THESIS PROJECT **2020**

MADE FOR MALAI

STUDENT: **SMRUTI MULCHANDANI**

PROJECT: Impact edge

SPONSOR: Made from Malai

PROGRAM: Undergraduate Professional Programme

AWARD: Industrial Arts and Design Practices

GUIDES: Dharun Rao, Jacob Matthew and Tulip Sinha

SRISHTI

Institute of Art, Design and Technology

Acknowledgements

It has been a long, winding road to completion with this project, and I could not have done it on my own. I would like to thank my faculty, Jacob - for the resources and reality checks, and all the relevant lectures to make this project as professional as I could make it, Dharun - for the feedback and encouragement, and Tulip - with her valuable constructive criticism at every stage of the project, resources, and the push of motivation (sometimes loving, sometimes frustrated) when it didn't look like this project would ever end.

I am also very grateful for the help of Susmith and Zuzaana, the founders of malai, for being patient and always ready to answer my questions, entertain my discussions, and even help with ideas.

A big thank you also goes out to the workshop assistants at N6, especially Sabastin, for their guidance in the workshop and for coming in on days they wouldn't normally, and for cheering me up and on when I needed it. And to Kumar, Ritu, Jayasimha and Ajay for their time to discuss my ideas and add perspective to the situation.

Finally, I'd like to thank my friend and peer, Suvansh Bohra. Through the course of this project, he has taught me all I wanted to know about machines and motors, checked up on my progress and never left me hanging when I needed advice or help, and I couldn't be more grateful.

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Industree Foundation

"Industree Foundation holistically tackles the root causes of poverty by creating an ownership based, organised creative manufacturing ecosystem for micro-entrepreneurs."[1]

Industree Foundation's comprehensive approach helps communities assess their traditional skill base, organise them into production units, develop products that appeal to modern markets, and create consistent demand to create sustainable businesses at the lowest possible costs. Our approach has tripled the incomes of artisans in non-farm occupations by leveraging their artisanal skills and integrating them into the creative industries sector.

Impact edge

Impact edge is a joint initiative between the Industree foundation and the students of Srishti, Institute of Art, Design and Technology, that seeks to educate, incubate and accelerate impact entrepreneurs in their endeavors to solve some of the world's most complex problems. [2] This particular project under Impact Edge tries to understand an eco-friendly alternative to leather, made by Malai Biomaterials, that is made from bacterial cellulose of coconut water and other fibres, and to help them expand and make their material more accessible/desirable to the consumer base of leather artifacts.

malai

Made from Malai

"Our start-up company specialises in creating and developing bio-based materials." [3]

Malai is a material developed by Sushmit and Zuzana (Designers) that is made with natural fibres and pure bacterial cellulose, which has a production process similar to paper but is a lot more durable, and looks a lot like leather, but is manufactured sustainably.

They are currently manufacturing a material they call malai, in small numbers (30 a batch) in their warehouse factory in Cherthala, Kerala. This material is a sheet of fibres held together by cellulose from bacteria, and looks a lot like leather. They sell this material to small business owners who make products from them that you would otherwise make with leather, and sell it to consumers who subscribe to the idea of Vegan leather.

The process involves washing, pulping and mixing together of the fibres and the bacterial cellulose, dyeing the mixture and pressing it into sheets. These sheets are sold, after coating and massaging (for finish, water proofing and texturing), in custom GSMs and natural colours.

Right now, their company Malai Biomaterials is situated in a small warehouse in Cherthala, Kerala, and they are selling the sheets mainly to designers and small companies that experiment with the material and sell products.

Zuzaana and Susmith

Malai


malai
STUDIO
malai
STUDIO

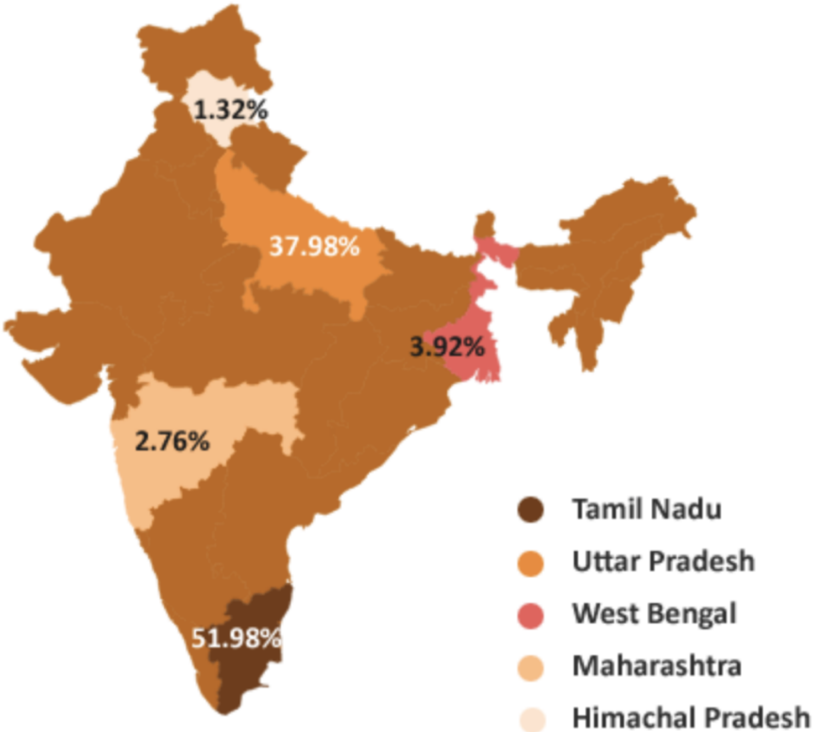
Research

Genuine leather industry

India

1000kg raw material
50,000 kg water[5]

200kg leather output



Distribution

https://www.exportgenius.in/blog/leather-export-from-india-in-2017-list-of-leather-suppliers-in-india-211.php

2nd largest producer of leather footwear[4]

2nd largest exporter of Leather Garments[4]

3rd largest producer of saddlery and harness[4]

The making of Genuine leather

slaughter + retrival of skin

The skin is removed from the animal, the flesh is removed from the skin before it dries out, so it can dry out properly, and you are left with a white, clean surface. [6]

removal of flesh from skin

dry the skin

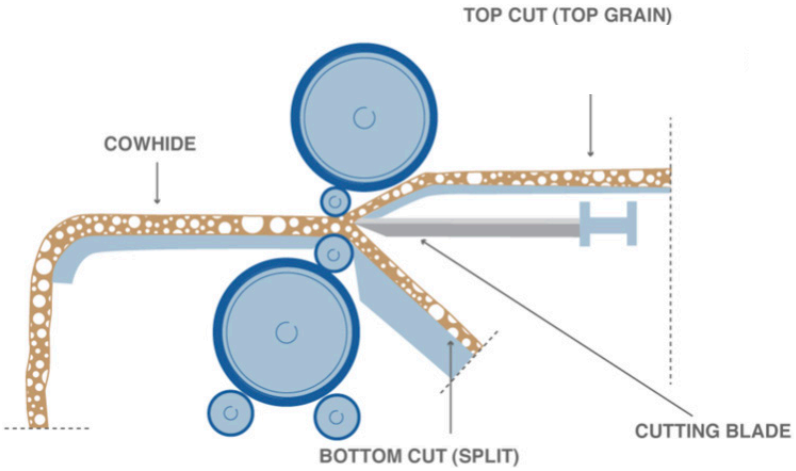
salted to halt decomposition

The hide is salted or placed in a salt brine, to stop the decomposition process, then either stored with flesh sides together or soaked in water to remove any other materials.

lime bath

A lime bath (calcium oxide) removes the hair and softens the leather.

splicing



Now the leather has moisture and is about 4mm thick, it can be spliced and the two layers of leather are processed. Outer layer has better structural integrity and hence is of a higher value.

tanning

The leather is then tanned to halt the decomposition process. It is placed in a drum with a tanning liquid (special mix of either vegetable tanning agents or a chromium salt mix) [7]

Some tanning is done manually.

Problems with Genuine leather

Perhaps the biggest problem with genuine leather is animal cruelty.

- Most leather comes from cow hides from India and china.
- A PETA investigation [8] found that workers routinely break cows' tails and rub chili peppers and tobacco into their eyes in order to force them to get up and keep walking after they collapse from exhaustion on the way to the slaughterhouse.
- Shortly after birth, workers drag calves away from their mothers before throwing them onto the ground to punch holes in their ears.
- Workers were also caught on camera electroshocking cows and hitting and jabbing them with metal-tipped sticks. [10]
- Even unborn calves—whose skin is considered a "luxury" material—are mutilated for leather. Some are purposely aborted, while others are cut out of the bodies of slaughtered pregnant cows.
- Animal skin is turned into finished leather by the application of a variety of dangerous substances, including mineral salts, formaldehyde, coal-tar derivatives, and various oils, dyes, and finishes—some of them cyanide-based.
- Leather Is bad for the environment. Methane and carbon emissions, energy and water use, rainforest destruction, fossil fuels — the production of leather is also extremely detrimental. "A chrome-tanning facility wastes nearly 15,000 gallons of water and produces up to 2,200 pounds of 'solid waste' (e.g., hair, flesh, and trimmings) for every ton of hides that it processes (Source - PETA) [9]
- You're left wearing the remnants of cyanide, formaldehyde, and all those other not-great chemicals, which may be why we see people who work in and around leather production getting cancer at such high rates.
- Sadly, this risk also extends to people who live near leather production. The Centers for Disease Control and Prevention found that the incidence of leukemia among residents near a tannery in Kentucky was five times higher than the U.S. average.
- Arsenic, a common tannery chemical, has long been associated with lung cancer when people are exposed to it on a regular basis.
- Studies of leather-tannery workers in Sweden and Italy had cancer risks "between 20% and 50% above [those] expected.

Instances of animal cruelty

- According to Florida's regulations, it is legal to put as many as 350 6-foot alligators into a space the size of a typical family home.
- Alligators on farms may be beaten to death with mallets and axes, sometimes remaining conscious and in agony for hours after they're skinned.
- Snakes are often nailed to trees and skinned from one end to the other. In many cases, they're still alive as they're skinned.
- The skins of unborn calves and lambs—some purposely aborted, others from slaughtered pregnant cows and ewes—are considered a "luxury."

Genuine leather

Why?

Mouldability

Durability

Tensile strength

Water resistance

Due to the high price and properties, the perceived value of leather is fairly high, and often serves more as a status symbol than anything else

Why Not?

Animal cruelty

Tanning process involves carcinogens

These carcenogens are in the waste from the process, along with huge amounts of other animal material

Leather, once treated, is not biodegradable

Cattle rearing and production of leather is unsustainable

The industry involves child labour, and unfit working conditions with continuous exposure to toxic chemicals

Alternatives.

Vegan Leather - Rexine

Involves toxic chemicals (plastics) that leach out when exposed to heat

Organic vegan leather

A lot of small scale experimentation is being done on using natural fibres and/ or organic fermentation processes to create leather like materials.
These materials do not feel like leather enough, and are not very durable or water resistant.

