The use of textile waste in furniture design through sculptural art

LAB University of Applied Sciences, Institute of Design
Bachelor of Culture and Arts, Designer
Interior Architecture and Furniture Design

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Abstract

This thesis was a study on textile waste and its uses in furniture design.

Research has been done on the origin and lifecycle of textile waste, the significance of recycling, and the function of design in a circular economy. This work aimed to highlight the potential and aesthetic value of waste materials while also drawing attention to societal overconsumption habits. Furthermore, it offers an alternative to traditional furniture production. This thesis was done with a material-based approach, focusing on the design process itself. The result, which is presented at the end of this paper, is a modular seating arrangement designed with an artistic approach.

Key words

Textile waste
Recycling
Circular economy
Experimental material
Art installation

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Supervisor: Harri Kalliomäki

Tiivistelmä

Opinnäytetyö on tutkimus tekstiilijätteen käyttömahdollisuuksista kalustemuotoilussa. Opinnäytetyön tietoperustassa perehdytään tekstiilijätteen alkuperään ja elinkaareen, sekä kierrätykseen ja muotoilun rooliin kiertotaloudessa. Tavoitteena oli näyttää jätemateriaalien potentiaali ja esteettinen arvo, sekä kiinnittää huomiota yhteiskunnan kulutustottumuksiin. Työn tarkoituksena oli haastaa ajatuksia siitä minkälaisen lepokalusteen tulisi olla, ja samalla tuoda vaihtoehtoja perinteiselle kalusteteollisuudelle. Opinnäytetyön suunnitteluprosessissa edettiin materiaalilähtöisesti, ja painopiste oli itse prosessissa. Suunnittelutyön lopputuloksena syntyi taiteellisesta näkökulmasta valmistettu modulaarinen istuinkokonaisuus.

Avainsanat

Tekstiilijäte
Kierrätys
Kiertotalous
Kokeelliset materiaalit
Taide installaatio

LAB-ammattikorkeakoulu
Muotoiluinstituutti
Muotoilija (AMK)
Sisustusarkkitehtuuri ja kalustemuotoilu

Vilma Karppinen / kevät 2023
Opinnäytetyö
40 sivua
Ohjaava opettaja: Harri Kalliomäki

Disposition

Introduction

1.1 Subject and background

We are living in critical years as society is shifting towards a circular economy, and all industries are finding new ways to support this change.

The design industry is an important part of our circular economy, as more and more designers are becoming environmentally conscious and are finding new innovative ways to minimise their environmental footprint.
As upcoming designers, we must strive to work with recycled and waste materials, and that is exactly what was done in this thesis. The use of unconventional materials in design is fascinating to me, and thus decided to explore this further by using textile waste as my primary material.

The choice to use textile waste was made because it is rapidly generated as a surplus of mass clothing production, and therefore is easily accessible. This is also a current topic because the big amounts of textile waste produced are causing significant environmental issues worldwide.

1.2 Method

The information presented in this thesis was gathered through reading, observing, benchmarking, and testing. In addition to reading and writing, I worked primarily hands-on with the material, finding different techniques and ways of using the material, and creating multiple prototype versions.

1.3 Goals

This thesis is a material study and an art project.

Waste and recycled materials have great potential to be used in design and art projects. With my work, I wish to encourage others to do so.

The goal of this thesis was to dig deep into recycled materials, specifically textile waste. This was done by studying the properties and potential uses of the material. I saw an opportunity to challenge traditional thoughts of furniture design, which is what I aimed to do with an unconventional material such as textile waste. The aim was not to design the new best standard ergonomic piece of furniture but rather to look at furniture design from a different perspective, through an artistic lens. Material-wise, the goal was to use as many recycled materials as possible and showcase them in the final prototype.

The purpose of this paper is to present the research gathered during my work and show my design process up until the final result.

Research

2.1 Recycling

Our society has long been characterised by overconsumption and thus overproduction, resulting in significant environmental degradation. Our society is consuming and producing at an alarming rate, rapidly depleting our limited natural resources. Every year, 2.12 billion tonnes of waste is discarded, and 99% of this waste comes from items we throw away within six months of purchase *(The world counts)*.

