furniture enabling more sustainable practices within the industry. The intention was for it to be applicable to any design company and adaptable to the design of any type of furniture. As the system is developed based on the development of FORMA, the requirements for the design proposal are specified towards the particular furniture category and brand. However, it is possible to convert those requirements into general requirements applicable for the system, as seen on the following page.

Whether this system can be applied by any design brand to design any piece of furniture is yet to be explored and tested. It can be validated by developing a dining chair concept within a different design brand or developing another type of furniture based on the requirements of the system. In doing so, potential adjustments to the system may be identified in order to accommodate different brands or furniture types.

SYSTEM REQUIREMENTS	CASE SPECIFIC REQUIREMENTS
It must be possible to seperate all materials	No elements of different materials should be glued Staples must not be used for upholstery
Permanent parts must have a timeless appearance	The chair frame must have a timeless appearance
Permanent parts must allow for maintenenace	The chair frame must must allow for maintenenace Chair frame must be made of solid wood
The furniture must be developed as parts of a well-established, known brand	The chair must be developed as parts of a well-established, known brand
The interchangeability of non-permanents parts must be percieved as easy	The interchangeability of seat and backrest must be percieved as easy
The interchangeability of non-permanents parts must be practically easy	The interchangeability of seat and backrest must be practically easy
Interfaces must have a high degree of feedforward and feedback	Interfaces must have a high degree of feedforward and feedback
The furniture must be positioned in the Mid-Market segment	Sales price of the chair must not exceed 3500 DKK Cost of a chair must not exceed 875 DKK (4 x markup)
Sales price of interchangement must not exceed 1/3 of the initial sales price of the furniture	Sales price of seat and backrest must not exceed 1/3 of the initial sales price of the furniture Cost of one seat and backrest must not exceed 575 DKK (2 x markup)
Interchangeable parts must be able to reflect both a trend-based and timeless appearance	Seat and backrest must be able to reflect both a trend-based and timeless appearance
Fasteners and similar components must be standard parts	Fasteners and similar components must be standard parts
The aesthetics (colors, materials, form language, tactility) of the furniture must match the portfolio of the particular brand	Colors must be either combined tone on tone or in pairs of complementary colors Form language must be geometrically inspired and defined by simple, clean lines Edges must be rounded or curved Materials must be either solid wood, powder coated steel, molded plastic, glass, aluminum, textiles
The furniture should be ergonomically designed	The backrest must be positioned 28-34 cm above the seat of the chair The curvature of the backrest must be R25-75 cm The angle of the backrest must be 102-106° The seat must be positioned 40-48 cm above the ground The depth of the seat must be 38-46 cm The width of the seat must be 40-51 cm The angle of the seat must be 5-8° Lenght of armrest must be 25-30 cm
Threaded bushings or similar must be used in assembly joints between permanent and non-permanent parts	Threaded bushings must be used in assembly joints between the frame, seat and backrest

PHASE 08
EPILOGUE

CONCLUSION

This thesis has strived to counteract the pressing throwaway culture within the furniture industry by proposing a more responsible approach to furniture design - both in the form of a product proposal and a potential system that could be applied across companies and furniture types.
The aim was to address aesthetic obsolescence as the primary driver of premature furniture disposal. Furthermore, the proposal strives to provide a viable business for companies, thereby promoting the production of long-lasting furniture.

The result is FORMA - a dining chair designed for aesthetic adaptability. By its interchangeable seat and backrest, FORMA offers change in aesthetic appearance - either to keep up with current trends or to maintain a timeless design. The proposal is targeted for HAY, which is reflected in its aesthetic appearance and the degree of customizability offered in terms of forms, colors and textiles. The sustainable aspect of interchangeability relies on a take-back system that facilitates the refurbishment of interchangeable parts, with the aim of providing a viable and more sustainable business case for the company.

Based on the unique selling points of FORMA, it has potential to bring something new to the market if implemented. However, there are limited to no chairs to compare cost and value against and hence to analyze the exact business potential upon. Furthermore, it is uncertain whether the logistics and handling costs of a take-back system will deem the sustainable practice of refurbishment within the proposal unviable.
If implemented, will it provide lasting value by satisfying consumers' desire for renewal?
– only time can tell.

REFLECTION

PRODUCT

MODULAR FIXTURE - IS IT 'BANG FOR THE BUCK'?

We chose to introduce the modular fixture in order to accommodate a wider range of aesthetic and ergonomic degrees of freedom regarding the angles and curvature of the backrests. However, the fixture presumably constitutes a significant part of the total cost of the backrests offered. Whether the fixture delivers enough value for money is difficult to determine definitively, but it could be an element that companies might choose to omit in order to reduce the costs - given they can standardize the angles and curvature in the design of their variants. Additionally, if managing to do so, it would allow for all the variants to be produced using the same bending mold, which would reduce the costs further.

DESIGNING FOR AESTHETIC RENEWAL

As identified, furniture is often replaced prematurely due to consumer's desire for aesthetic renewal. Therefore, we aimed to design FORMA in a way that allows for as many possibilities for aesthetic renewal as possible - regarding forms, colors, and tactilities within the limits of what is ergonomically, structurally, economically, and sustainably feasible.
However, whether this proposal is enough to satisfy the urge for renewal, and thereby lead to an extended lifetime, remains uncertain. What consumers say is one thing, but how they unconsciously behave is ultimately what determines the fate of the chair. Therefore, it can only be determined by implementing the chair to see how it performs in the real world.

COLLABORATION WITH HAY

As previously mentioned, it would have been beneficial for the development of FORMA to discuss it with HAY to align with their internal business structures and competencies and evaluate the viability of a take-back system within their company. However, considering these aspects, collaborating with HAY could have posed a risk of compromising the vision of the project, as they may not be seeking a proposal that addresses furniture design in this way. Therefore, this project presents a visionary approach to furniture design for those who are bold enough to pursue it.

SYSTEM DESIGN FOR MORE RESPONSIBLE PRACTICES

Based on the design of FORMA, a system for more responsible furniture design was proposed. However, as stated, the validity and foundation of this system require further exploration. By doing so, the system could be adapted for application in both varying brands and furniture types, thereby providing the foundation for a step toward more responsible practices within the furniture industry.

PROCESS

REFLECTION - IN AND ON ACTION

During the development of FORMA, it became apparent how dependent the evolution of both the problem and solution space is on reflective practices. In the early phases of the project, when trying to address and define the rather intangible challenge of designing for aesthetic variety, it was difficult to propose methods or experiments for exploring potential solutions. This resulted in a stall in progress, as we found ourselves reflecting on possible outcomes before taking any concrete action.
It therefore became clear that we needed to focus on externalizing the potential solution space through experiments, sketches, mock-ups, and similar methods in order to define and engage with the problem more effectively. This approach laid the foundation for reflecting both in and on action, which allowed us to refine our understanding of the problem and its possible solutions, while also informing the subsequent actions in the process. Fortunately, once we got the ball rolling - without worrying too much about where it might go - it kept rolling, driving the development of the proposal for the project forward.

THE WICKEDNESS OF AESTHETIC VARIETY

This project dealt with the wicked problem of addressing aesthetic obsolescence in furniture design. Therefore, it was initially expected that the focus would lie on the aesthetic design of the proposal. However, this proved to be a significant challenge - particularly in determining the necessary degree of aesthetic variety to satisfy the identified need for renewal.
An attempt was made to evaluate the extent of aesthetic variation the solution should offer through user engagement, but this primarily led to a desire for the highest possible degree of variety. Consequently, it became clear that it was necessary to define the boundaries the possible aesthetic variation was reliant upon in order to reverse the process. By establishing these boundaries, it became possible to make the degree of aesthetic variety more tangible.
As this establishment happened rather late in the process, the time allocated for the actual design of the proposal became more limited than desired. Especially the design on the interchangeable parts, being the elements providing the aesthetic variance, could have been explored and refined even more. Specifically, the formal variety of the variants showed significant potential for creating distinct and compelling aesthetic diversity - beyond what could be achieved through changes in color and tactility alone.

REFERENCES

Bocken, N., Stahel, W., Dobrauz, G., Koumbarakis, A., Obst, M. and Matzdorf, P. (2021). Circularity as the new normal: Future fitting Swiss business strategies. [online] Maastricht University, PwC Switzerland, pp.1–33. Available at: https://cris.maastrichtuniversity.nl/en/publications/circularity-as-the-new-normal-future-fitting-swiss-business-strat [Accessed 27 Apr. 2025].

Building Green Together. (2024). TAKT – Designed for repair - Building Green Together. [online] Available at: https://buildinggreen.eu/together/2024/03/04/takt-designed-for-repair/ [Accessed 4 May 2025].

Burns, B. (2010). Re-evaluating Obsolescence and Planning for It. In: T. Cooper, ed., Longer Lasting products: Alternatives to the Throwaway Society. Surrey: Gower, pp.44–60.

Carl Ras (2025). Samlebeslag EV/32-Set, Festool. [online] Carl-ras.dk. Available at: https://www.carl-ras.dk/samlebeslag-ev-32-set/?product=39776498/39776498 [Accessed 3 May 2025].

Dollerup, S. and Gade, J.I. (2024). LOMMEBOGEN - Emotionelle Kundetyper. 1st ed. Institut for Kundetyper.

Ellen MacArthur Foundation (2025). Circular Economy Introduction. [online] Ellen MacArthur Foundation. Available at: https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview [Accessed 27 Apr. 2025].

Ellen Macarthur Foundation (2021). The Butterfly Diagram: Visualising the Circular Economy. [online] ellenmacarthurfoundation.org. Available at: https://www.ellenmacarthurfoundation.org/circular-economy-diagram [Accessed 27 Apr. 2025].

Ellen Macarthur Foundation (2022). The Technical Cycle of the Butterfly Diagram. [online] www.ellenmacarthurfoundation.org. Available at: https://www.ellenmacarthurfoundation.org/articles/the-technical-cycle-of-the-butterfly-diagram [Accessed 27 Apr. 2025].