Genuine leather industry

Market Research

- The Leather industry in India holds a significant place in the Indian economy.
- The Leather industry in India is consistent in its high export earnings and is among the top 10 foreign exchange earners for India.
- The Leather industry in India stands at $17.85 Bn (Exports – $5.85 Bn, Domestic Market – $12 Bn). The exports from April-Jan 2018-19 are recorded as $4750.62 Mn. [4]
- Export of different categories of Footwear (leather & non-leather and components) holds a major share of about 50.34% [4].
- The Leather industry in India is an employment-focused industry, providing jobs to about 4.42 Mn people.
- India is the 2nd largest producer of footwear, 2nd largest exporter of Leather Garments, the 5th largest exporter of Leather Goods and 3rd Largest Exporter of Saddlery and Harness items. [4]

Brand Research

COACH

- Started as a mens brand, started making tote bags in 1940, continued to make women's products
- Primarily calf leather for bags and other products
- Goat leather for quilted bags (lighter, better texture, more costly)
- Glove tan - a tanning to make leather more supple
- Used for baseball gloves originally (NY)
- Comes from the culture of hand me down gloves
- Scratch resistant, but very durable structurally
- Texture gets better with use, lasts well over 15 years
- Buffalo leather forms a patina and veins with time, gets darker.
- Canvas/coated canvas (non-leather alternatives)
- Natural finish - pebble finish
- Leather is beaten to make it smooth, and then embossed with other textures (cross grain-scratch resistant, different sized pebble, crocodile print)

Charlie Carryall

A coach handbag

A coach duffel bag

A ladies wallet

Coach handbags and Totes with the signatrure coach tag

Each product has:

- Is part of a silhouette
- Logo and name - metal
- A turn lock
- A story patch inside
- A tag (distinct shape)
- Monograming names on the tag

H&S - custom leather arts
(primarily exports)

- Manufacturing, tanning in Ranipet, Chennai
- More economical range
- Mosty calf leather
- Cow leather - less soft
- Sheep leather, warmer, softer (used in women's gloves)
- Buffalo leather - stronger, less soft
- 2k wallets - 25k laptops and backpacks
- Custom made shoes, CAD based manufacturing for personalized shapes and sizes, based on your feet
- Part of the KH group, biggest leather manufacturer in Chennai
- All hand woven bags, they have their own craft people
- Manufacturers for Muhib, NMZ, Farida group
- Ambur - manufacturing unit

- Made in NY, regardless of manufacture location (because the design comes from NY team)
- Manufacturing in Vietnam, China, India

H&S handbag

H&S gloves (goat leather)

Most luxury brands

- have silhouettes (bag with the same silhouette, different colours, materials, patterns, other small tweaks)
- Coach - Parker bag, idi style
- Price range : 25k-75k (35-50 is the common range)
- No fully PVC products
- Slow fashion, products last very long, range changes slowly
- Status symbol
- Gucci has gone fur free, will soon go vegan (with PVC)
- Flagship vs Outlet
- Same quality
- Different silhouettes
- Fewer zips
- Difference in after sales services

Customers

- 35 - 40% people walking in are regular customers and will buy something (most people go pick it up from the US, lower price)
- Doctors
- Politicians
- Few bollywood celebrities
- Regular corporate people
- 34+ year old women, or people buying gifts

LALU DAS

- Use mostly Ox leather, cow leather, sheep leather, some ostrich leather to order.
- Makes custom shoes, has a leather workshop
- Does patina with dyes
- Charges 3.5-4.8k per pair of shoes, makes a prototype with a mock material, has a trial, and hands over original shoes within a month
- Wants to expand business, branding, bigger store

WOODLAND

The outer sole and heel is made of crepe rubber (natural raw rubber) and the upper body is made of vegetable tanned leather, which has also been utilized in the lining of the shoe. Cellulose has been used to make the insole, toe puffs and the counters.

HUSH PUPPIES

They claim to use animal hide that is the by product of animal rearing for meat, as opposed to slaughtering animals just for their skin, and discarding the rest.

Brand comparison - Price range

	M.S. Leather	HIDESIGN	WOODLAND	COACH NEW YORK
BRAND VALUE	Low range accessories Promising quality and durability	Ahimsa leather Natural/vegetable dyes Contemporary designs /prints	Status and Brand Symbol International Recognition Charity to animal welfare
PRESENTATION	Less walking space Less storage space Unplanned product placement No proper lighting	Planned use of space (600 sqft of floor space has 350 products on display) Fast moving products: placed in the front, on the sides. Slow moving products: placed at the back. New collection: placed in the center. Sale products: distributed Objects placed as informative pieces Lighting similar across the store Well designed ad campaigns	Focus Attention to products "Gallery" like browsing experience Cozy Aesthetics, Mood lights, spacious layout Minimalistic and creative window display
CUSTOMER RELATION	Customer loyalty Custom made products Informal customer relationship	After Sales Services Products under warranty – free service Loyal customers – free minor repair services, free polishing Giveaways for promotion	Care and warranty Personalising products Staff Presentation Loyalty Programs
PRODUCT RANGE	Wallets, Belts Shoes, Bags / Handbags Jackets	Handbags, Sunglasses, Backpacks, Keychains Wallets/purses, Belt, Messenger bags Travel – duffel, trolley	Small Leather Accessories Additions to classic silhouettes
INSIGHTS	Store location determines revenue Jackets and bags sell more Fast fashion brand	Store location determines revenue Well designed ad campaigns lead to wider audience Surface embellishment used as a tool to convey the collection Woman's products sell more.	These accessories are sold as a one time investment and meant to be used in a long run. Language of accessories are 'timeless' designs.

Market research from in depth conversations
Category - leather shoes at different price points

	Lalu das Custom leather shoes	Hush puppies Leather shoes	H&S Custom leather shoes
Price range	₹3,000 - ₹4,500 (negotiable)	₹799 - ₹9999 (fixed)	₹12,000 - ₹20,000 (fixed)
Product range	All ages, styles (bring reference picture, pick from reference pictures)	Adult men and women shoe sizes, mostly formal shoes.	All ages, fixed styles, adjustments for foot conditions or abnormal sizes.
Particular store location	Quiet street in Brigade road.	Second lane in MG road.	Second floor, UB city mall.
Area of store	2x2m (excluding workshop space)	5x7m	8x8m
Other stores	None	Across India, 120 other countries.	Across India
Most selling product	Formal shoes	Formal mens' shoes	Formal shoes
Kinds of leather	Primarily cow, calf, ox, crocodile and ostrich	Cow and crocodile	Cow, calf, pig and goat
Leather source	Supplier in Tamil Nadu	Internationally sourced, sources confidential	Ambur, Tamil Nadu

	Lalu das Custom leather shoes	Hush puppies Leather shoes	H&S Custom leather shoes
Observing customers	Alone to discuss a particuler design, with husband to discuss shoes with special dimensions. They all sit outside the small space on stools.	Two men, well dressed, walking around the small showroom and looking at shoes, quietly.	Inquizzitive family walked in, inquired about the product/service and walked back out again.
Stance on animal cruelty	If a customer asks for vegan leather, they source it. They give people what they want, they “are a business.”	All skin used is a by product of the mean industry, no slaughterhouses of their own.	“Leather is a luxury and a status symbol that people will not give up.” They donate big amounts to environmental causes, and believe the monetary compensation is enough.
Are the products hand crafted?	Yes, by the owner and his son.	No, there are designs, blueprints and an assembly line.	Yes, by the village folk in Ambur. There is a group of women who do the weaving and stitching
Do customers ask for vegan alternatives?	Yes, and they source it easily, locally.	Yes, but they are a leather brand and kindly say no.	Rarely, because leather is a status symbol, people walk in to buy leather, specifically.

Alternatives to Genuine leather

Rexine

As we saw in the previous pages, leather may not be the smartest choice of material for upholdtery or clothing, but the consumer base of leather is fairly loyal. Rexine is one of the kinds of artificial leathers available in the market, the registered trademark of an artificial leather leathercloth fabric produced in the United Kingdom by Rexine Ltd of Hyde, near Manchester, England.[11] It was made of cloth surfaced with a mixture of cellulose nitrate (a low explosive also used as the propellant in firearms rounds), camphor oil, pigment and alcohol, embossed to look like leather. It eliminates the points of concern with leather - like animal cruelty and risk of working with carcinogens. Often called Faux leather, leatherette, PU leather, the material looks remarkably like genuine leather, and is sometimes sold as genuine leather too.

It is primarily made from a base layer of some kind of fabric, which is coated in either PVC (poly vinyl chloride) or PU (polyeurathine). [12]

Rexine

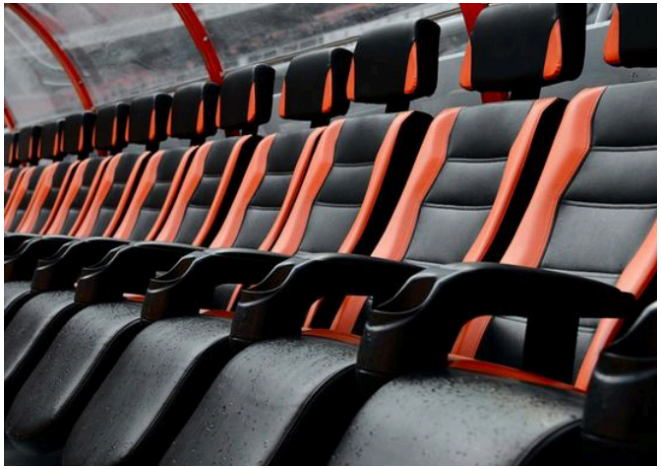
Rexine products

Brands' overview

Rexine

Naugahyde

"In 1914, an exciting new product was developed at the U.S. Rubber Company plant in Naugatuck, Connecticut. Since it looked like a hyde and was made in Naugatuck, these two words were linked and Naugahyde was born."[13]
One of the first rubber based artificial leathers to be manufactured.



Alter Nappa

This breakthrough material is made from polyester and polyurethane and has a recycled polyester backing. This reduces the amount of petroleum we use in our products. And the alter-nappa coating is made with over 50% vegetable oil, a renewable, natural resource. As well as being less energy and water intensive, they are made without solvents and therefore much safer for people to work with. This leather is developed and used by star designer Stella McCartney. [14]

Problems with Rexine

- The production of the PVC used in the production of many artificial leathers requires a plasticizer called a phthalate to make it flexible and soft.
- PVC requires petroleum and large amounts of energy thus making it reliant on fossil fuels. [15]
- During the production process carcino genic byproducts, dioxins, are produced which are toxic to humans and animals. Dioxins remain in the environment long after PVC is manufactured. [16]
- The polyurathene used is a toxic substance, that has claims against it for leaching out of the leather when it comes in contact with direct heat, but nothing has been proven yet.

In conclusion, rexine is a safer, more responsible alternative to genuine leather, but has problems of its own, along with not being a durable enough of comfortable enough material, like leather. Let us look at other alternative leather options.

Alternatives to Genuine leather

Organic Vegan leather

The problems with genuine leather and rexine have left a consumer base that enjoys the look and feel of leather but cannot use it without hurting their moral compass, and this has opened the market for big and small busniesses to start experimenting, to some success, with more environment/animal friendly raw materials. Across the globe now are several materials that look and feel like leather to a great extent, and are picking up pace and popularity quickly, but are still in the development phase. The following are some examples:

Piñatex

"Piñatex® is one of those rare products of design thinking that hits all the sustainability buttons at once: it is a material that is completely cradle to cradle, it substitutes leather that has a very heavy environmental and welfare impact, and it brings new income streams to subsistence farmers, allowing them to fully utilise their crops. The implementation of Piñatex® will have far-reaching societal and environmental benefits."[17]
-CLARE BRASS, DIRECTOR, DEPARTMENT 22