We are living in a time of environmental crisis, which means that significant changes toward sustainable production and consumption patterns are needed to live by the Earth's limited capacity. Society is slowly shifting from a linear to a circular economy, which means reusing and recycling materials and products to maximise resources and create as little waste as possible *(Worell, Reuter, 4)*. The perception of recycling has changed greatly over the past 20 years. Earlier, it was considered a waste management issue, however, today recycling is driven by resource efficiency and environmental concerns. *(Worell, Reuter, 10.)*

Thanks to the EU's recycling legislation, waste recycling rates are slowly rising in the European Union, going from 27.3% in 2000 to 46% in 2022. However, large amounts of waste still end up in landfills or incineration. *(European Environment Agency 2022.)*

Shifting from a linear economy to a circular economy means being mindful of the Earth's limited resources, using materials for as long as possible, and creating long-lasting products *(European Parliament News 2023)*. It is crucial that we as the new generation of designers, continue to drive this change, as it is not only a step a towards a circular economy, but also an opportunity to further change the perception of waste.
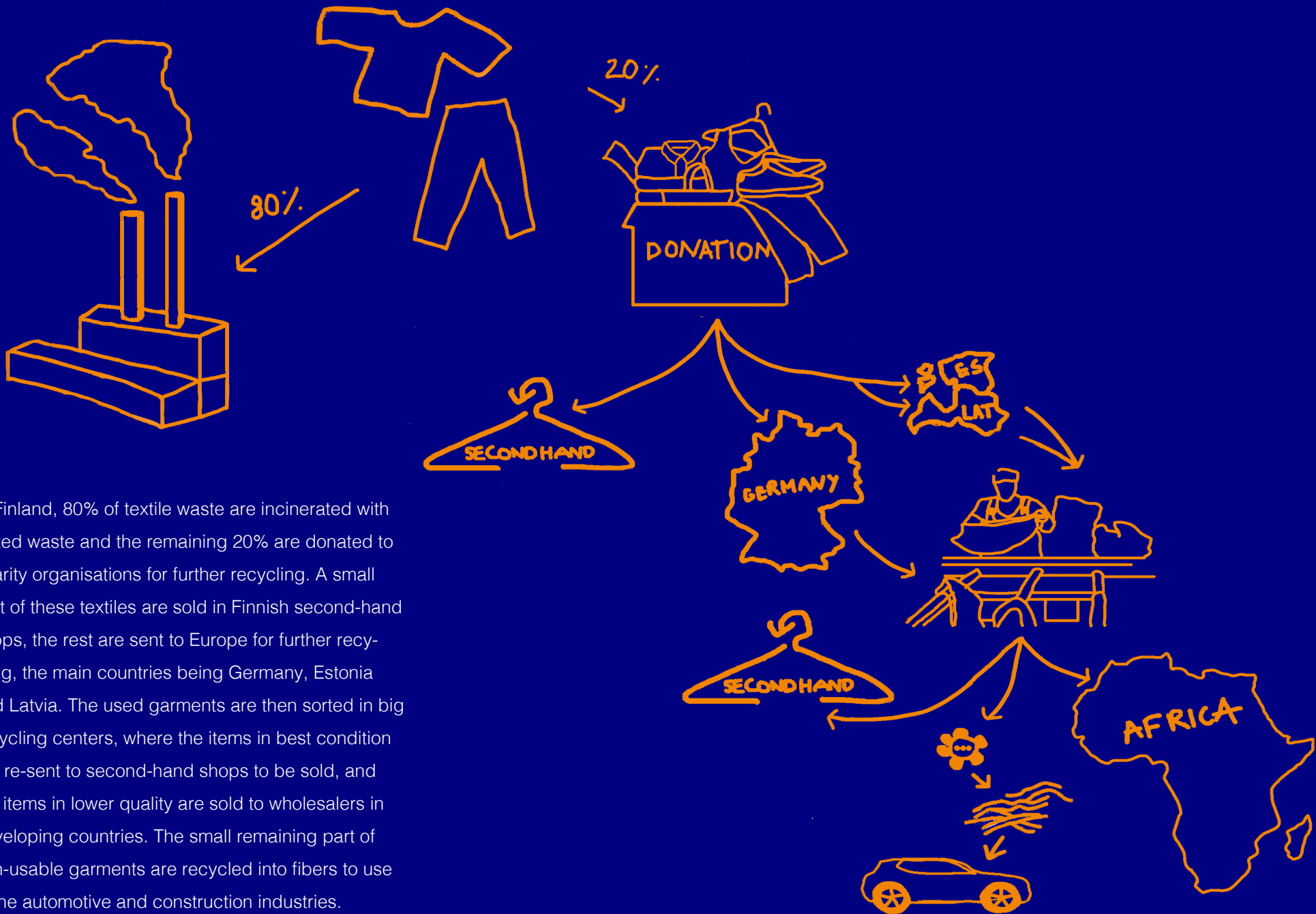
2.2 Textile waste