Erasmus (2017). CIRCULAR ECONOMY IN THE FURNITURE INDUSTRY: OVERVIEW OF CURRENT CHALLENGES AND COMPETENCES NEEDS. [online] Available at: https://circulareconomy.europa.eu/platform/sites/default/files/circular-economy-in-the-furniture-industry.pdf.

Forrest, A., Hilton, M., Balinger, A. and Whittaker, D. (2017). CIRCULAR ECONOMY OPPORTUNITIES IN THE FURNITURE SECTOR. [online] Available at: https://eeb.org/wp-content/uploads/2019/05/Report-on-the-Circular-Economy-in-the-Furniture-Sector.pdf? [Accessed 24 Apr. 2025].

Frahm, L.B., Laursen, L.N. and Tollestrup, C. (2022). Categories and Design Properties of Inherited Long-Lasting Products. Sustainability, [online] 14(7). doi:https://doi.org/10.3390/su14073835.

Gabriel (2019). Gabriel Fabrics. [online] Gabrielfabrics.com. Available at: https://www.gabrielfabrics.com/inspiration/loop/ [Accessed 15 May 2025].

Haase, L.M. and Laursen, L.N. (2023). Designing for Longevity: Expert Strategies for Creating Long-Lasting Products. 1st ed. Routledge.

Jensen, P.B., Laursen, L.N. and Haase, L.M. (2021a). A Practical Approach to Companies' Transformation toward Product Longevity: A Best-Case Study. Sustainability, [online] 13(23), p.13312. doi:https://doi.org/10.3390/su132313312.

Jensen, P.B., Laursen, L.N. and Haase, L.M. (2021b). Barriers to product longevity: A review of business, product development and user perspectives. Journal of Cleaner Production, 313(313), p.127951. doi:https://doi.org/10.1016/j.jclepro.2021.127951.

Kvist (2019a). Form press + Solid wood - Kvist Industries A/S Headquarters. [online] Kvist.com. Available at: https://www.kvist.com/lets-create-furniture/craftmanship/form-press-plus-solid-wood/ [Accessed 15 May 2025].

Kvist (2019b). Surface treatment - Kvist Industries A/S Headquarters. [online] Kvist.com. Available at: https://www.kvist.com/lets-create-furniture/craftmanship/surface-treatment/ [Accessed 15 May 2025].

Kvist (2019c). Upholstery - Kvist Industries A/S Headquarters. [online] Kvist.com. Available at: https://www.kvist.com/lets-create-furniture/craftmanship/upholstery/ [Accessed 15 May 2025].

Lobos, A. (2014). Timelessness in Sustainable Product Design. In: J. Salamanca et al., ed., The colors of care: proceedings of the 9th International Conference on Design & Emotion. Universidad de Los Andes, Bogotá, pp.169–176.

Marius Pedersen A/S (2015a). Affaldstræ | Indsamling og sortering af træaffald. [online] Mariuspedersen.dk. Available at: https://www.mariuspedersen.dk/affald/traeaffald [Accessed 2 May 2025].

Marius Pedersen A/S (2015b). Indsamling af træ (fra produktion A2) | Marius Pedersen A/S. [online] Mariuspedersen.dk. Available at: https://www.mariuspedersen.dk/affald/traeaffald/trae-fra-produktion-a2 [Accessed 2 May 2025].

Marius Pedersen A/S (2015c). Marius Pedersen A/S indsamler træ (blandet A2). [online] Mariuspedersen.dk. Available at: https://www.mariuspedersen.dk/affald/traeaffald/trae-blandet-a2 [Accessed 2 May 2025].

Megafurniture. (n.d.). When Is the Right Time to Replace Your Furniture Megafurniture. [online] Available at: https://megafurniture.sg/blogs/articles/when-is-the-right-time-to-replace-your-furniture-megafurniture.

Mercer, N. (2024). Flat Packed: The Sustainable Design Approach to Shipping. [online] Adorno. Available at: https://adorno.design/editorial/flat-packed-the-sustainable-design-approach-to-shipping/ [Accessed 7 May 2025].

Miljøstyrelsen (2018). Kortlægning af genanvendeligt træaffald i Danmark. [online] Available at: https://www2.mst.dk/Udgiv/publikationer/2018/03/978-87-93614-89-5.pdf [Accessed 2 May 2025].

Ornli (2025). Produkter - Ornli. [online] Ornli. Available at: https://ornli.dk/produkter/ [Accessed 5 May 2025].

Q-System (2017). Q-System: Optimering Af HAY-stol Produktionen. [online] Q-System. Available at: https://q-system.com/en-hay-stols-forste-rejse/ [Accessed 15 May 2025].

Simalfa (2025). Simalfa. [online] Simalfa. Available at: https://www.simalfa.com/products/301 [Accessed 15 May 2025].
Skovdam, A.M.F., Kaupang, S.K.V. and Amtoft, E. (2024). Consumer Motivations and Barriers for Online Resale of Furniture. [online] Aalborg University. Available at: https://kbdk-aub.primo.exlibrisgroup.com/permalink/45KBDK_AUB/a7me0f/alma9921953168005762 [Accessed 4 May 2025].

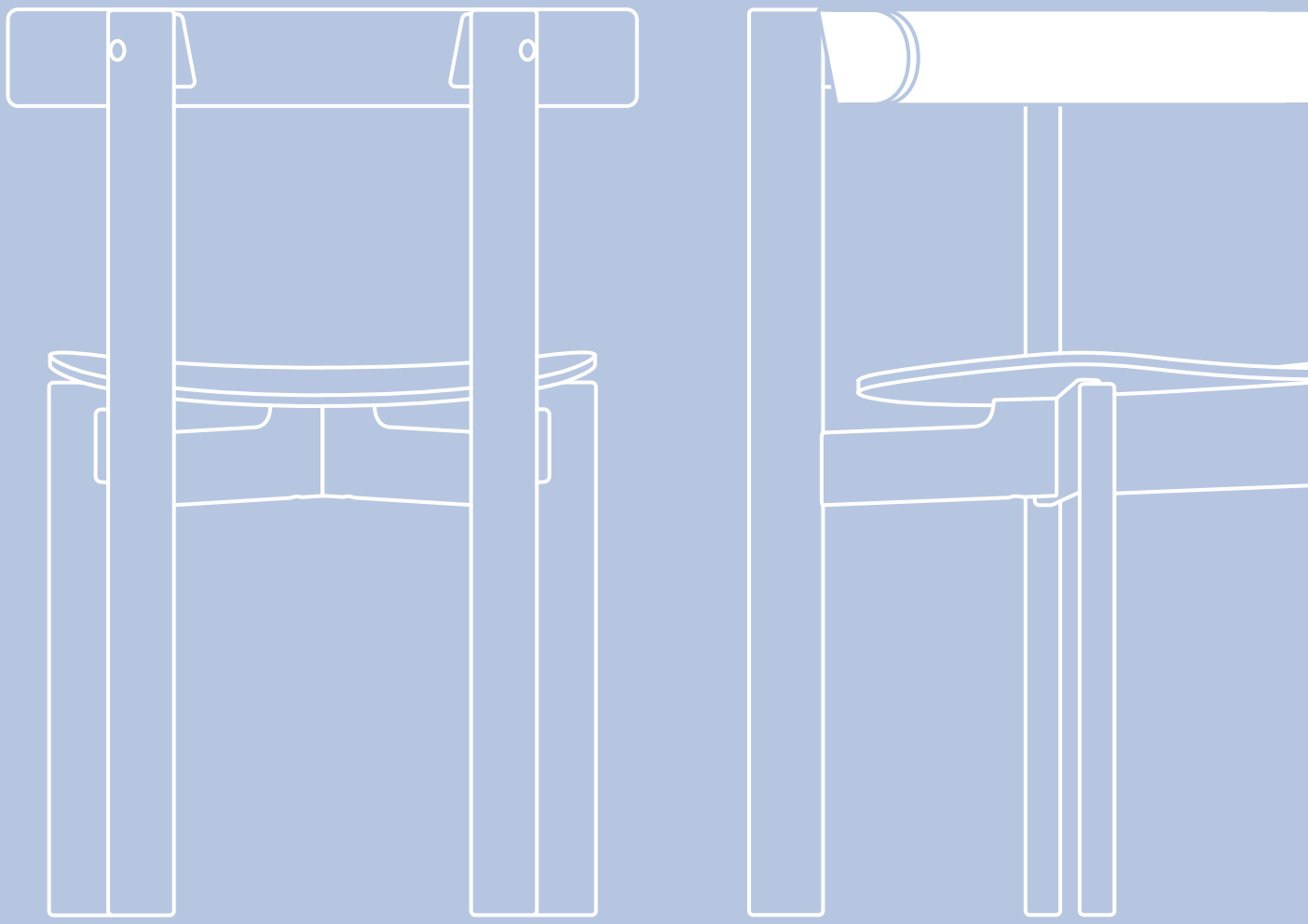
Strategyzer (2024). Value Proposition Canvas. [online] Strategyzer. Available at: https://www.strategyzer.com/library/the-value-proposition-canvas [Accessed 5 May 2025].

Thompson, R. (2018). Manufacturing Processes for Design Professionals. London: Thames & Hudson.

Vind, D.L. (2024). Danish Design Heritage and Global Sustainability. Danish design heritage and global sustainability. Abingdon, Oxon: Routledge.