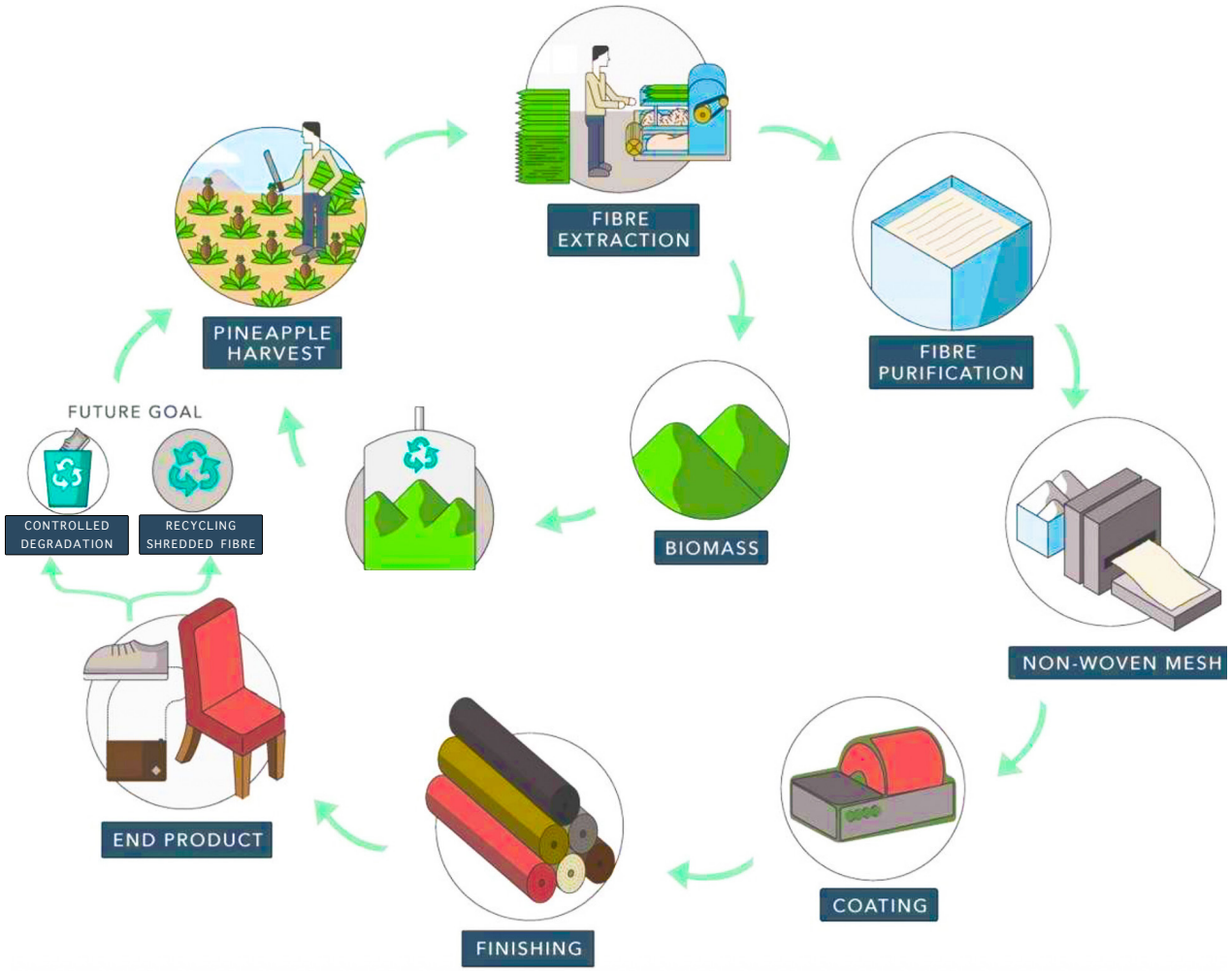
The journey of Piñatex® began while Carmen, a leathergoods expert, was consulting on the Philippines leather export industry in the 1990's. Shocked at the environmental impact of mass leather production and chemical tanning she realised this could not continue, but knew that PVC alternatives were not the solution. She was driven to research a sustainable alternative.[18]

The material uses pinapple leaf fibre, which is agricutural waste being discarded all over the world. Using a sustainable material that would otherwise be discaded removes a load from the environment the pressure that comes from the preceding alternatives.

How its made

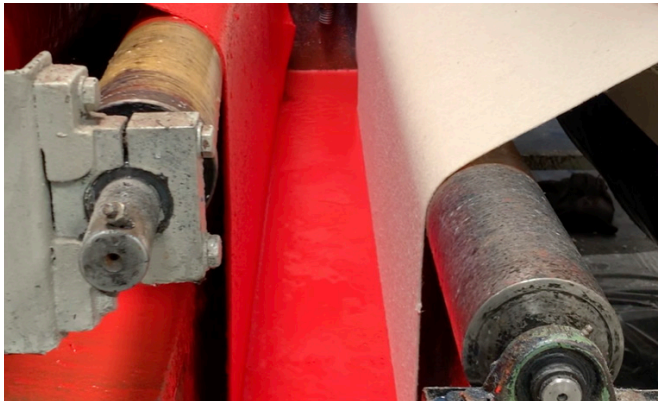
"This fluff-like pineapple leaf fibre (PALF) gets mixed with a corn based polylactic acid (PLA) and undergoes a mechanical process to create Piñafelt, a non-woven mesh which forms the base of all Piñatex collections. The rolls of Piñafelt are then shipped by boat from the Philippines to Spain or Italy for specialised finishing."[19]

Pinatex manufacturing process



Pinapple harvesting

Extracting fibre



Non woven mesh formation

Colours available and outfits made from the material.

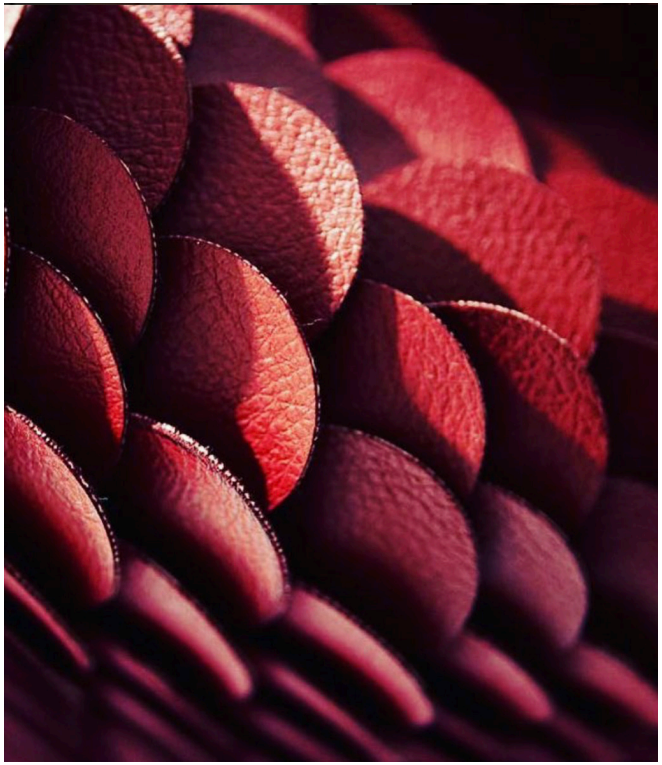
Dr. Carmen Hijosa, Founder and Chief Creative & Innovation Officer for Ananas Anam Ltd. (Pinatex)

Frumat

Frumat's Apple Skin is a bio-based leather alternative derived from the apple industry food waste. Born in the Tyrol region in the north of Italy, a region renown for the production of apples and which every year is faced with a significant amount of waste, Frumat developed a new raw material to answer both the local apple-waste issue and the increasing demand for ecological alternatives to leather. The result is a cellulose-based material featuring a variety of textures, thicknesses and embossing and laser prints, allowing for it to be used across industry and that can easily It can be produced on demand and easily personalised.

By using apple skins and cores sourced locally, Frumat offers a versatile, high performing alternative to both leather and paper with a low environmental impact. The company is now one of the most dynamic realities in the field of agricultural and food waste recycling.

Frumat makes two kinds of leather alternatives, a soft version that is being used as textile in the clothing and furnishing industry, and the PU version (with 50% apple fibre and 50% Polyurathene) is sturdier and used for luggage and other hardier applications.[20]



Other alternatives

Vegea

The company makes an organic alternative to leather using the by products of wine production, like grape skins, seets, stalks, [21]

Mulbtex

Mulberry based leather. [22]

Mirum

Mirum is a high-performance plant-based material. With 100% natural inputs and zero use of plastic, the possibilities are limitless. Raw materials include waste cork, hemp, coconut, and non toxic natural pigments. [23]

Nuvi Releaf

Simply elegant, monochrome material with a smooth feel and a light surface texture made from upcycled tobacco scrap. Designed to meet the demands of leather manufacturing. [24]

Mylo leather

Mylo is created by combining mycelium cells with a substrate of corn stalks and nutrients. Over 10 days the cells grow into the substrate, creating an interconnected mass that can be made into almost any size. The result is a material that looks and feels remarkably like animal leather. [25]

Zvnder

Another fungus based leather that is lab grown. [26]

Kombucha Leather

leather like substrate of a "symbiotic colony of bacteria and yeast" or SCOBY that is dried and then finished. [27]

Modern Meadow

says it can "biofabricate" leather without the rest of the cow. It does not quite grow cow skin, either; it grows a strain of yeast engineered to produce collagen, the protein in skin that gives leather its strength and stretch. Traditionally, making leather amounts to removing almost everything from skin (fat, hair, etc.) that isn't collagen. [28]

Drawbacks of organic vegan leather

- Most alternatives are not as durable as leather
- Lack of water resistence
- Lack of stretchability and moulability
- Most look similar to leather but not exactly like leather, breaking the status symbol.

The market for vegan leather

- The India polyurethane (PU) synthetic (artificial) leather market size was valued at USD 3.97 billion in 2016. [29]
- It is witnessing augmented demand from applications in automotive and footwear industries.
- It is also used as an alternative to genuine leather, a factor that is significantly propelling its demand.
- The polyurethane artificial leather market in India was recorded at 931.2 million square meters in 2016 and is estimated to progress at a CAGR of 7.5% from 2017 to 2025. [30]
- The India polyurethane (PU) synthetic/artificial leather market size is expected to be valued at USD 8.14 billion by 2025. [31]

The company we are working with for this project is one such startup that manufactures vegan leather from fibres and bacterial cellulose, and is called Made from Malai.

Personas

from the customer segments of
Vegan leather

Name: Dimple Malhotra

Age: 42

Status: Married, two children (12, 15), lives with family in Delhi

Occupation: owns a boutique

Hobbies: cooking, singing and fashion blogging

Yearly income: 2.5lakhs

Dimple is a happy mother and wife and buisinesswoman, is very involved with her children. She has cleaning and cooking help for the house, but helps her chilren with homework and drives them around when her husband is busy. She makes around 2.5L a year. Her older daugher has learned in school the horrors of animal rearing for meat and leather, and has put her foot down and decided that no one in the family is to buy leather goods, and has told her mother to cut the mean consumption of the family. Dimple is now learning the ways of partial veganism, and looking for alternatives to sell in place of her leather accessories, and in her own household wallets and jackets, along with vegetarian foods that will keep the family happy.

Name: Smitha Suresh

Age: 26

Status: Lives with friends in rented rooms, Mumbai

Hobbies: Public speaking, fitness

Monthly income: 60k

Smitha is a biotechnology major from Delhi, where her parents live. She has just finished her PHD in Mumbai, and is starting out as a research assistant in a Lab. Smitha is beloved in the area she lives, and is well spoken and confident. She has strong values and beliefs, one of which is her fight against animal cruelty. Smitha is vegan by choice, and she strongly recommends veganism to people around her. Ever since her parents took her to the Zoo in Delhi, she has loved animals and as she grew up she learned how animals are exploited, and it caused her to change her habits and ways.

Made from malai

The company

"Our start-up company specialises in creating and developing bio-based materials."[32]

They research and explore methods and sustainable resources to produce new biomaterials with impeccable environmental credentials due to their emphasis on the use of wholly natural and healthy materials.

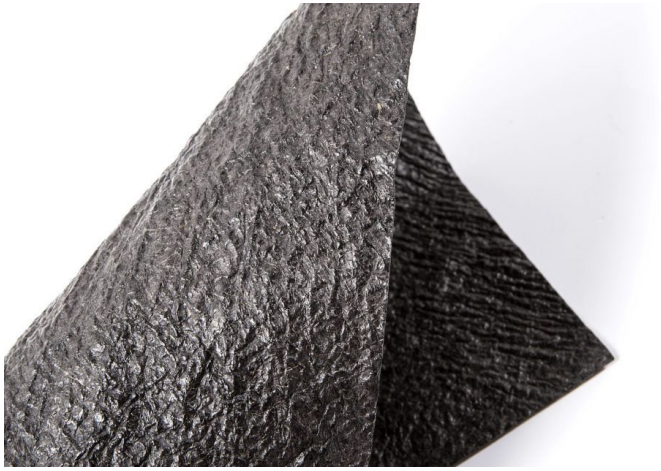
They are currently manufacturing a material they call *malai*, in small numbers (30 a batch) in their warehouse factory in Cherthala, Kerala. This material is a sheet of fibres held together by cellulose from bacteria, and looks a lot like leather. They sell this material to small business owners who make products from them that you would otherwise make with leather, and sell it to consumers who subscribe to the idea of Vegan leather.