Textiles have been an important material and tool for human civilisation throughout history. They have been used to express our identity, wealth, and even power. In ancient times, textile was considered a rare and extremely valuable material that was traded worldwide. Unlike today, as textiles are being made into endless amounts of poor quality clothing.

The consumption of textiles has increased as society is guided by materialism and consumerism, which has lead to the growth of the fast fashion industry. The fast fashion industry is based on low manufacturing costs and cheap labour, relying on the buyer's frequent consumption. Frequent consumption often leads to frequent discarding of clothing, as the fast fashion industry is guided by passing trends. The increasing production of garments is associated with environmental impacts such as large amounts of water waste and water pollution; more than 2000 litres of water is needed to produce one T-shirt. Water pollution is caused by the dyes and microplastics stemming from textile production, being released in water streams. *(European Parliament 2020.)*

Adding to the environmental impacts mentioned earlier, the textile industry alone is responsible for 10% of greenhouse gas emissions *(European Parliament 2020).*

Every year, 92 million tonnes of textile waste is produced globally, of which only 1% is recycled, and the rest is incinerated or put in landfill *(Niinimäki et al. 2020).*
Textile waste goes through a long process before being discarded, and most people do not know where the textiles end up after dropping them off at the recycling station.

In Finland, 80% of textile waste are incinerated with mixed waste and the remaining 20% are donated to charity organisations for further recycling. A small part of these textiles are sold in Finnish second-hand shops, the rest are sent to Europe for further recycling, the main countries being Germany, Estonia and Latvia. The used garments are then sorted in big recycling centers, where the items in best condition are re-sent to second-hand shops to be sold, and the items in lower quality are sold to wholesalers in developing countries. The small remaining part of non-usable garments are recycled into fibers to use in the automotive and construction industries.

Figure 1. Visualisation of textile path from reycling stations to across the globe *(Adapted from Knus-Galan, Kurki 2020)*

Africa has become a global dumpsite, receiving everything from used clothing to electronic waste. According to customs export statistics, over 2 million kg of textiles had been shipped from Finland to African countries, such as Mozambique and Kenya in the last five years *(Knus-Galan, Kurki 2020)*. The imported textiles are then sold in street markets. However, most textiles sent from abroad are in extremely poor condition and are unsellable, ending up in landfills.

Unlike European countries, developing countries in Africa do not have the capacity to properly dispose of such high amounts of waste, resulting in waste being openly burned or dumped into waterways, posing significant environmental and health hazards (image 1 and 2). *(Kaledzi 2022.)*

Sending second-hand clothes to Africa is often coated as charity, but it has a negative impact on the country's own economy. Once vibrant textile industries are now dying and employment rates are reducing. For example, 20 years ago the textile industry in Kenya, employed half a million people, but today employs less than 20 000 people. *(theEEBchannel 2020.)*

Certain countries, such as Rwanda are fighting this and prioritizing their own economies by banning the import of used clothing from Europe.