ILLUSTRATIONS

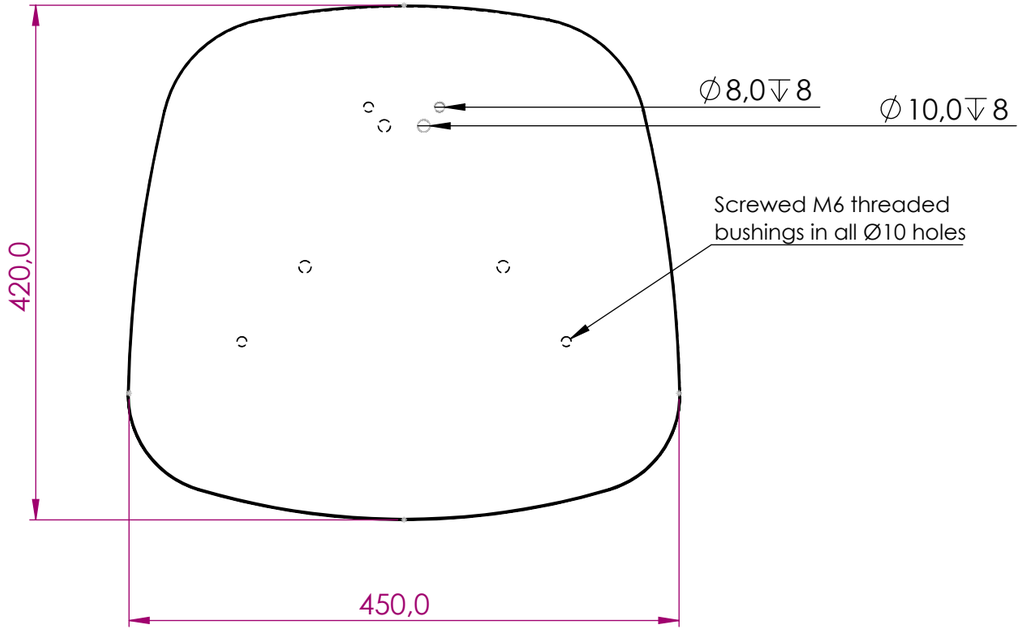
AALBORG
UNIVERSITY

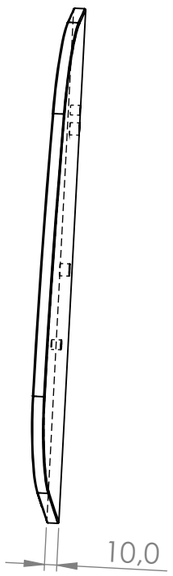


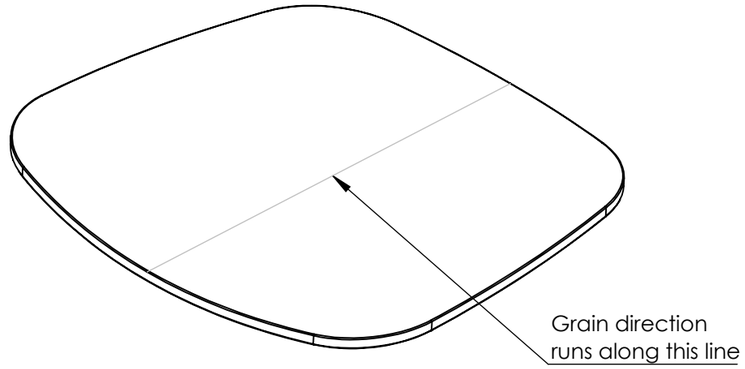
FORMA COLLECTION

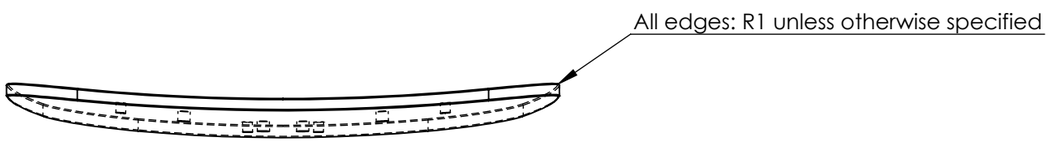
AMALIE MATHILDE FUNDER SKOVDAM, EMILIE AMTOFT,
SARA KATRINE VANGGAARD KAUPANG

TECHNICAL DRAWINGS / MA4-ID11 / MAY 2025

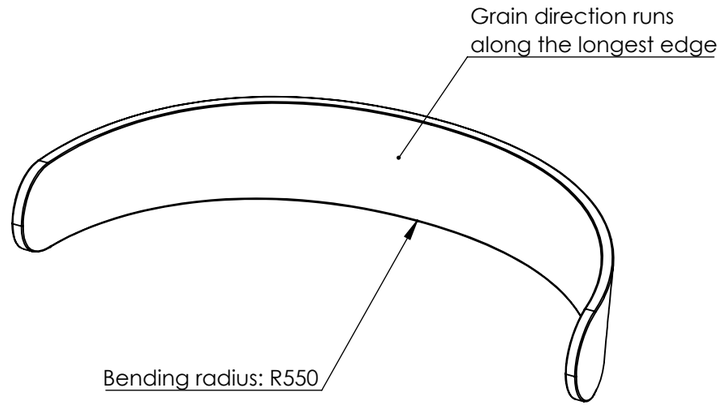


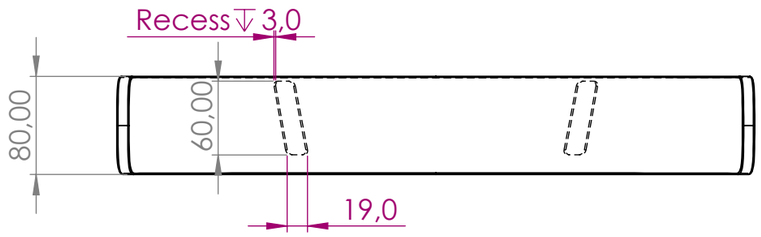


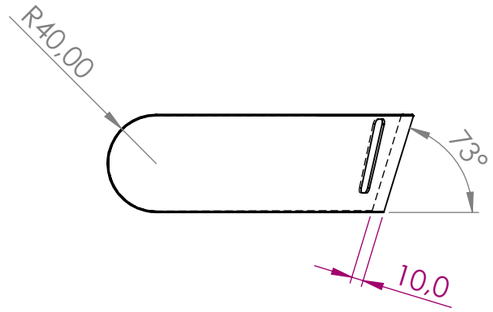


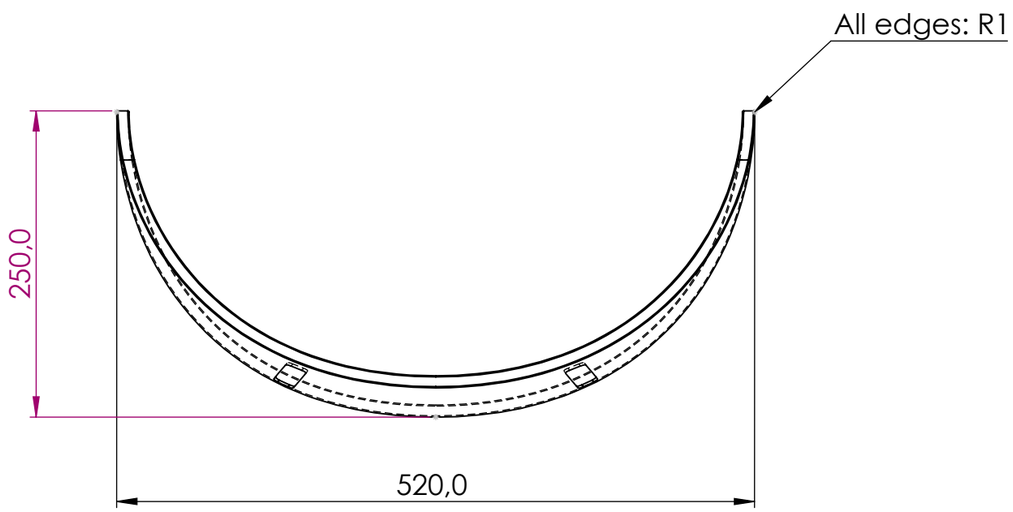


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: 0,2 LINEAR: ANGULAR:	FINISH: Natural varnish, Black stained, Painted RAL 360 30 35 Painted RAL 130 80 10 Painted RAL 270 80 15	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION		
	NAME	SIGNATURE	DATE			TITLE: Seat
DRAWN						
CHK'D						
APPV'D						
MFG						
Q.A				MATERIAL: Form pressed veneer		DWG NO. 1
						A3
				WEIGHT:	SCALE:1:5	SHEET 1 OF 1