"We are inspired by the beauty and purity of natural materials, and by the life-cycle and ecology of the coconut palm in particular. We work in close partnership with the local coconut farmers and processing units in our region of South India who provide us with their waste coconut water, the primary resource we need to start the growth of our bacterial cellulose, which will eventually be transformed into Malai. We also collaborate with local communities of makers as well as working with suppliers whose ethical approach is transparent and verified."

In 2017 they moved to a coconut-cultivating region in Southern India and began working full-time to develop Malai and to "consider in what context this new material could be applied". They chose to target it towards the sustainable fashion market, because of its aesthetic appeal and with a view that fashion is the second most polluting industry, beaten only by oil.

In February 2020 Malai was awarded India's biggest fashion sustainability award when it emerged as a winner of the Circular Design Challenge ran by IMG Reliance & UN India presenting their unique approach to circular fashion.

They are, at the moment a small team of less than 10 people consisting of labour staff in the workshop, 2 directors, sales representative, a bunch of talented interns & external consultants, 6 cats and one dog.



The material

"Malai – (noun) a newly developed biocomposite material made from entirely organic and sustainable bacterial cellulose, grown on agricultural waste sourced from the coconut industry in Southern India."[33]

Malai is a flexible, durable biocomposite material with a feel comparable to leather or handmade paper. It is water resistant and will not cause any allergies, intolerances or illness, due to the fact that it is made from all natural, no synthetic materials.

The material is purely vegan, and PETA approved. They claim the material can even be eaten safely.

Malai Biomaterials works with the local farmers and processing units, collecting their waste coconut water (which would otherwise be dumped, causing damage to the soil) and re-purposing it to feed the bacteria's cellulose production. One small coconut-processing unit can collect 4000 litres of water per day, which can be used to make 320 sq. meters of Malai.

The word *malai* refers directly to the creamy flesh of the coconut and it is the coconut water (a by-product from the harvesting of this flesh) that sustains the bacteria whilst they are producing the cellulose, which is then in turn collected and refined until it becomes the finished material: malai.

Other components of this material are fibres of Sisal, Hemp and Banana fibre, in different ratios, and some plasticizers (gums and glycering) to make the material a little more pliable. the material holds very well, oweing to the Hydrogen bonds between the pure cellulose from bacteria and the cellulose based fibres, causing a cohesive bond, as opposed to the adhesive one in paper, or plain friction in woven fabric.

Malai is highly customisable when it comes to weight. The higher the weight the stronger the material. Thinner weights are more flexible and softer. They accomodate the material weight depending on your application.

Malai soft

300-500 gsm
Material suitable for fashion application with smooth finish and soft feel. We recommend to back it up with an adhesive lining in order to increase the strength.

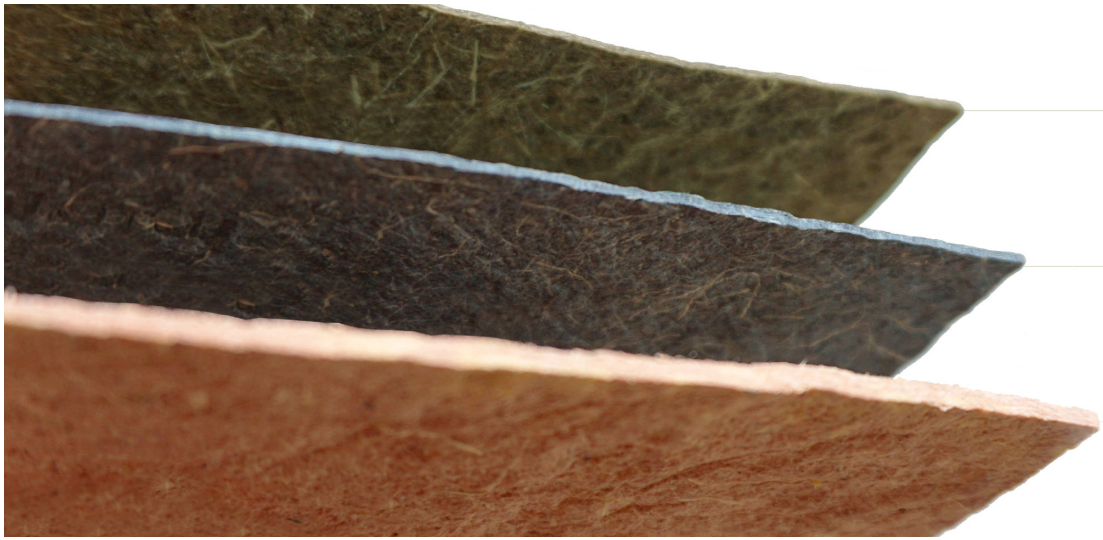
Malai medium

550-650 gsm
Material suitable for fashion accessories, stationary, packaging and furnishings application. This range has more textured surface finish, remains flexible and has a medium soft feel. We recommend to back it up with an adhesive lining.

Malai strong

700-1000 gsm
Material suitable for furnishing application, interior surface design, stationary. Malai strong is more structural, textures and has a rougher, more rigid feel. [33]

The different GSMs are made by using a different weight of the ingredients, maintaining the proportion.



Malai soft
300-500 gsm

Malai medium
550-650 gsm

Malai Strong
700-1000 gsm

STRONG

FLEXIBLE

RECYCLABLE

BIODEGRADABLE

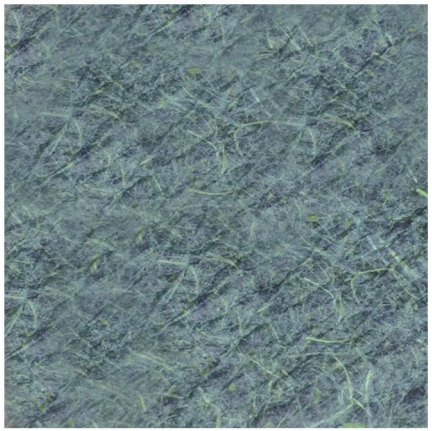
BREATHABLE

WATER RESISTANT

VEGAN

SUSTAINABLE

PETA - APPROVED VEGAN



Manufacturing cost Per sheet

120×80 cm

Labour	₹1000	fixed price
Packaging	₹60	fixed price
Electricity	₹20	fixed price
Dyes	₹80-₹100	varies
Raw Materials	₹1200-1300	varies
Total	₹2360-₹2480	
Selling price	**₹3000-₹3400**	

Approximate selling price per sheet

120×80 cm

	1 sheet	> 5 sheets	> 20sheets
450 gsm	35.5 Eur	33.5 Eur	31.5 Eur
550 gsm	36 Eur	34 Eur	32 Eur
750 gsm	37 Eur	35 Eur	33 Eur

Raw Materials cost breakdown

Banana fibre	₹160 + ₹40 (transport) /kg	×10 per month
Hemp	₹185 + tax /kg (variable)	×8 per month
Sisal	₹0 (in house by product from owner of warehouse)	
Bacterial Cellulose	₹80/kg	×8 per month
miscellaneous coatings	negligible	
Total	₹4120	per month

Other Processes (Optional, used if required)

Pressing	₹30/sheet	(based on order and output)
Massaging	₹100 per sheet / in house labour cost	(based on order and output)
labour costs	inclusive in ₹1000 per sheet to employees	(based on order and output)

Additional costs

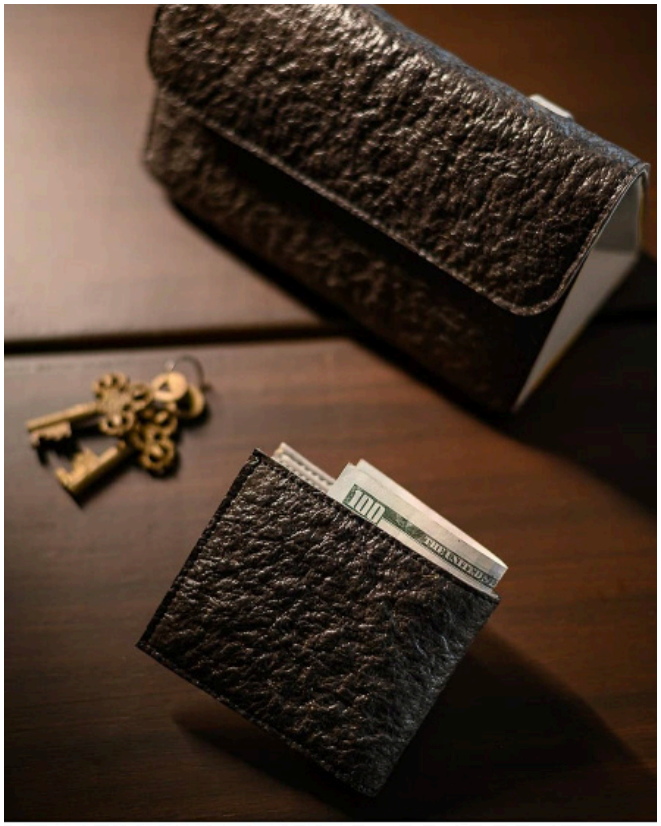
Machines		
Perforated table	₹20,000	fixed cost
Press	₹25,000	fixed cost
Mixer	₹50,000	fixed cost
Massager	₹90,000	(including iterations and design alterations for the customised, new machine)
Folding machine	₹45,000	fixed cost
Collinder beater	₹4,00,000	fixed cost
Machine maintenance	included in labour cost / negligible	
Miscellaneous		
Rent for the place	₹10,000	Recurring cost (per month)
Electricity bill	₹2500-₹3000	Recurring cost (per month)
GST	₹2,000	Recurring cost (per month)

Malai's clients

The company regularly ships out samples, to at least 15 startups/individuals a month, across the globe. They get more attention from more developed countries, where people believe in veganism and that's how they find them.

In India, these a few startups make products from malai and sell them.

Riti



Noos Eco

ManiLeather studio

Lemniskáta

Personas
of Malai's clients

Name: Shail Mukharjee

Age: 21

Occupation: Third year of Design college, Pune

Status: Lives in hostel

Hobbies: Crafts, reading

Shail is a Design student studying and living in Pune. She is a product design major, specializing in material and material technology. Lately, she has been experimenting and testing new materials being developed by companies and individuals around the world, and hopes to have a widely known Material library of her own someday. She also enjoys other aspects of her major and loves to make/build things. Her parents and younger sister live on the other side of Pune, both her parents are engineers.

Name: Sunil Reddy

Age: 26

Status: Lives in rented apartment with business partner, in Bangalore

Hobbies: gaming, running

Monthly income: 30k-50k

Sunil and his business partner Shankul have a small startup that sells lifestyle accessories with the promise of environmentalluy friendly, cruelty free products. A lot of these products are made from leather alternatives, plastic alternatives, etc, like wooden figurines and vegan leather wallets and belts. Sunil spends most of his time now in growing his business and researching, looking for more products in the market that require alternatives. His family lives in Gurgaun, he finished his B.Tech and moved to Bangalore with his new sense of calling to set up this business.

Manufacturing process

A flow chart

Sourcing the material

Fibres

Cellulose

Prepping the Bacterial Cellulose

Cutting

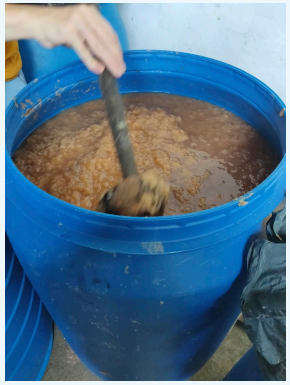
Washing

Prepping the fibres

Cutting

Cooking

Pulping



Dyeing and mixing

Massaging and coating

Forming and drying

Forming/ pressing

Drying

Manufacturing process

Sourcing the material

The main raw materials used in *malai* are-

Banana Fibres:

70% of the fibres in malai are banana fibres. These are sourced from Maharashtra, 100 kilos at a time and are transported by road. This happens about twice every three months.