Image 1. Dandora dumpsite in Nairobi *(Rogerson)*

Image 2. Textile waste flowing into water streams Dandora dumpsite *(Rogerson)*

The world has become aware of the environmental impacts caused by the increasing amount of textile waste, and measures have been put in place to reduce the amount of this waste. For example, the EU's strategy for sustainable and circular textiles by 2030, aims for a greener and more sustainable textile industry.

All textile items on the EU market are to be durable, repairable, and recyclable. This is to be achieved through new textile design requirements, such as making repair services widely available, as well as introducing a digital product passport. *(European Commission 2022.)* This means that QR codes are printed on each garment containing information about the product's lifecycle, information about the manufacturer, composition of the fabric, sourcing of materials, carbon footprint and maintenance of the garment *(Lewe 2022).*

Another measure in the strategy is to restrict textile waste exports to non-OECD countries, such as Kenya. (OECD: Organisation for Economic Co-operation and Development). Exporting waste to a non-OECD would only be possible by demonstrating the capacity for sustainable management.

The strategy also addresses the mislabelling of textile waste as second-hand goods by imposing new criteria, to distinguish between second-hand items and waste. *(European Commission 2022.)*

Following the EU's Waste Framework Directive, the collection of textile waste in the EU will be mandatory by 2025, meaning that all member countries are to establish separate textile collection *(European Commission 2022)*. Finland started the regional collection of textile waste two years earlier, in January 2023. Currently, Finland has one textile recycling center in Paimio that can process up to 8 million kilograms of textile waste annually, which is 10% of Finland's yearly textile waste. The center produces fibers from end-of-life textiles, which can then be used in insulation, acoustic panels, etc. (image 3). *(Lounais-Suomen jätehuolto 2021.)*

A new textile waste processing center is being built in Turku, Finland, and is expected to be operational by 2025. This new center would make Finland the first country in the world where post-consumer textiles can be recycled nationwide *(Lounais-Suomen jätehuolto 2022)*.

Image 3. Fiber made from recycled textiles at Paimio recycling center *(Lehti)*

2.3 Benchmarking

Image 4. Traditional rag rug *(Yle 2023)*

Textile is a diverse material that can and has been used in several different ways throughout history. Rag rugs are traditional Finnish carpets dating back to the 1880s. They are made from old textiles, which are then cut into strips and used as yarn. In the 1900s, rag rugs were used to keep cold air from coming through floor cracks, however, they were also symbols of wealth. *(Gunst 2019.)*

Textile waste has been used in its original shape for example, by Tejo Remy in the Rag chair (image 5), and Tobias Juretzek in the Remember me chair (image 8).

Image 5. Rag chair *(Droog)*

Image 7. T-Shirt loom *(Tompkins 2022)*

Image 8. Remember me chair *(Studio Nito)*

Image 6. RAGMATE cushion covers *(The Ruggist 2018)*

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Material study

3.1 Material acquiry

To start my project, I decided to only get a small amount of textile waste to get a feel for it and to get my ideas flowing. I acquired the textile waste from Kierrätyskeskus, which is the biggest second-hand shop in the Helsinki area. Quickly into the process, I realised that I would need to use a structural material such as wood, foam rubber, or steel in my design. I decided to use foam rubber which I acquired from foam mattresses off of Facebook marketplace.

For my second round of ideation and material testing, I acquired materials from the LAB University of Applied Sciences recycling laboratory. The recycling laboratory has a textile unit that recycles textile waste into fibers for new uses. I took leftover textile waste that could not be processed into fibers to use in my project. The plastic foam and ropes used in the ideation phase were also leftovers from the school.

3.2 Material testing

Textile is a familiar material; the clothing we wear, the bedding we sleep in, and the bags we carry are all made of textile fibers, so we all know how textiles behave as a material and what they feel like on our skin. When experimenting with the material, the goal was to keep an open mind and let the material guide me. I used glue, scissors, and textiles (image 9) and tried different things, such as cutting, rolling, gluing the strips of textiles together (image 10), folding, and tying them into small bundles.