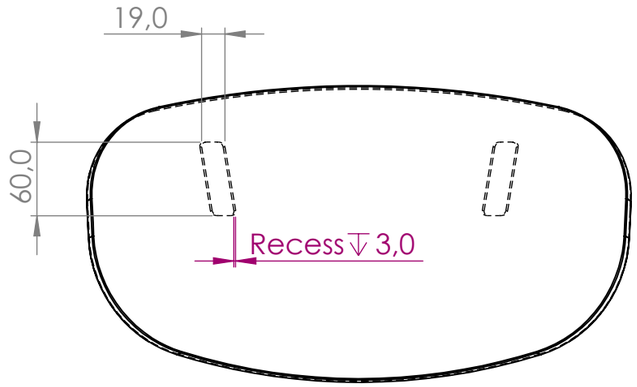


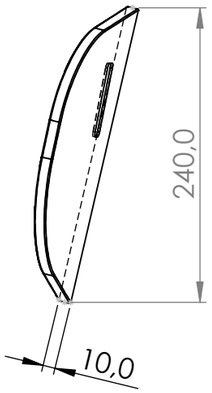


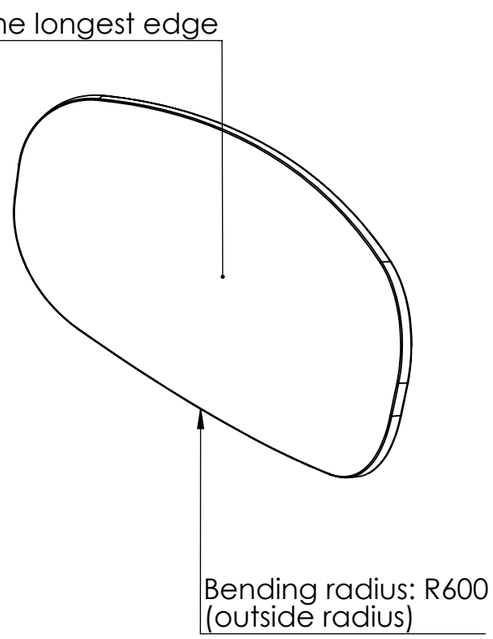


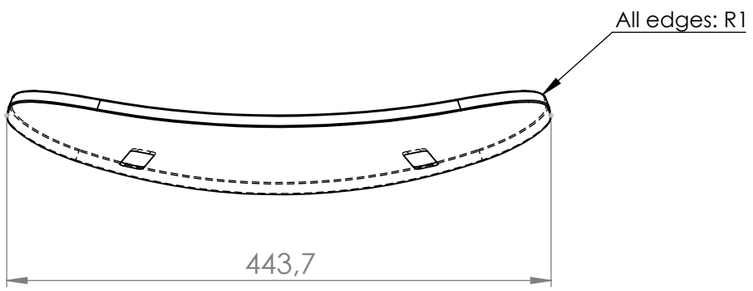


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: 0.2 LINEAR: ANGULAR:		FINISH: Natural varnish, Black stained, Painted RAL 360 30 35, Painted RAL 130 80 10, Painted RAL 270 80 15		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE: Filippa	
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL: Form pressed oak veneer		DWG NO. 2.1	A3
				WEIGHT:		SCALE:1:5	SHEET 1 OF 1

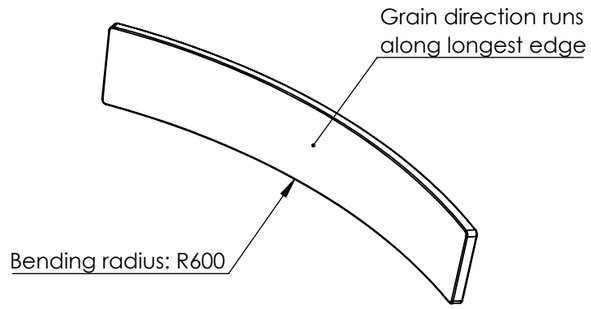


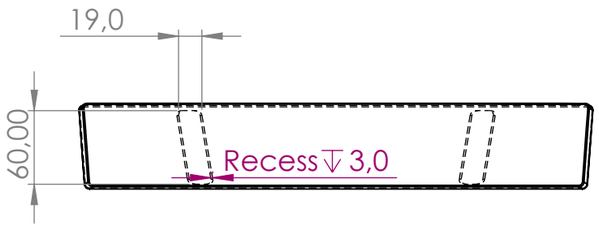


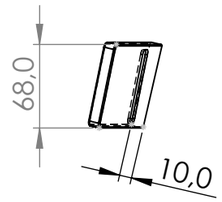


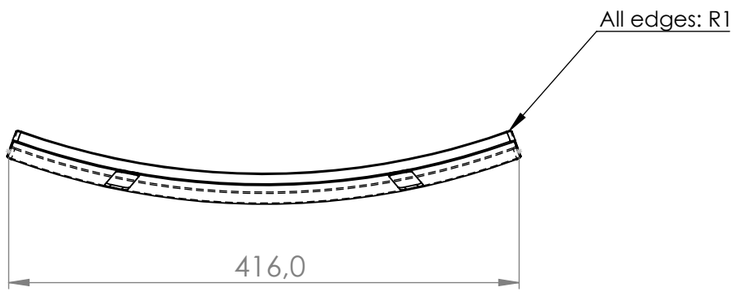


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: 0,2 LINEAR: ANGULAR:		FINISH: Natural varnish, Black stained, Painted RAL 360 30 35, Painted RAL 130 80 10, Painted RAL 270 80 15		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE: Mona	
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL: Form pressed oak veneer		DWG NO. 2.2	A3
				WEIGHT:		SCALE:1:5	SHEET 1 OF 1

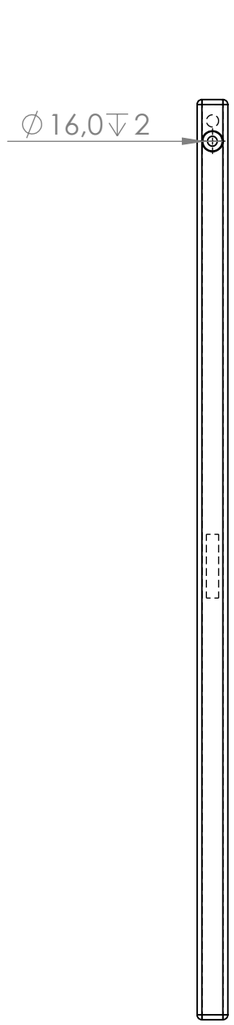


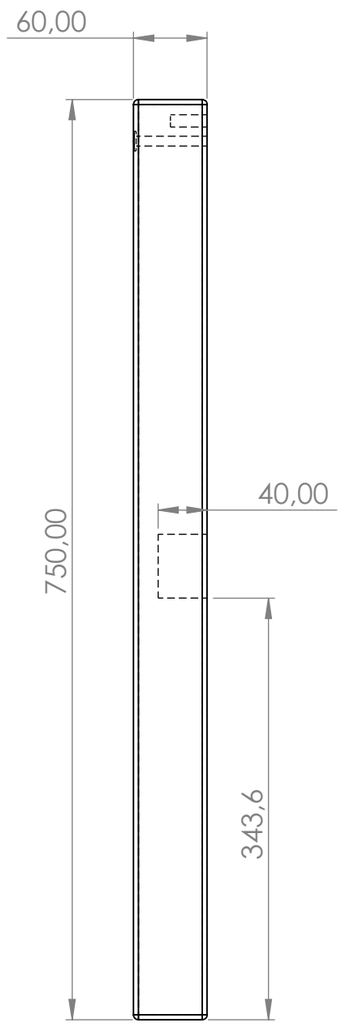


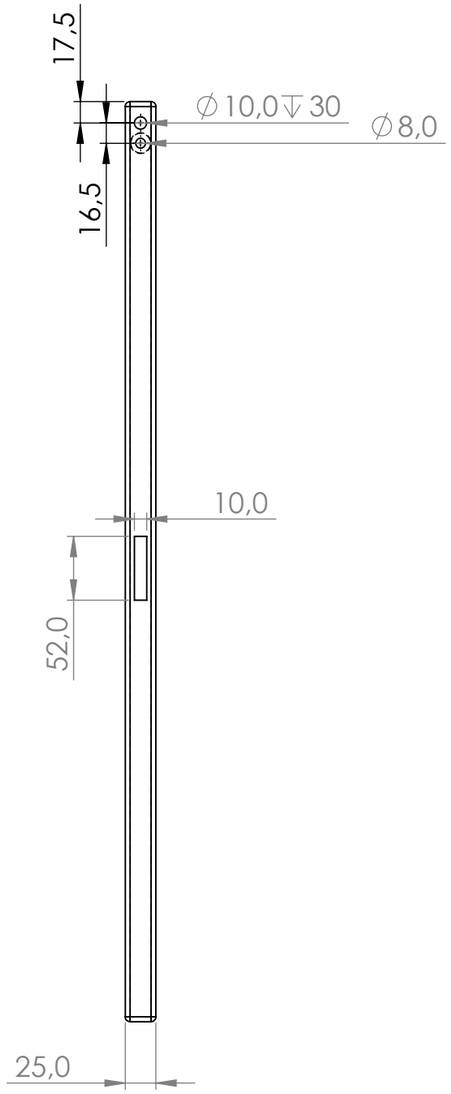


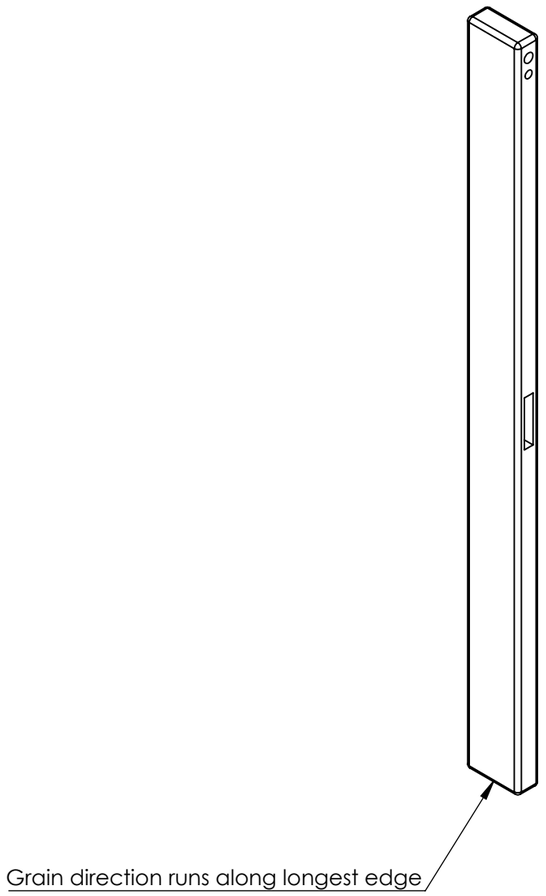


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: 0,2 LINEAR: ANGULAR:		FINISH: Natural varnish, Black stained, Painted RAL 360 30 35, Painted RAL 130 80 10, Painted RAL 270 80 15		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING	REVISION	
	NAME	SIGNATURE	DATE			TITLE: Lina		
DRAWN								
CHK'D								
APPV'D								
MFG								
Q.A				MATERIAL: Form pressed oak veneer		DWG NO. 2.3		A3
				WEIGHT:		SCALE:1:5	SHEET 1 OF 1	