Hemp fibres:

15% of the fibres are hemp fibres, and they are ordered in from BOHECO, Uttarakhand.

Sisal fibres:

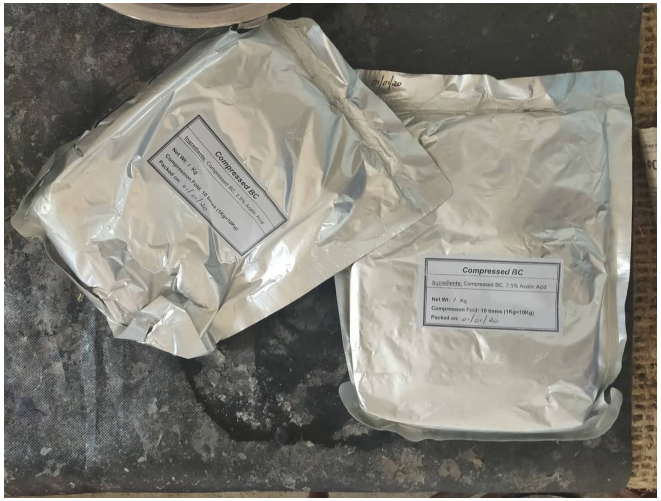
On account of Indian sisal fibres being of a different texture than that required for the material, Australian Sisal is used, the trimmings and waste from the fibres after the Madam uses. Sisal makes up the remaining 15% of the fibres.

Bacterial cellulose:

The bacterial cellulose is pure cellulose, grown by bacteria as they feed on the sugars in coconut water. It comes from Chennapatna in Karnataka, and sometimes from a supplier in Kochi.

Fibres

Bacterial Cellulose



Prepping the material (cutting and cooking)

The fibres that arrive are often of varying lengths, and are fairly long. Long fibres get caught in the pulping machine, so they are first cut up into inch long bits on a makeshift machine. A handheld tool has been welded to the bottom of a table, blade up and through a cut in the base of the table.

Once the fibres are cut up and ready, they are cooked. The cooking does two main things:

- It removes debri/husk from the fibres, hence cleaning them.
- The cooking is done in an alkaline solution of caustic soda. This helps in lignin removal from the fibres, which leaves behind cellulose, thus making it both more plyable and more likely to form a cohesive sheet.

.

The cooking process lasts about 3 hours a batch, and is done in a large vessel, shown below.

After cooking, the fibres are ready to be pulped.

Prepping the material (Pulping)

Pulping the fibres breaks them down further and defibrilates them (splits the ends of the now tiny fibres to allow for better cohesion). The pulping machine is the same one used in the paper industry, and is located outside the warehouse.

Pulped fibre

Prepping the material (shredding and washing)

The bacterial cellulose (nata di coco) arrives dehydrated to 10% of its original volume, in a bit of acetic acid to keep it fresh. Once the cellulose arrives, it needs to be broken down from the dried, condensed state it is in, and this is done in a high powered blender.

Once shredded, the cellulose is washed thoroughly, so that the acetic acid doesn't affect the strength of the sheet or the pH value.

Dying and Mixing

The team has an excel sheet with fixed proportions of the three fibres and bacterial cellulose, you enter the GSM of the sheet to make and get the amount by weight of each component. That is multiplied by the number of sheets that will be needed for the batch, and the amount of dye needed, and the components are then set to dye.

One the fibres and cellulose have been dyed, the mixture is further homogenized in a makeshift mixing machine.

Forming the sheet

A lot of water is added to the mixture in the mixing stage, the allow even dispersion of the fibres and particles throughout the mixture, and to make sure the fibres settle evenly once the water is drained, which is the next step.

The mixture is deposited onto a perforated table lined with a fine mesh and surrounded by a frame. The water drains as the particles settle, and the sheet forms on the fine mesh.

Pressing

Once the water is naturally drained, a small amount of the remaining water is squeezed out of the sheet under a hydraulic press. Another benefit of pressing is to push the fibres closer together and help in forming the sheet.

Drying

Any remaining moisture in the sheet is expelled by sun drying the sheet on framed wire meshes. The sheets are dried in the sun for a minimum of two hours, or as long as the sun is bright, and overall dried for about 24 hours. This produces a dry, wrinkly but tough sheet that can withstand great deals of strain.

They also have a small make-shift drying rack that holds about ten sheets at a time. It is a closed rack with slots, and a heating fan placed below for a steady stream of air that is 60 degrees.

Pressing

These dried, wrinkly sheets are sent over to be flat ironed with a hand iron. This process is outsourced from far off places, and hence depends on when someone who owns a vehicle is free to go, adds costs and depends on the schedule of the ironing guy.

Massaging

An interesting process developed by malai is massaging. It breaks the material like you would the spine of a book, and makes it a lot more plyable and leather like. In addition to this, it gives the material that skin like surface texture, making it look more like leather.

The perforated table

Coating

The Sheets are coated several times, with several different substances. The first coating is a mix of glycerine, tung oil, and lemongrass oil. This is primarily a plasticizer that makes the material softer, and is sprayed onto the sheets before they are sent to be ironed.

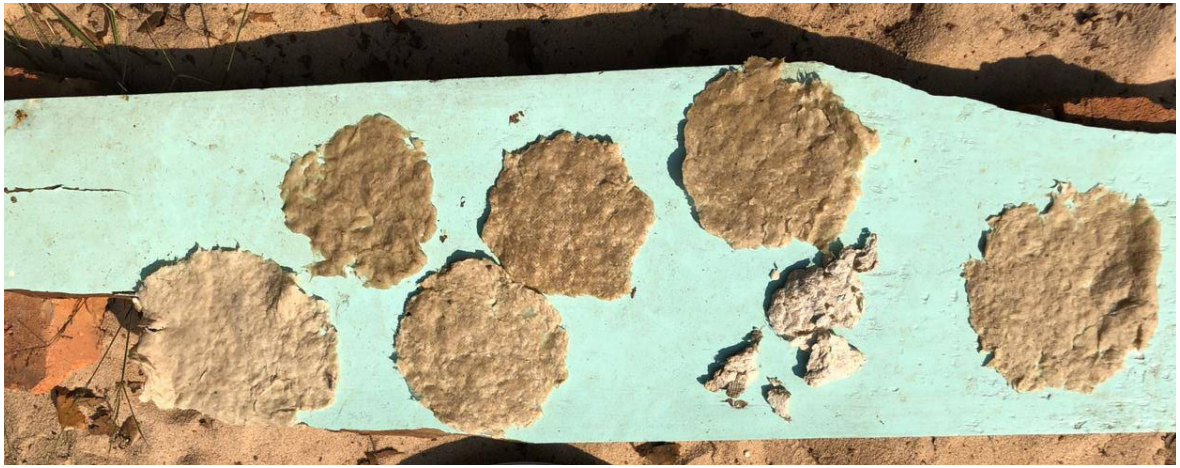
Another coating is that of konjac root gel. This gives the sheet its water resistence, and is plopped onto the sheet and then spread by hand.

One final coat of aromatic oils is massaged into the sheet to lock everything in and give it a shine, resembling that of leather.

Trimming

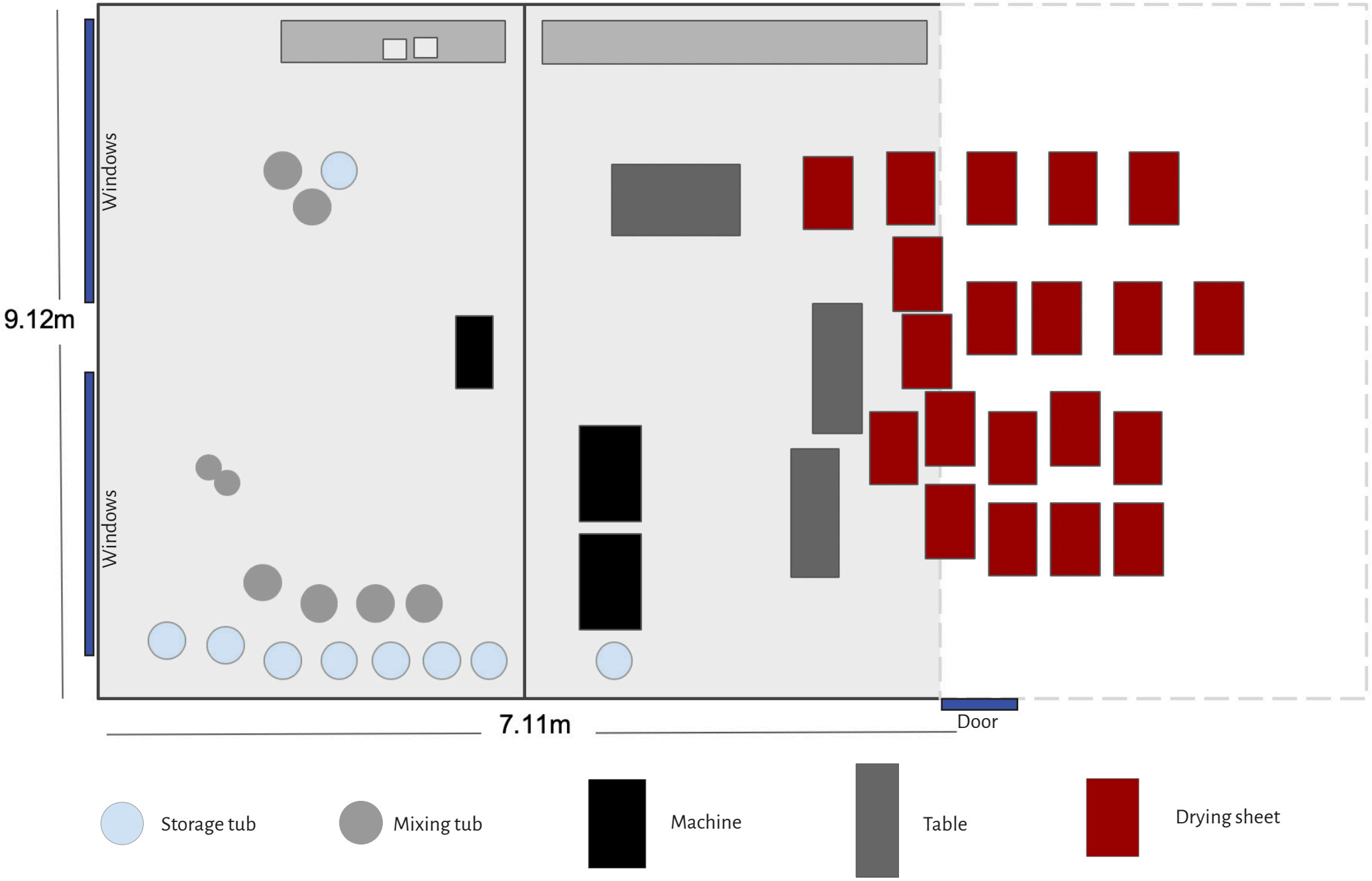
After pressing, the sheets are not as straight edged as they are before they dry, so they are trimmed to straight edges and approximately the right dimensions with a pair of scissors, by hand.