There are infinite ways to design using textile waste. While playing with material, I decided to keep the fabrics in their original form, meaning no cutting or processing, as well as not using adhesive products, which makes future recycling easier.

Image 9. Material study

Image 10. Material study

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3.3 Fabric types

The most used fabrics in the textiles collected were synthetic fabrics such as nylon and polyester, and natural fibers, such as cotton. This was not surprising since polyester and cotton are the most commonly used fabrics in the textile industry.

Polyester is used in 52% of the world's fiber production. It is made from melted plastic that is formed into threads and worked into fabric. Synthetic fabrics are popular because they are easily accessible and affordable, they are an essential part of the throwaway culture in the fast fashion industry. Synthetic fabrics have a bad reputation and are widely known to be toxic to the environment because their production relies in part on fossil fuels. For instance, polyester is made from a chemical reaction and these chemicals are derived from fossil fuels. *(Wicker 2021.)*

Cotton is the most commonly used natural fiber in the textile industry, with a production of 25 million tons in 2020. Though being a natural fiber, cotton cultivation is a long and tedious process, requiring lots of land, large amounts of water, and pesticides to control insect attacks. The toxic chemicals used in pesticides are a major reason for environmental degradation as well as having negative impacts on public health. *(Banuri 1998,18.)* Despite the negative impacts of cotton farming, it is a big source of income and employment in developing countries such as Pakistan *(Banuri 1998, 9).*

The environmental impact of fibers depends not only on the type of fiber but also on the context of production (scale of production, location, energy use, waste management, etc.)
The best way for the average buyer to support environmentally friendly fabric production is by choosing recycled fabrics or organically produced fibers. For instance, organic cotton relies on natural processes for disease resistance and better soil quality, meaning that it is produced without chemical inputs, resulting in less water use and less chemical exposure. *(Banuri 1998,10.)*

Design process

4.1 Topic defining

While doing my research on textile waste and material tests, I was drawn to the materials bold and rough appearance. I defined the scope of my project and decided to design seating furniture. The choice to design seating furniture felt logical, and it was the way I could display the material in its natural state to the fullest. Designing seating furniture also felt achievable in the given timeframe. I continued my process with the ideation phase, which involved inspiration boards as well as sketching shapes and developing prototype versions.

4.2 Inspiration

When thinking about the textile industry and the waste produced, I think of developing countries in Asia and Africa, where the negative effects of the textile industry are the most visible. As mentioned earlier, 40% of imported textile waste in Africa, are low-grade textiles that cannot be sold further. This waste ends up in dumpsites, washed into the sea, or openly burned, posing significant environmental and health risks. *(BBC 2021.)*

Textiles are transported to developing countries, in tightly packed plastic bags zip-tied shut, which are then stacked on top of each other, for space efficiency (image 11).

The hundreds of bags, of all different colors, stacked on top of each other look chaotic and even overwhelming, but at the same time, I saw beauty and playfulness in it. My idea of modularity came about from these pictures.
My design process was guided by wanting to use the material as it is, the aim was not to beautify it, but to showcase it in its raw form. Waste is not to be seen as something ugly and something to close your eyes to, we should rather think of ways to reduce it and realise the endless design possibilities it brings.

Image 11. Stacked textile bags in warehouse (Rogerson)

The process continued by searching for inspiration images. I was drawn to images where textiles were used as colourful bundles, stacked on top of each other in different ways. (images 12 - 15). These images connect the playful feeling and the variety of colours portrayed in them.