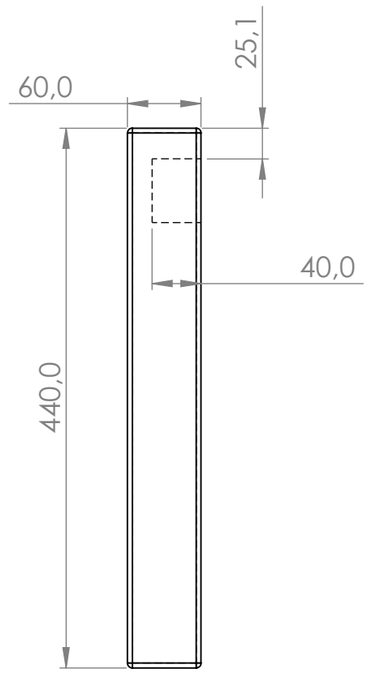


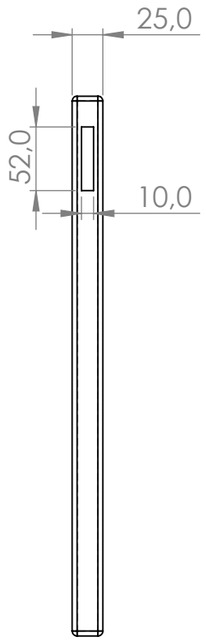


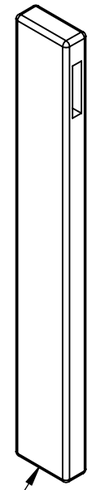




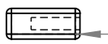
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: 0,2 TOLERANCES: LINEAR: ANGULAR:	FINISH: Natural varnish, Black stained		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING	REVISION	
	NAME	SIGNATURE	DATE		TITLE: Rear leg		
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL: Solid oak	DWG NO. 3		A3
				WEIGHT:	SCALE:1:5		SHEET 1 OF 1





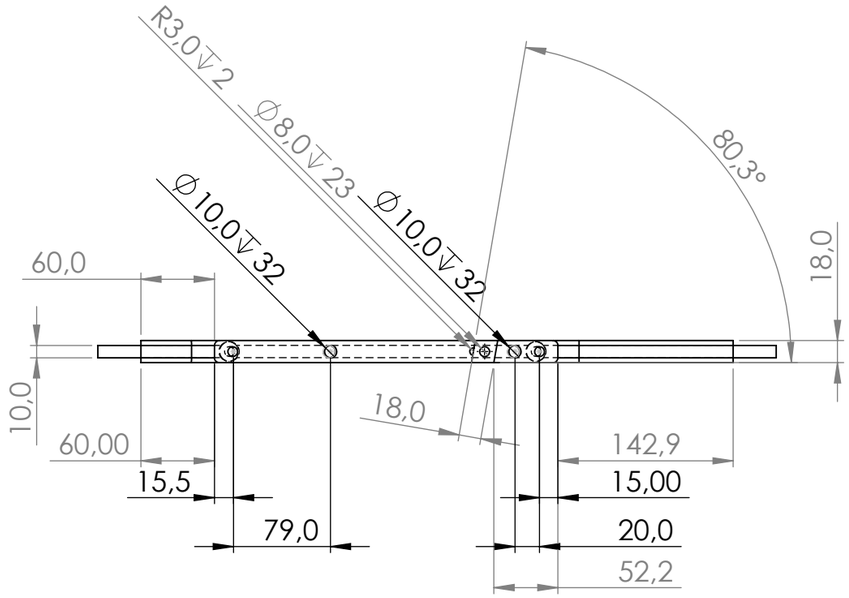


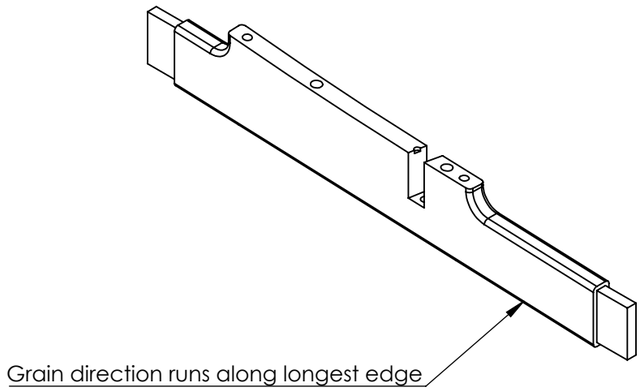
Grain direction runs along longest edge

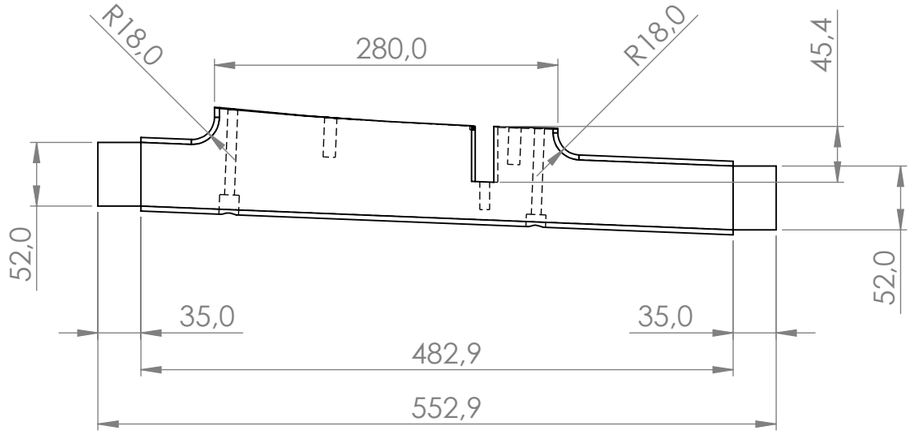


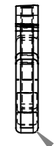
All edges: R4,0

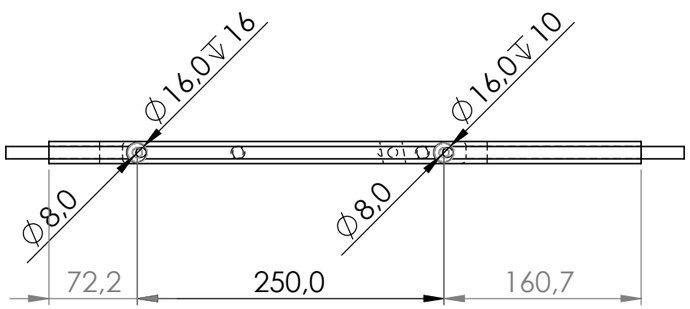
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: 0,2 LINEAR: ANGULAR:		FINISH: Natural varnish, Black stained		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE: Front leg	
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL: Solid oak		DWG NO. 4	A3
				WEIGHT:		SCALE:1:5	SHEET 1 OF 1