Experimentation with making malai and similar materials

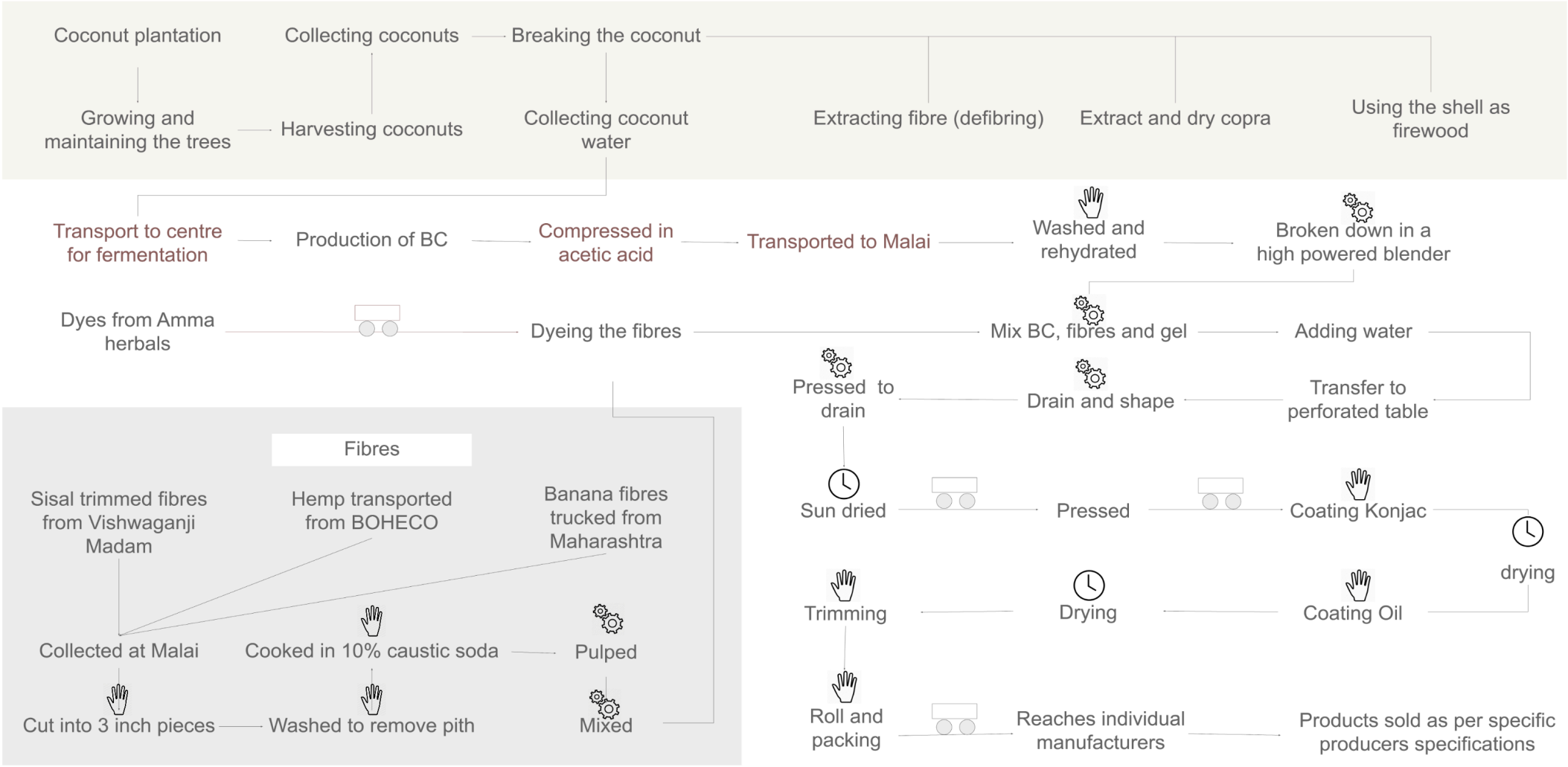


original malai

Layout of malai



Value Chain for malai



Observations and Insights

Manufacturing process:

On any given day, there are 3-4 out of six workers present and working	-	The output may not be as high as it could be if there were a higher attendance rate
There exist regularly used machines, but there are machines (like for massaging and folding) that need to be finetuned/can't be used.	-	**Appropriate/Customized machines suited to the manufacturing requirements needed**
Parts of the manufacturing process (massaging, pressing) are outsourced	-	This outsourcing puts the company at the mercy of the outside worker's schedule, adds extra manufacturing cost and adds time to the process.
No designated task assigned to the employees	-	In a situation where 50% of the workforce comes on any day, assigning specific tasks could backfire by holding up the production line
A lot of water was being wasted	-	Need for repurposing waste water
Many tasks were outsourced	-	They don't mind the small extra costs that take a load of their mind

The material:

There were few to none quality checks, and on being asked, we were told that being a startup gives them area to err, plus they cannot afford to throw out sheets unless they're seriously damaged.	-	They aren't making enough business to perfect their product, they seem to have stagnated.
Material has extensive potential (studying and talking to several leather brands, customers are asking for vegan alternatives everywhere)	-	They are only selling sheets, no products made from sheets, which may have potential.

Material looks a lot like leather but doesn't feel like leather	-	Need for a restructured marketing (eg. why still call it leather?)
Material doesn't feel or look as expensive as it costs	-	Require better suppliers/ research alternate, more cost efficient sources

The ecosystem:

Location of the set up does not benefit production, the weather hinders production, money is lost in transporting materials	-	There wasn't too much research/ thought that went into picking the location or sources of material.
Field visits to several other units, factories, and watching the coconut processing system's level of efficeincy	-	Told us that it is possible to make Malai's process more efficient
There's women willing to work but don't have jobs (community study)	-	If they wished to rehire a more dedicated workforce, they could, but they prefer not to have a new crowd to re-teach the processes.

The brand:

No patent or trademark for malai	-	Disinterested in safeguardiung proof to legal authenticity
There isn't too much focus on spreading the word about malai's existence	-	Requires better branding
Less sales revenue	-	Requires better marketing

Other:

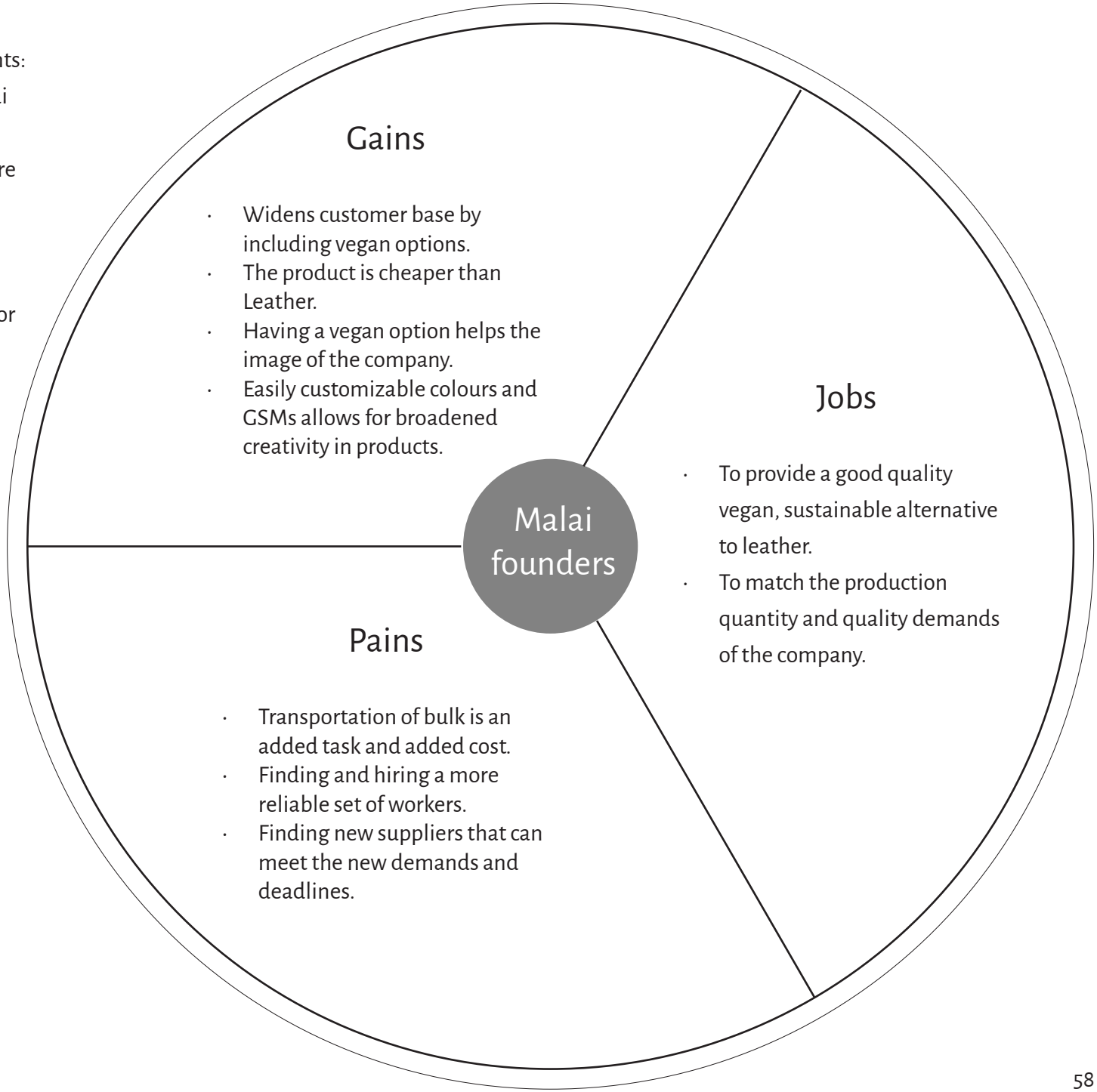
Haphazard placement of processes and machines	-	Improved layout planning may improve efficiency

Value proposition chart

Made from malai has two main customer segments:

- Small businesses making products from malai and selling them
- Individuals who believe in veganism and/or are curious about the material, and get products made from the material for themselves.

To grow, the company would have to pitch the material to bigger businesses, like Hush puppies or Fossil.



Business model canvas

Key partners

- Investors
- Logistical and Transportational Support
- Bacterial Celluloseprocessing plant (outsourced- Channapatna. (In-house)
- Hemp Fibre Suppliers:
- BOHECO, Mumbai
- Basket and Carpet Weavers who supply sisal fibres as industrial waste:Cherthala, Kerala

Key Activities

- Sourcing Materials
- Sourcing Capital
- Research and Development (in-house)
- Production of the material
- Managing outsourced processes
- Inventory Management
- Marketing) (Karnataka)

Key resources:

- Coconut water
- Hemp, Sisal and Banana Fibres
- Bacterial Cellulose
- Natural Dyes
- Coating Oil- Glycerin, tang, lemongrass, konjac
- Machinery · Transprotation
- Manual labour
- Warehouse

Value Proposition:

- Cruelty-free and environmentally friendly
- Bio degradable
- Durable
- Water resistant
- Compostable
- Edible
- Flexible and leathery in feel Stain resistant
- Recyclable
- Breathable
- Sustainable
- Made entirely from waste and by products
- Satisfies the claims
- Satisfies the legal criteria

Customer Relations:

- Trust based relationship
- On-time delivery and supply
- Taking and responding to feedback
- Good product range

Channels:

- Social Media Presence
- Direct pitches
- Word of mouth
- Material libraries
- Personal website
- International Press
- Transportation of material through bulk postal services.

CUSTOMER SEGMENT:

- B2B - Businesses that have are open making and selling products with a new material that is vegan and sustainable, who have customers that are becoming increasingly aware of the negative impacts of leather and are asking for alternatives.

Cost structure

- Bacterial cellulose ₹80/sheet
- Labour cost ₹1000/sheet
- Fibre cost ₹1300/sheet
- Transportation to and from ₹1000/batch

Detailed breakdown of costs on page 36 and 37

Revenue Streams:

- Sampling: 3 A4 sheets for Rs 1000 sold on the website (Otherwise negotiable according to order size for businesses)
- Selling sheets to small businesses making vegan leather products
- Crowd funding campaigns

Studying other industries

Namratha Oil Refineries

Located in Tiptur, Karnataka

The refinery was names after the daughter of the owner. Following is a study of their process.