After finding inspiration images, the process was continued by sketching. The sketches portrayed organic and playful shapes, that were all similarly defined by combinability, stackability, and modularity.
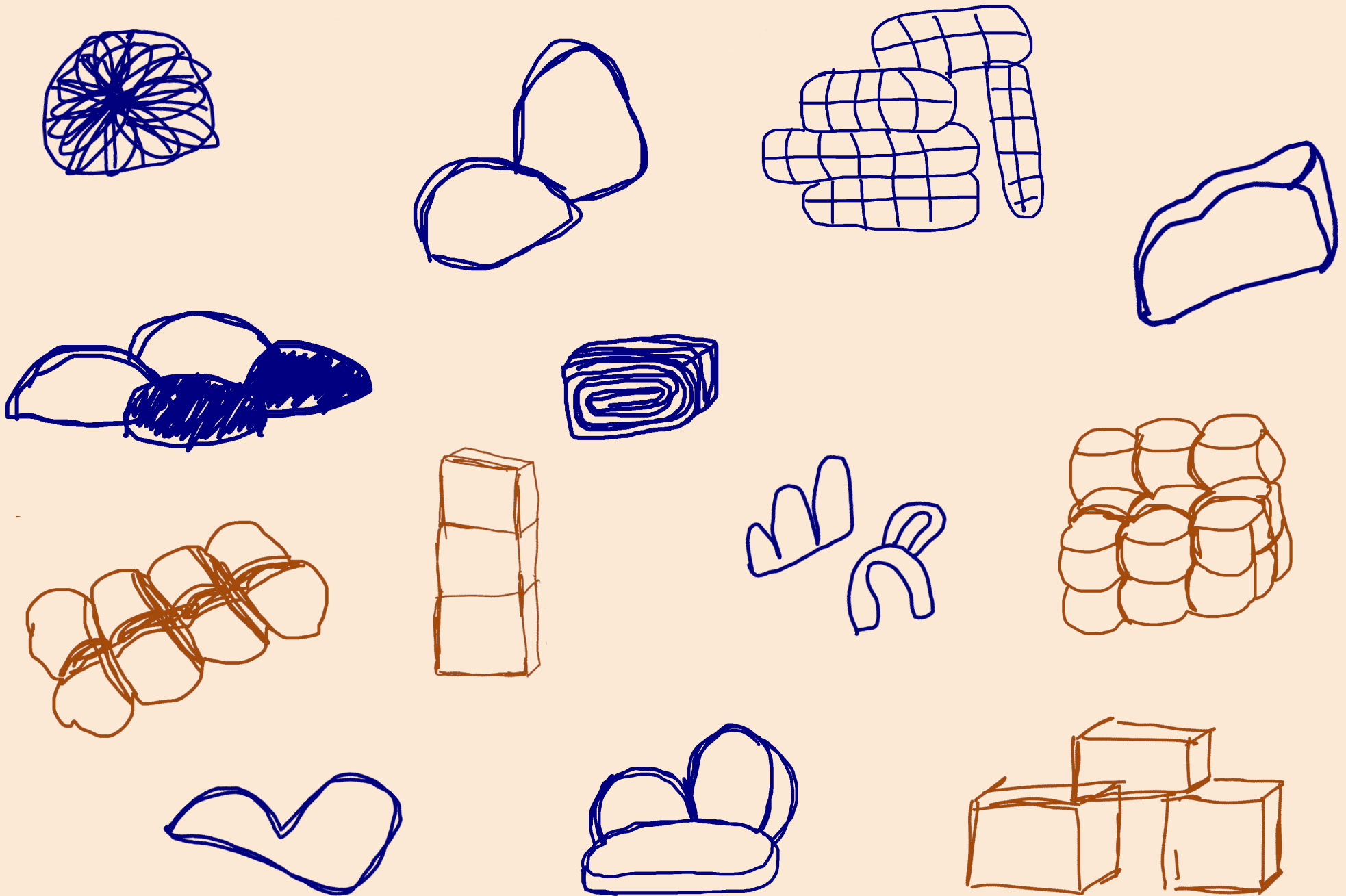
Image 12. Sheila Hick's Off Grid exhibition *(Bird 2022)*

Image 13. Textile bags at second-hand store

Image 14. Exhibition piece by Lotte de Haan *(2019)*

Image 15. Alain Delorme's "Totem" photo series *(Delorme 2010)*

4.3 Trial and error

I started creating textile waste bundles, by trying different techniques.
The core was made out of thin plastic foam strips with several layers of textile waste wrapped around it. It was a challenge to layer the textiles neatly, as both the fabric type and size of each item is different.