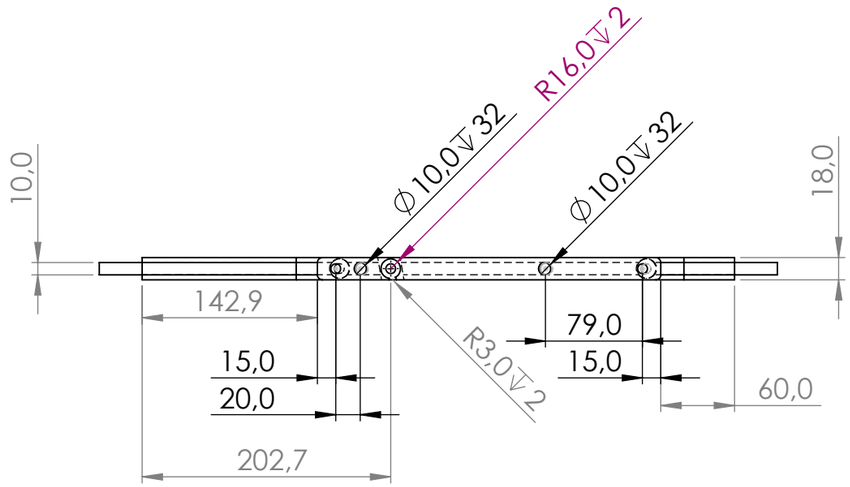


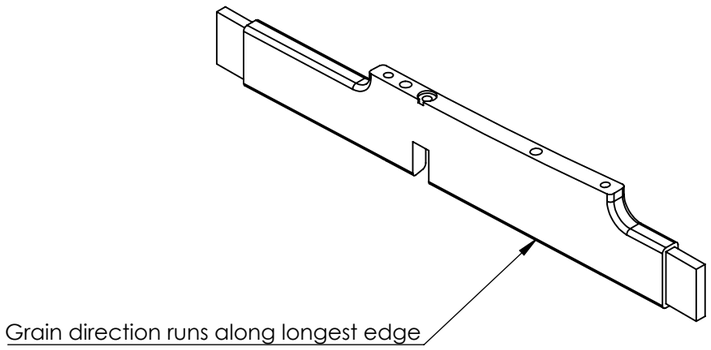


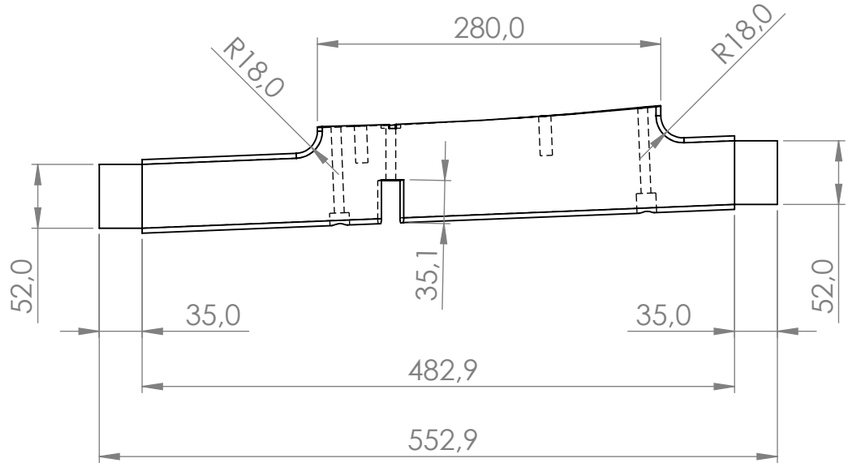


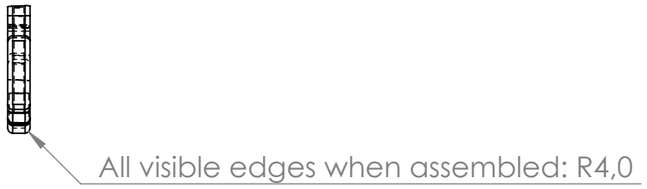


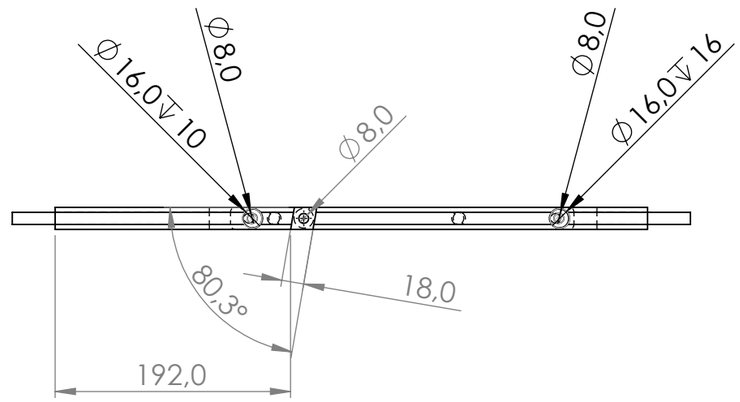
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: 0,2 LINEAR: ANGULAR:		FINISH: Natural varnish, Black stained		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE: Apron, left	
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL: Solid oak		DWG NO. 5	A3
				WEIGHT:		SCALE:1:5	SHEET 1 OF 1



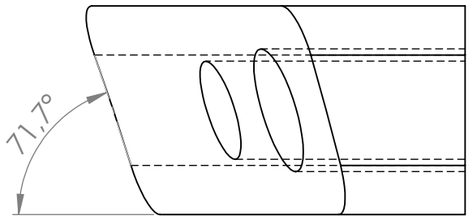


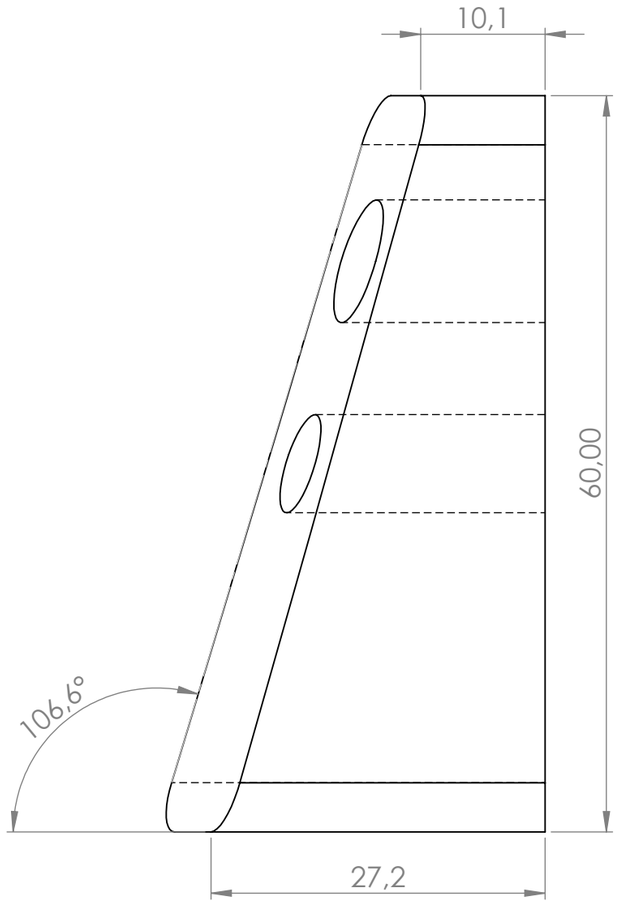


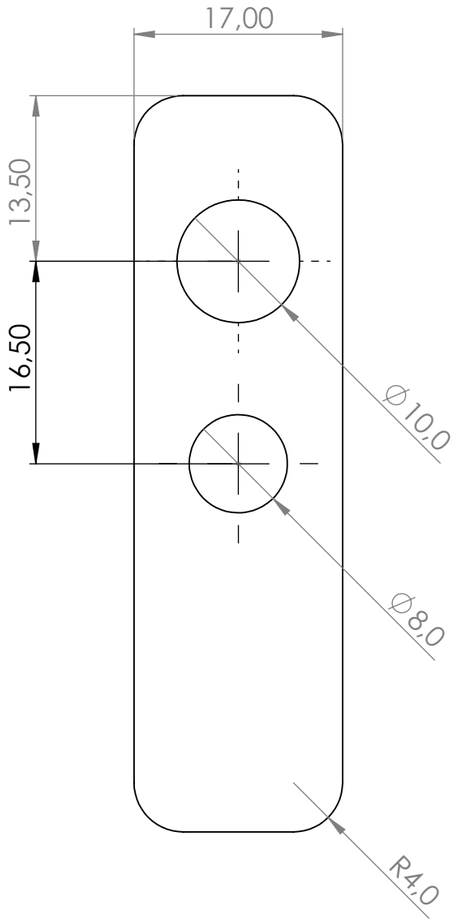


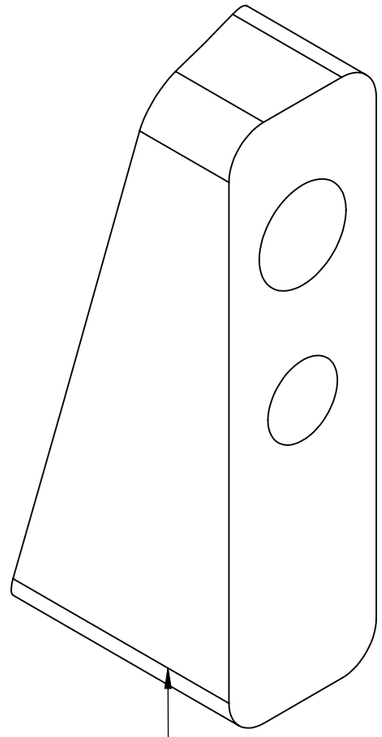


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: 0,2 TOLERANCES: LINEAR: ANGULAR:	FINISH: Natural varnish, Black stained				DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE: Apron, right	
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL: Solid oak		DWG NO. 6	A3
				WEIGHT:		SCALE:1:5	SHEET 1 OF 1