ACQUIRE COCONUTS (9AM, weekly)
TIPTUR APMC (FARMERS MARKET),
1500 Tonnes a month

Transporting the raw material
Own transport used, fuel costs incurred

Weighing

Drying

Segregation based on quality
The copra is segregated based on the quality:

Low FFA (free fatty acid)
Desired quality, dried for 8-9 months
higher grade, used for cooking,
companies like Mother Dairy, Amul
Chocolate.

High FFA
Lower quality, cheaper,
dried for 1.5-2 years
Partially rancid, oil used in soaps
and hair oil like Nirma, Parachute,
patanjali

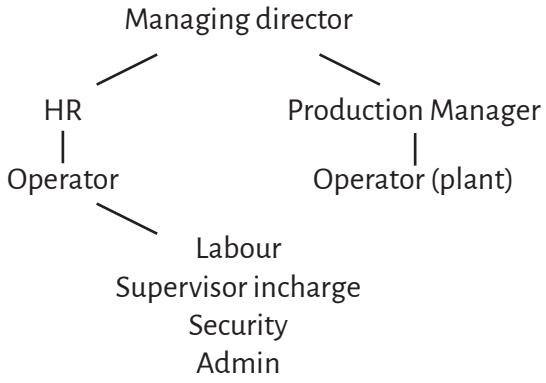
Crushing the Copra
There are two crushing Units
First crush - 60% good oil
Second crush - lower quality oil
Final crush - 10% very low quality oil
By product (HINDI) - Fodder for cattle

Pure Copra: ₹85-125/kg
FOOD GRADE OILS:
Cooking oils, hair oils,
ice cream and chocolate industries

Village Copra: ₹45-50/kg
Soaps, detergents, other products.

About the Refinery

Employees:
155 employees
99% local, 1% operators and managers
38 women, part of ground staff
Shifts:
24 hour plant
4 shifts a day
6am - 2pm, 2pm - 10pm, 10pm - 6am
staff shift: 9:30am - 6:30 pm



10 people for loading and unloading, on contract.

ESIC medical insurance

No canteen

The refinery:

2 crushing sections, 1 refinery, 1 new refinery being built for bigger capacity.

Parts of the Refinery:

1. Solvent extraction
2. Boiler section
3. ETP section
4. Electrical section
5. Workshop
6. Laboratory
7. Packing section
8. Oil loading section
9. Security section
10. Admin office

More about the refinery

- The lab is for quality checking, levels of FFA, cross checking the colour of the oil.
- The business is B2B, they tried B2C for a while, but it didn't take off.
- They have 3 generators with a 10 second startup time, 500HP capacity.
- At any time, 100 tonnes of coconut is being processed, while 600 tonnes are waiting to be processed.
- 10 tonnes of oil produced per shift
- Extensive storage with spare parts, if anything were to fail.
- Cooling uses water, which is recycled and sold back again at a lower price.

Insights:

- They work like clockwork, people are handed duties and they follow them.
- Tasks are delegated,
- Good schedule and good attendance.
- The quality of the product has given them monopoly over the business in south India.

Mat Pressing

Crusheig recycled tyer powder and China clay

Rubber Mats

Printing

Manufacturing

- Electricity Costs
- Water Costs (Boiler)
- Maintenence Costs
- Taxes and Licenses
- Labour Costs (7 Shifts)
- 9 looms
- Printing
- Packaging

Transport raw materials

- Use their own trucks
- Jute from Kolkata, trucked
- Coir from TN and Mysore
- Rubber: local

WILLIAM GOODCARE & SONS

(COIR & RUBBER FACTORY, ALLEPPY)

TRANSPORT FINISHED GOODS

Spuning

Jute weaving

2) BC2.0 (coir & jute)

Pressing

Quality

STORAGE UNIT

PACKAGING

Coir weaving

1) SK8 (coir and indoor &outdoor maps

Printing

Pattern making
Stencil cutting
Spray painting with the stencils
Drying
Finishing
Packing

Flocking

Pattern making
Screen making
Printing with glue
Printing with flock screen(Nylon powder)
Drying
Finishing
Packing

Quality

STORAGE UNIT

PACKAGING

Manufacturing
- Electricity Costs
- Water Costs (Boiler)
- Maintenence Costs
- Taxes and Licenses
- Labour Costs (7 Shifts)
- 9 looms
- Printing
- Packaging

Transport raw materials
- Use their own trucks
- Jute from Kolkata, trucked
- Coir from TN and Mysore
- Rubber: local

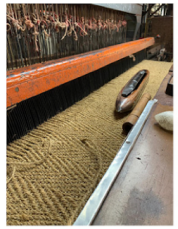
KERALA BALERS

(COIR FACTORY, ALLEPPY)

TRANSPORT FINISHED GOODS

Jute Mats

Alinment of spun bundle
Setuping warp
Weaving
Finishing
Packaging



Coir mats

Raw coir fiber shredding
PVC Rubber melting
Combining shred coir and melted rubber with heat pressing
Drying
Cuting of the sheets in Smaller mats
Shredding mats for leveling
Trimming edges

Studying surrounding ecosystem - related businesses

Mr Mataikuriakose - Coconut vendor
Cherthala, Kerala

COCONUT HARVEST

'Gauli' / Kalpa Jyothi

'Ti-Injudi'/Kalpa Raksha

Kalpa Samrudhi

Coconuts harvested from his own and neighbouring backyard farms every alternate weekend @ Rs. 15 per coconut. Approx 200 Houses enrolled.
Collects with brother and 1 dialy wage employee.
Weekly average collection- 2000 coconuts.

REMOVE THE HUSK

The coconut is broken into different parts.

OUTER LAYER: GREEN

BROWN SHELL: HUSK

INNER LAYER: 'TENGA'

The Husk of the matured coconut is the inner shell that contains fibres used to make Coir. The husk is collected to sell to the Coir Industry.
Coir Fibres bought monthly in bulk @ 1 Outer shell for 80 paise.

DRYING COCONUTS

Mr. Matai owns an Manual Dryer for indoor drying during rainy seasons. Otherwise all the coconuts are sun-dried in their terrace.

Drying 1 batch takes about 1-2 days depending on the season.

The waste generated between the husk removal & drying stage includes that of coconut water. Supposed to be tasteless so no designated use.

Each coconut has about 50 ml of coconut water that gets thrown away.

Due to space issues, the breaking and drying happens in batches.

Each coconut has an average of 5 Kg weight before drying.

About 500 coconuts dried per batch (about 250 Kgs).

CUT IN PIECES

The cutting happens in batches followed from the earlier stages.

Alongside the cutting, segragation of pure cout and village cout is done manually.
Both are sold to the Oil Factory for different purposes.

Village Cout is used for industrial grade oil and Pure Cout is used for producing food grade oil.

The cut pieces are stored (can be stored for upto 7 days) in white 'gunni' bags before being taken to the oil factory.
The rest of the remaining shell is used as fuel for burning or fed to cattle.

TAKE TO THE OIL MILL

The oil factory is about 2-3 kms away.
Mr. Matai arranges his own weekly transport for logistical reasons.

In the overall process, 100 kgs of coconuts give 20 kgs of oil, 10 kgs of waste 'Hindi' powder that can be fed to cattle.
Each pure coconut is bought for Rs. 45-50 and village cout for Rs. 25-30.

The oil is bought back by Mr. Matai for selling in the neighbourhood at subsidised rates. He sells virgin coconut oil for Rs. 230 per kg whereas the market rate is Rs. 160 per Kg with added preservatives and mixtures.

Defubrating unit, Allepy

SOURCING COCONUT HUSK FIBRES
Coconut husk sourced from Tamil Nadu as well as local suppliers weekly.
Average cost of raw materials=
Rs.750 for 35 Kgs.

WASHING
Lingening is added among other chemicles to wash and rinse the raw material.
This has been polluting the water in nearby wells and ponds and giving a pungent odour.

DE FIBRATING
The machine de-fibres it continuously. The output is collected and stored in bulk.
The average wastage is about 1-2% in a batch of 35 kgs.
About 2 workers are required to run a single machine.

DRY IN STACKS
Each stack is dried in a rolled bundle of 35 Kgs.
About 2-3 workers are assigned to stack collected coir continuously.
The stacks are sun-dried and take upto 24 hours to fully dry.

TRANSPORT TO BUYERS
Most of their buyers are B2B and local Coir product producers.
Products made from coir include woven goods, baskets, ropes, etc.

Each bundle about 35 Kgs of Coir and is sold for Rs. 900-1000.

Coir rope making enterprise, Allepy

SOURCING COIR STACKS
Coconut husk stack sourced from local suppliers daily.
Buy 1-2 bundles a day- depending on labour turnover.
Average cost of raw materials=
Rs.850 per 35Kg stack.

MAKE POCKET STACKS
Smaller pocket stacks plucked by hand-measure (2 fistfulls pocketed per pocket).

Each woman does it in her own time and home.
About 10-12 Women working in this enterprise.

ROLL INTO ROPES WITH 'RAAD' MACHINE
The machine rolls each pocket stack in a 20 Meter rope.
Approx. 1200 gms used for 1 rope.
Each woman has 1 machine.
All women put together have a turnover of 1000 ropes per day.

BUNDLE AND ACCUMULATE ROPES
Each rope bundle has 100 ropes. Per day about 10 bundles are made and stored.

Price per bundle=
Rs. 400.
Thus, Price per rope= Rs. 4

SELL AND DISTRIBUTE INCOME
The ropes are sold weekly in the market as well as to B2B buyers.

Each week about 7000-8000 ropes are made and sold. The profit is distributed among worker as per productivity.