The first bundles made were not stable enough. I tried to solve this problem in several ways; by wrapping the bundles into a bigger article, such as a sheet or blanket. However, covering the textile waste looked dull and it contradicted my design goal of showcasing the textile waste material (image 16).

I tried making walls on the sides of the bundle, for structure. This was done by rolling and tying big articles of textiles together (images 17 and 18). Ropes and belts were also used in trying to secure the textiles to the core (image 19). Up to this point, only recycled materials had been used for this project, which was my first intention.

New materials were needed because the materials I had to secure the bundles were not working.
I looked for slings and different types of net materials. After struggling to find these products recycled, I decided to purchase the needed materials.

Image 16. Prototype testing

Image 17. Prototype testing

Image 18. Prototype testing

Image 19. Prototype testing

4.4 Building prototype

The final bundles were made by using different types of nets and filling them with 30% plastic foam and 70% textile waste (images 20 and 21).

After finding the right technique to make the bundles, I continued to explore different shapes, colours, and combinations. I decided to make 3-4 textile bundles that when put together would make an interesting seating arrangement. Originally my aim was to create 3 identical pieces, however, the idea of different shapes was appealing and I liked the visual aspect they brought to the ensemble (image 22). Once creating the final bundles, the rest of the process consisted of finding different, functional yet visually interesting combinations (image 23).

Image 20. Net material

Image 20. Prototype piece

Image 22. Prototype pieces

Image 23. Prototype pieces

Final design

Image 24. Final prototype *(Kallio 2023)*

Image 25. Final prototype *(Kallio 2023)*

Image 26. Final prototype *(Kallio 2023)*

5.2 Material

Textile waste (around 7kg used)
Plastic foam
Net material from horse feeding nets, women's tights.