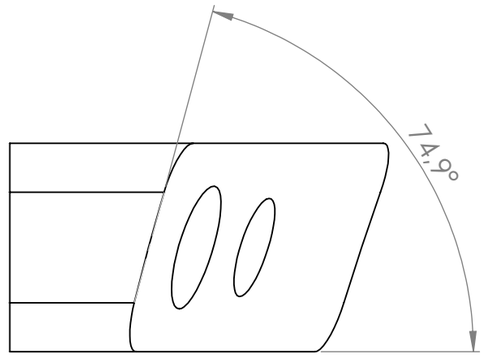


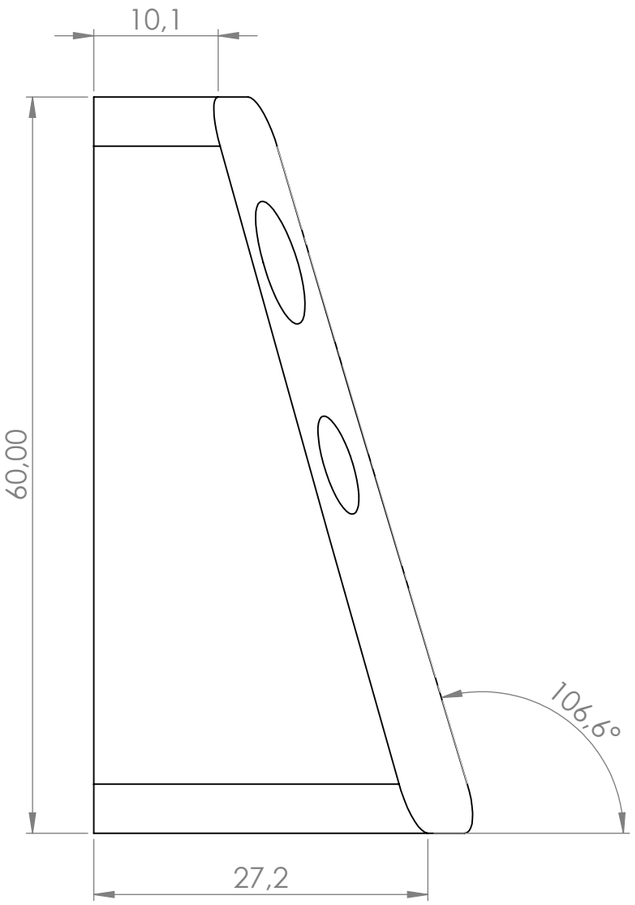


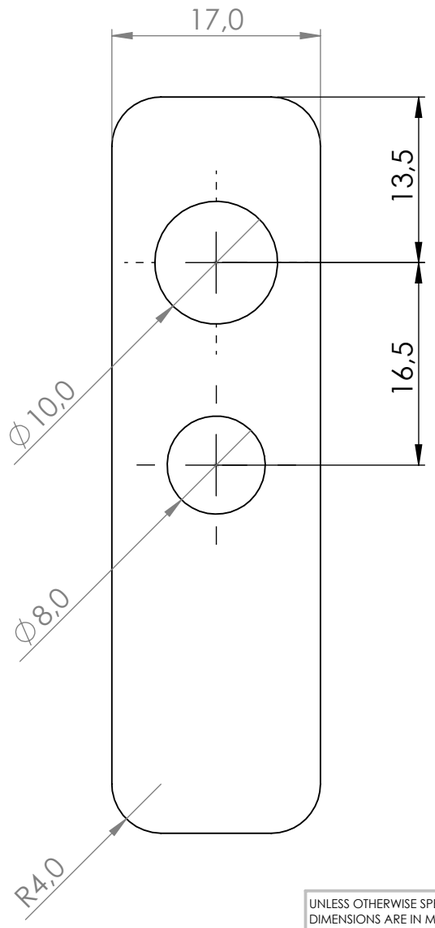
Grain direction runs along short edge

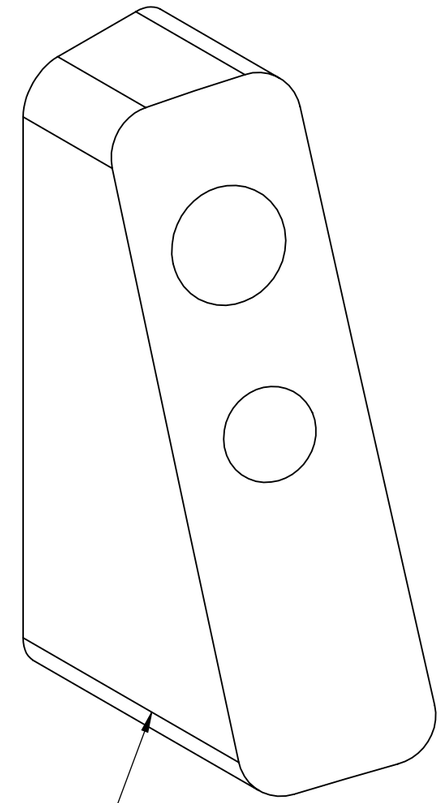
Grain direction runs along short edge

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: 0,2 LINEAR: ANGULAR:	FINISH: Natural varnish, Black stained, Painted RAL 360 30 35, Painted RAL 130 80 10, Painted RAL 270 80 15	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION	
	NAME	SIGNATURE	DATE	TITLE: Fixture, left	
DRAWN					
CHK'D					
APPV'D					
MFG					
Q.A			MATERIAL: Solid oak	DWG NO. 7	A3
			WEIGHT:	SCALE:2:1	SHEET 1 OF 1



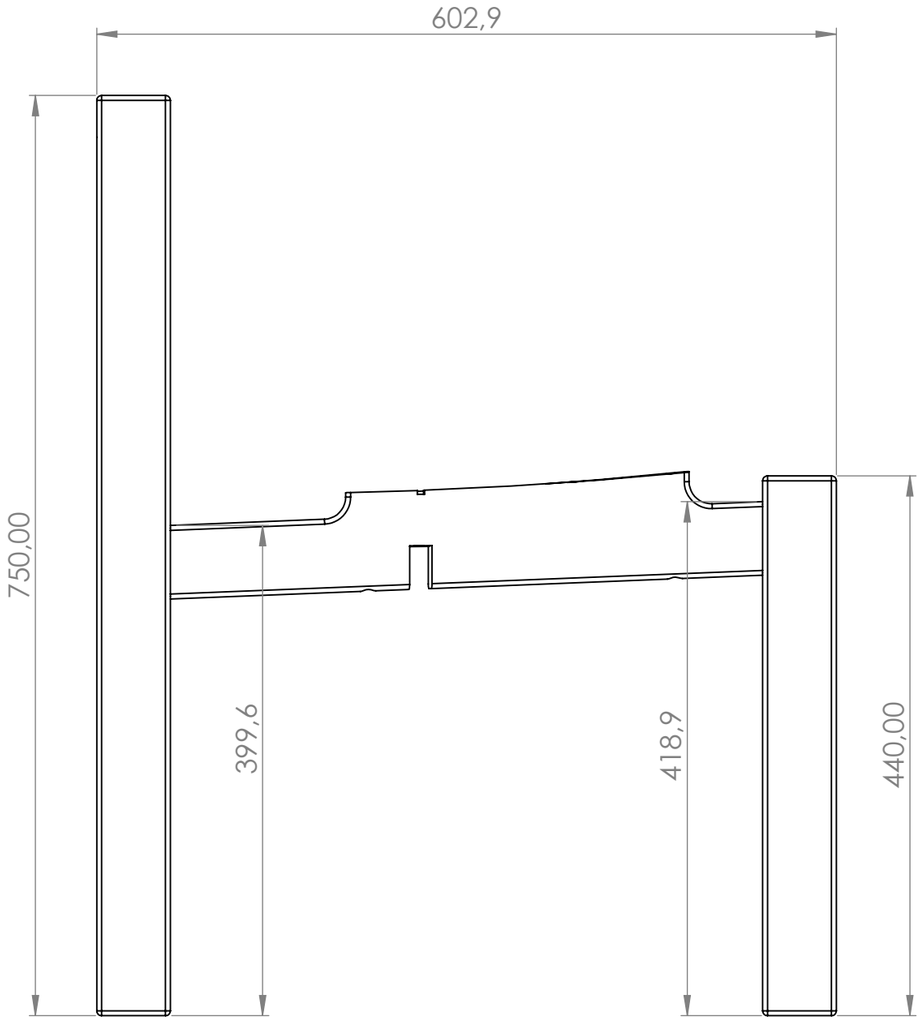


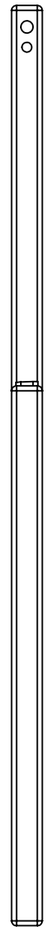


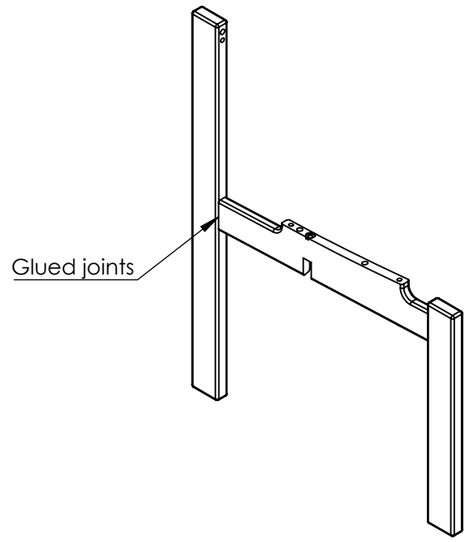


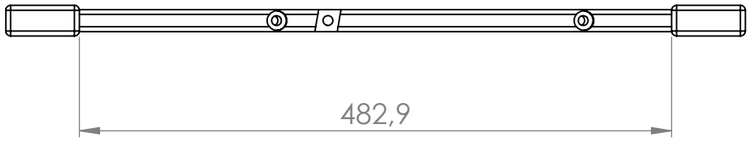
Grain direction runs along short edge

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: 0,2 LINEAR: ANGULAR:	FINISH:	Natural varnish, Black stained, Painted RAL 360 30 35, Painted RAL 130 80 10, Painted RAL 270 80 15	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION		
	NAME	SIGNATURE	DATE	TITLE:			
DRAWN				Fixture, right			
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:	DWG NO.		A3
				Solid oak	8		
				WEIGHT:	SCALE:2:1	SHEET 1 OF 1	

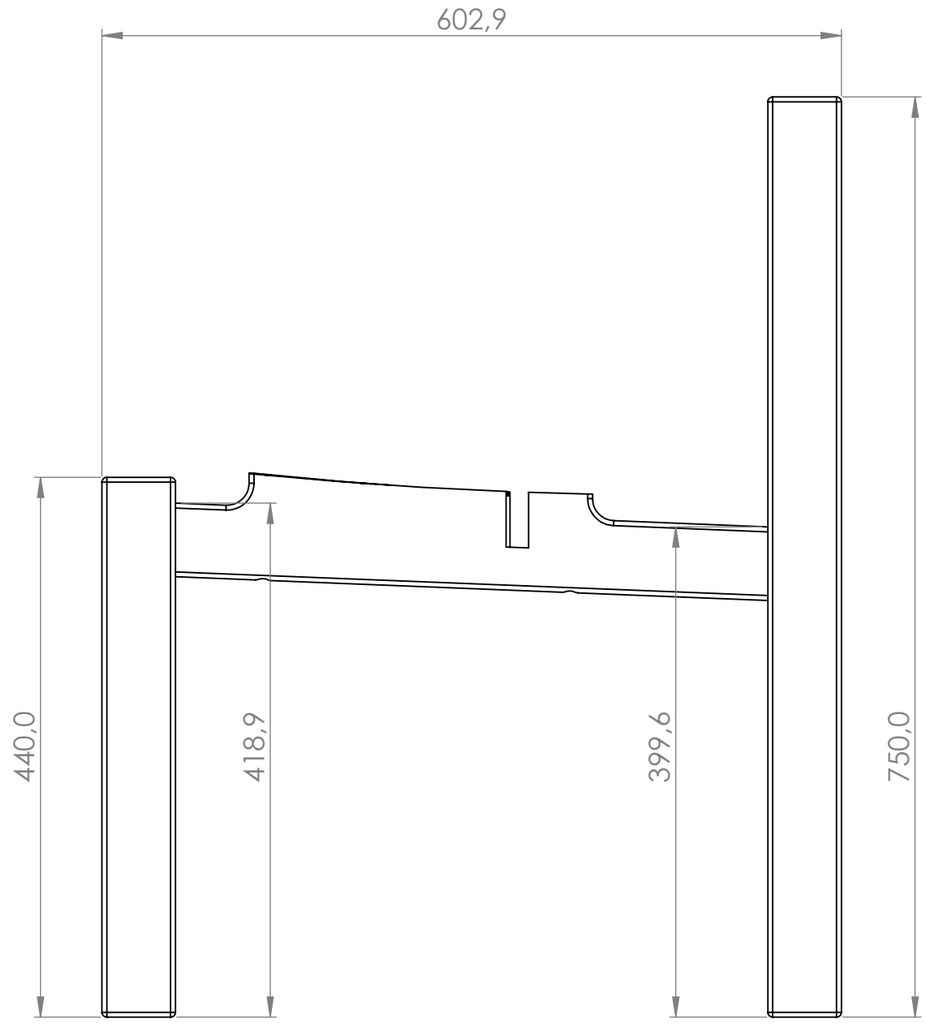


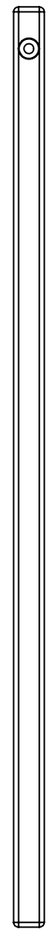


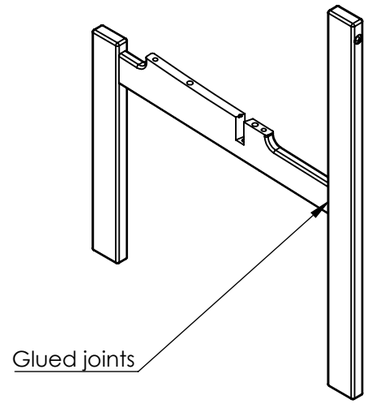


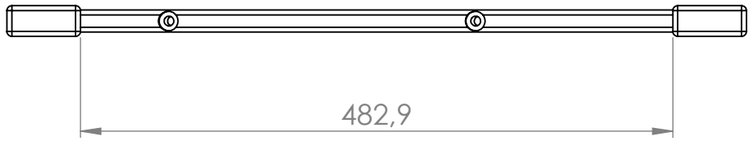


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: 0,2 LINEAR: ANGULAR:		FINISH: Natural varnish, Black stained			DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE: Leg module, right	
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL: Solid oak		DWG NO. 9	A3
				WEIGHT:		SCALE: 1:5	SHEET 1 OF 1

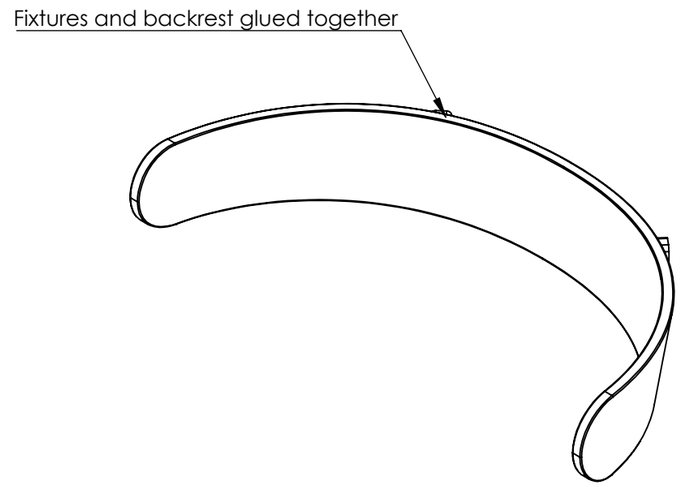


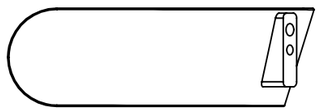


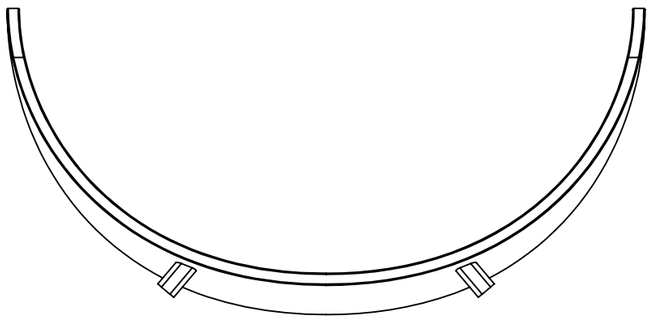




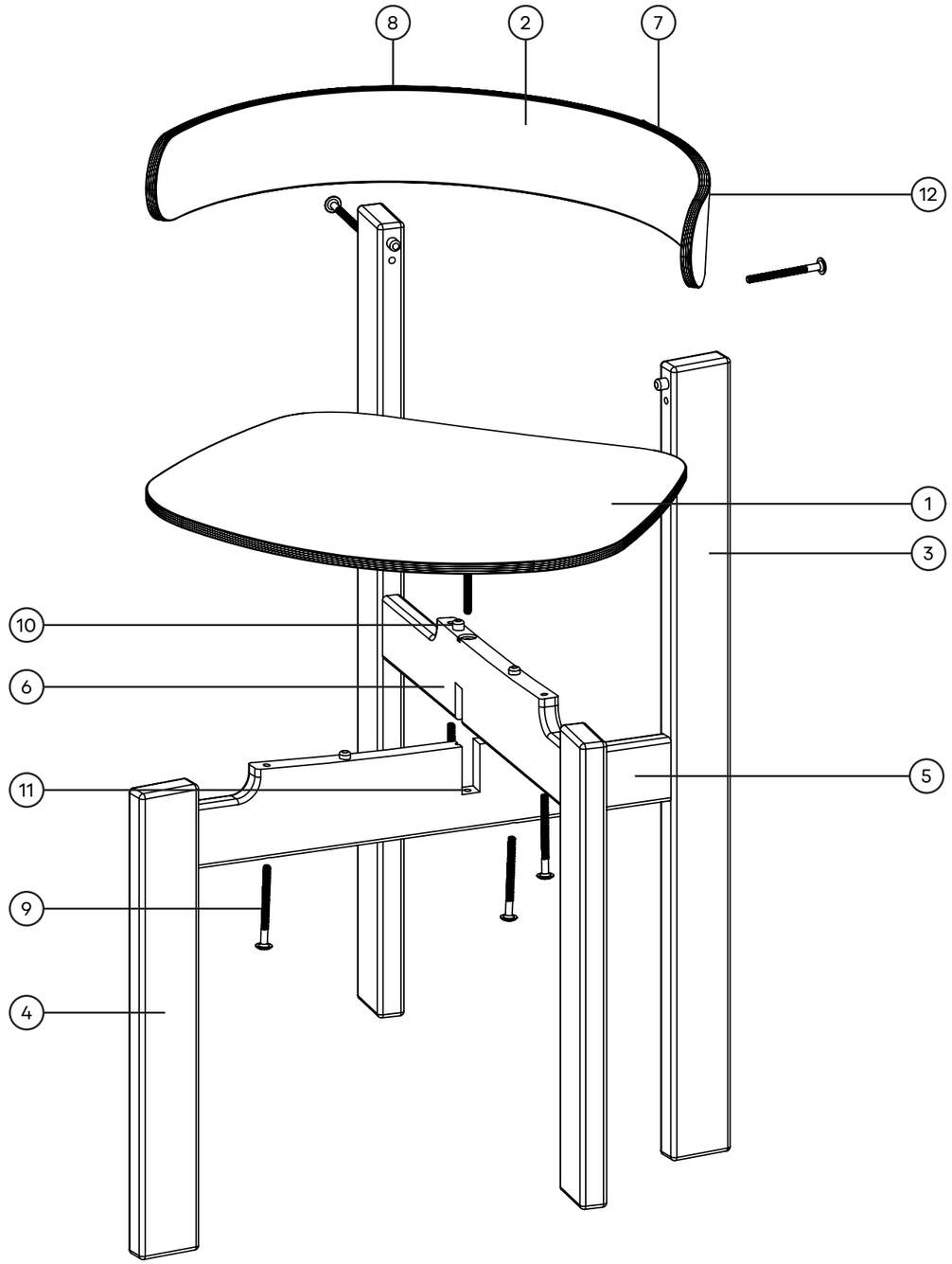
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: 0,2 LINEAR: ANGULAR:	FINISH: Natural varnish, Black stained					DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE				TITLE: Leg module, left	
DRAWN								
CHK'D								
APPV'D								
MFG								
Q.A				MATERIAL: Solid oak			DWG NO. 10	A3
				WEIGHT:			SCALE: 1:5	SHEET 1 OF 1







UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: 0.2 LINEAR: ANGULAR:		FINISH: Natural varnish, Black stained, Painted RAL 360 30 35, Painted RAL 130 80 10, Painted RAL 270 80 15		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE: Backrest assembly	
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL: Oak veneer, Solid oak		DWG NO. 11	A3
				WEIGHT:		SCALE:1:5	SHEET 1 OF 1



BOM

1	1 x Seat (bent veneer, CNC milled)
2	1 x Filippa backrest (bent veneer, CNC milled)
3	2 x Rear leg (solid oak, cut)
4	2 x Front legs (solid oak, cut and drilled)
5	1 x Left apron (solid oak, CNC milled)
6	1 x Right apron (solid oak, CNC milled)
7	1 x Left fixture (solid oak, cut and drilled)
8	1 x Right fixture (solid oak, cut and drilled)
9	7 x M6 furniture bolts
10	6 x Dowels, Ø10
11	3 x Threaded bushings, M6 x 17 mm
12	4 x Threaded bushings, M6 x 8 mm

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

FINISH:

DEBURR AND BREAK SHARP EDGES

DO NOT SCALE DRAWING

REVISION

	NAME	SIGNATURE	DATE
CHK'D			
APPV'D			
MFG			
Q.A			

MATERIAL:

WEIGHT:

TITLE: Exploded view

DWG NO. 12

A3

SCALE:1:10

SHEET 1 OF 1

AALBORG
UNIVERSITY