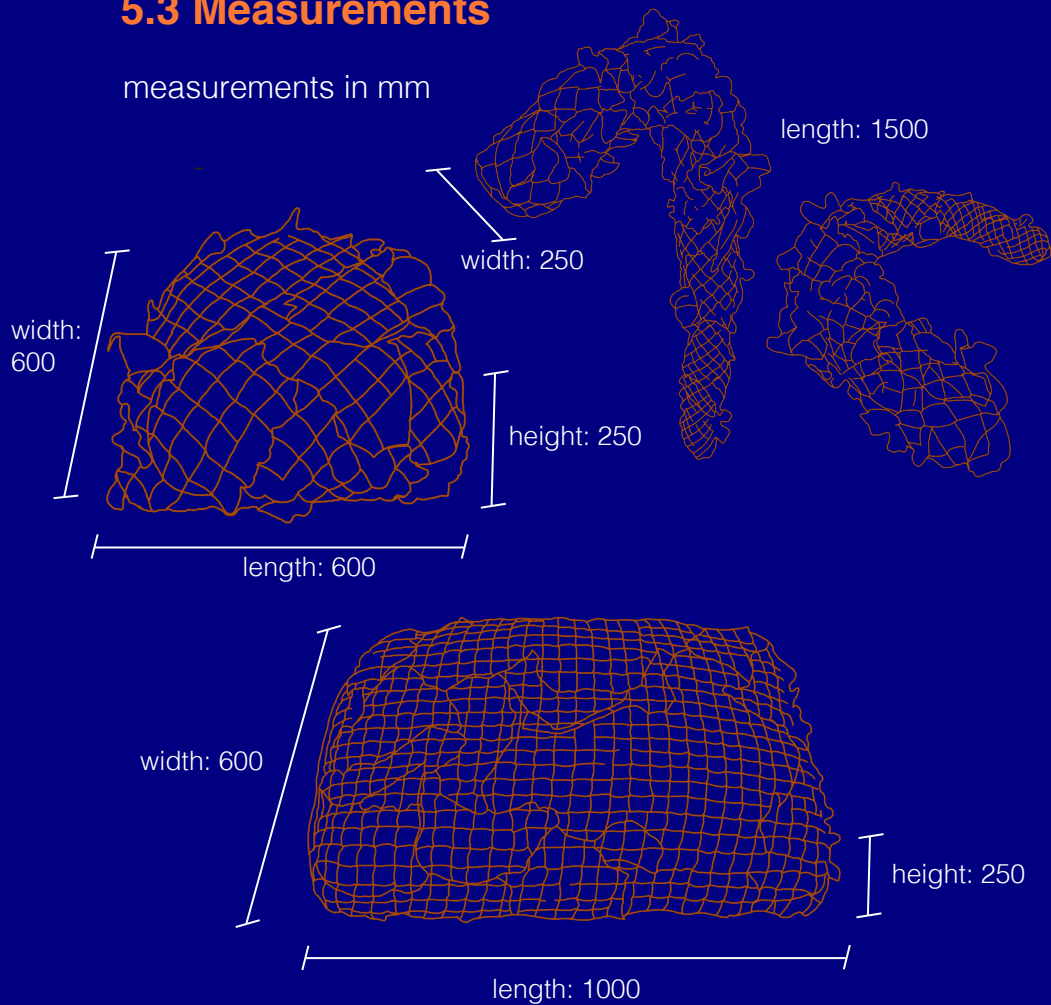## 5.3 Measurements

measurements in mm

length: 1500

width: 250

width: 600

height: 250

length: 600

width: 600

height: 250

length: 1000

Image 27. Prototype material *(Kallio 2023)*

5.4 Modularity

Modularity was a big part of this project. The final proto-type is easily modifiable since the bundles are not per-manently attached to each other. The final design allows the user to move the bundles as they wish; the combina-tions are endless. The biggest bundles contain several kg of textile waste and therefore are a little heavy but still manageable by one person.

The bundles can be made into a small seating ensemble by using 3-4 of them. On the other hand, by using many bundles; they can be made into a spatial concept (as seen in image 28).

Image 28. Visualisation of spatial exhibition

5.5 Further development

This project is only a glimpse of what could potentially be done with more time and resources.

There are many different techniques to make the bundles, and lots of possibilities material, shape, and colour wise, that due to the time frame, were not tested during this process. However, these should be explored in the future.

The approach taken in this thesis can be applied to conventional furniture design thinking to create a whole product line out of textile waste. Alternatively, it could be continued with an artistic mindset, creating a beautiful spatial exhibition using textile waste, raising awareness to waste and overconsumption.

Image 29. *(Kallio 2023)*

Evaluation

The aim of this thesis was to study textile waste as a material and its potential in furniture design while also challenging conventional thoughts about furniture design. I researched the subject of recycling, the origin of textile waste, and its material properties. This thesis addressed the possibilites of using a material, such as textile waste in design and presented a sculptural seating arrangement. The process was mostly material driven, with a significant amount of time spent on making the prototype. I document this process closely and could have written more about it, but I decided to keep it brief for ease of readability. This project is a mix of art and furniture design and I recognise that the user experience aspect of this project could have been thought about more.

Because this project was something new, and I had never worked with textiles in this way before, the beginning of this process was challenging and a little daunting. Nonetheless, it got easier when I began working with the physical material and started creating the prototype.

As stated in the further development chapter, I believe that this project has development potential, and I wish to return to this project in the future. My future goal is to make it on a larger scale while focusing on the user experience.

Overall, this thesis has allowed me to take a step back from overly logical design thinking, giving growing space for my personal design expression.
I challenged myself to use an uncoventional material and succeeded in creating a usable and visually interesting prototype.

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Figure source

Figure 1. Adapted from Knus-Galan, M. Kurki, R. 2020. Keräyslaatikosta kansainväliseksi kauppatavaraksi – Minne vanha vaatteesi päätyy?. YLE. Retrieved 20.01.2023. Available at https://yle.fi/aihe/artikkeli/2020/02/17/mot-laittoi-lahettimia-kierratysvaatteisiin-nain-lahjoittamasi-vaatteet

Image 30. *(Kallio 2023)*

THANK YOU