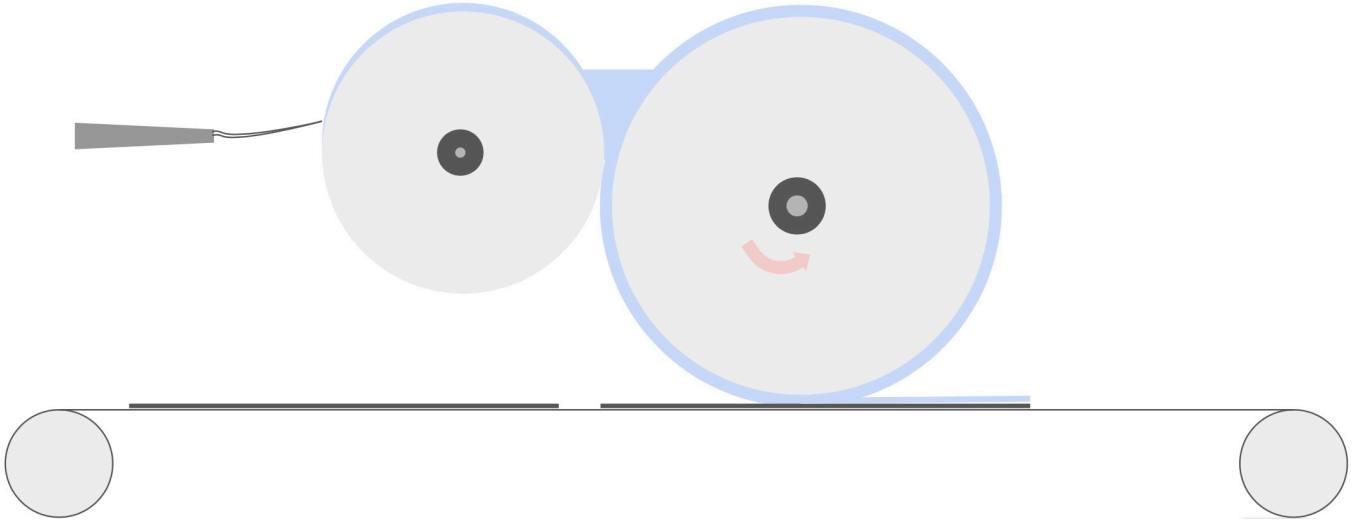
Studying Machines

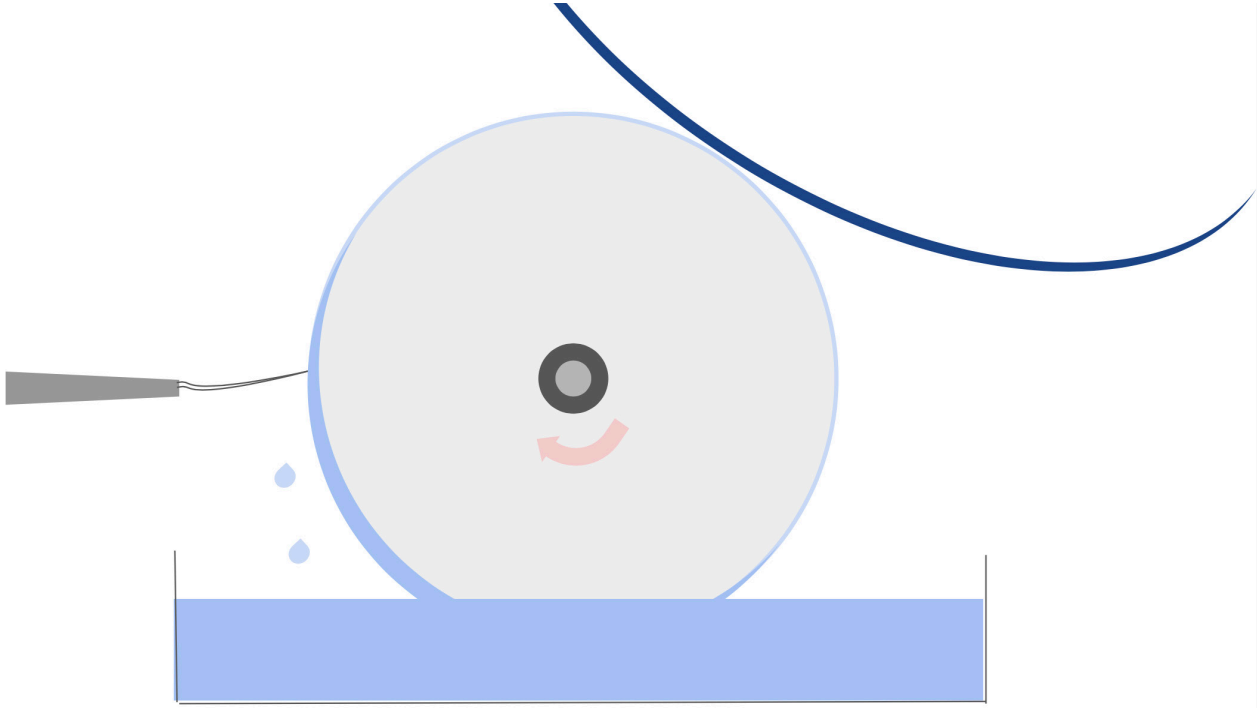
With similar functions

The following are concepts, methods and machines from my study of machines existing in the leather industry and otherwise, that I thought would help or inspire my project.

Mondy Release liner technology:

A method of coating paper, in sticker paper industries and others.





Roller coating:

Another method of coating paper, in sticker paper industries and others.

Electric toothbrush : Rotating bristles

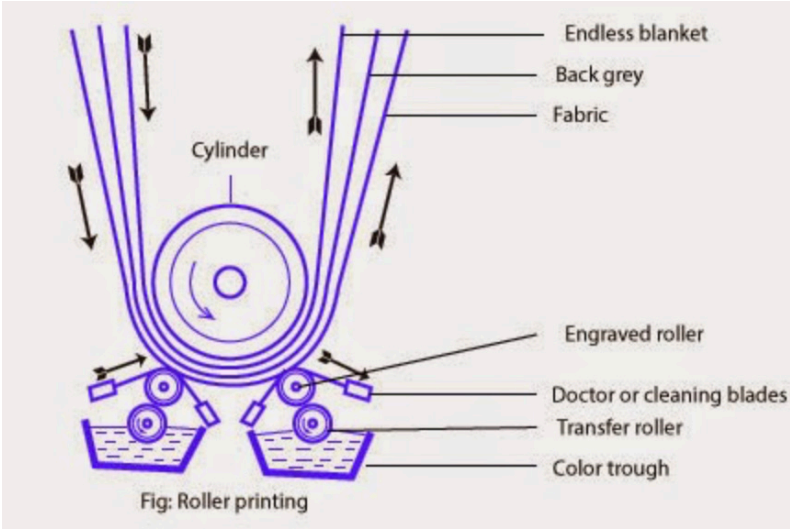
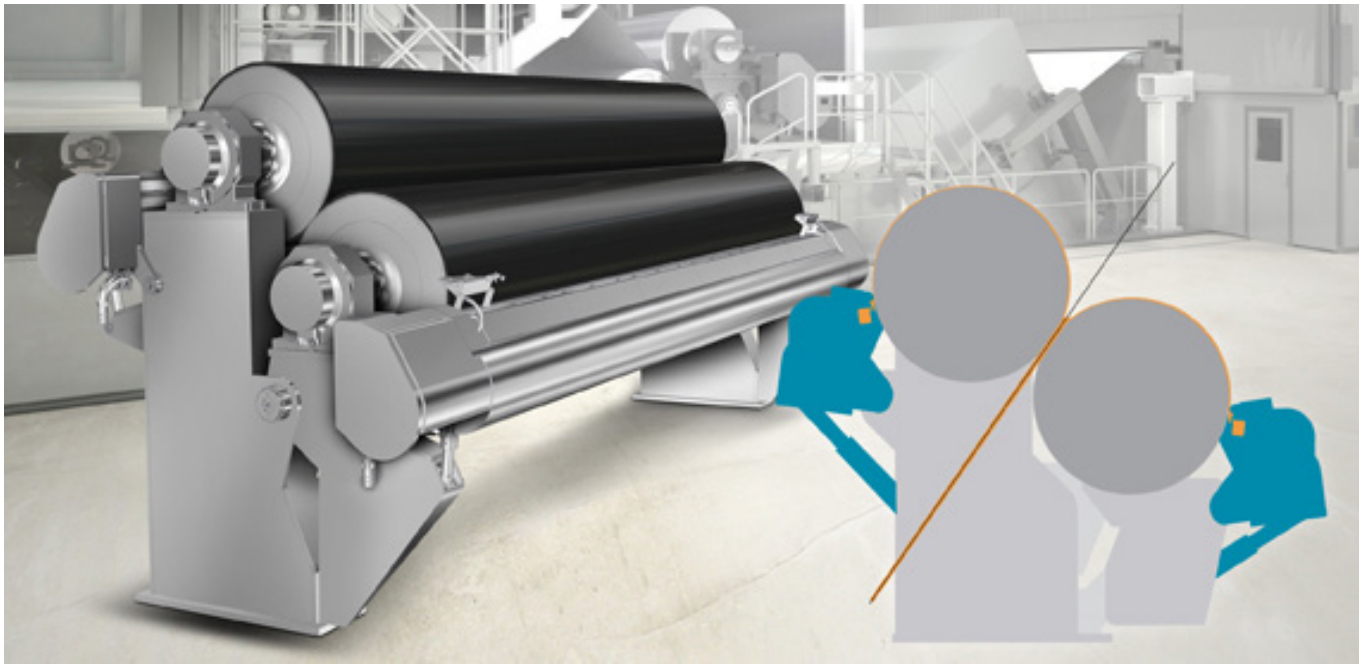


Fig: Roller printing

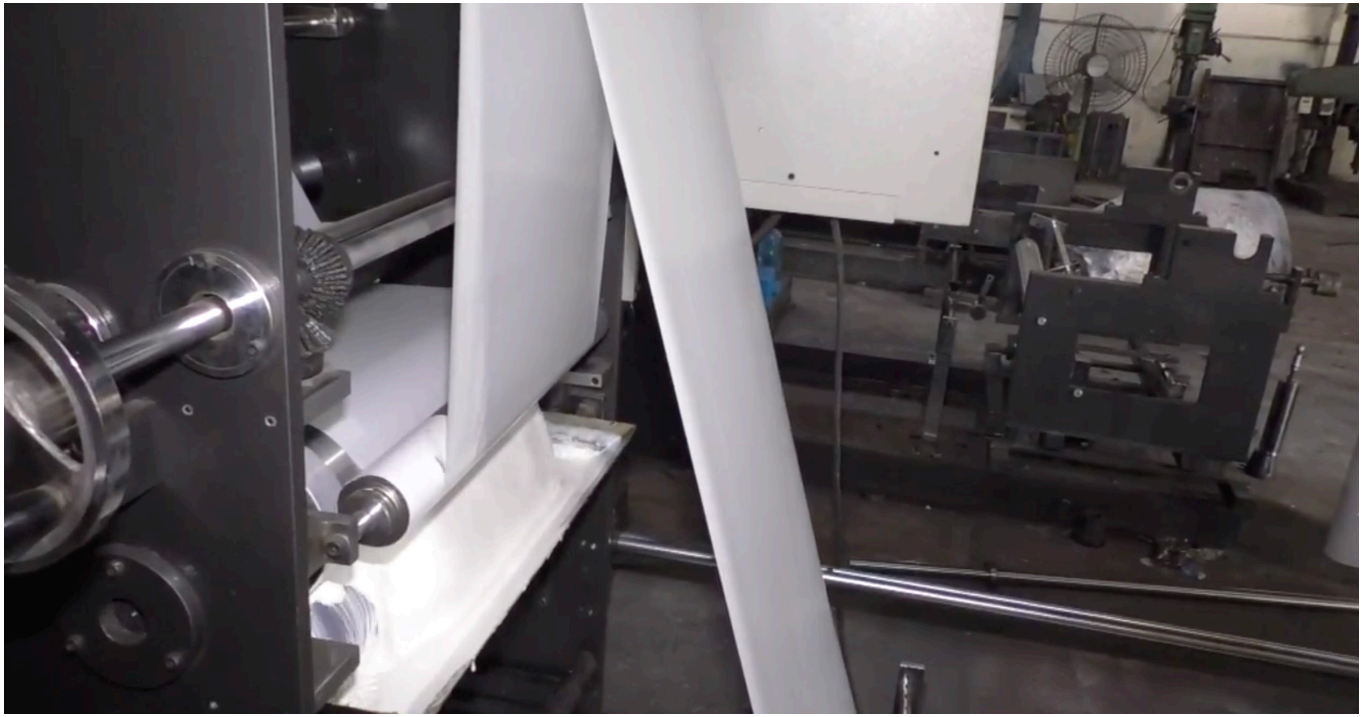
Printing technique similar to mondy

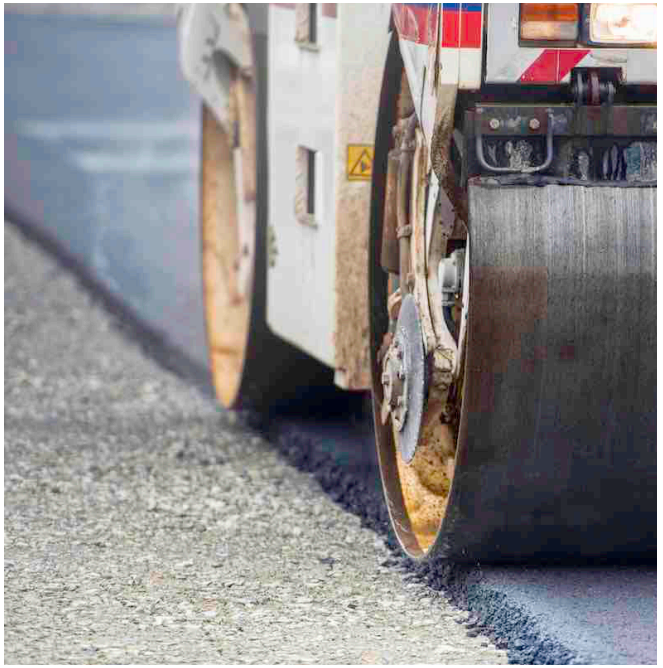
Mondy release liner tech

Carwash : rotating bristles to remove material



Coating both sides of a sheet



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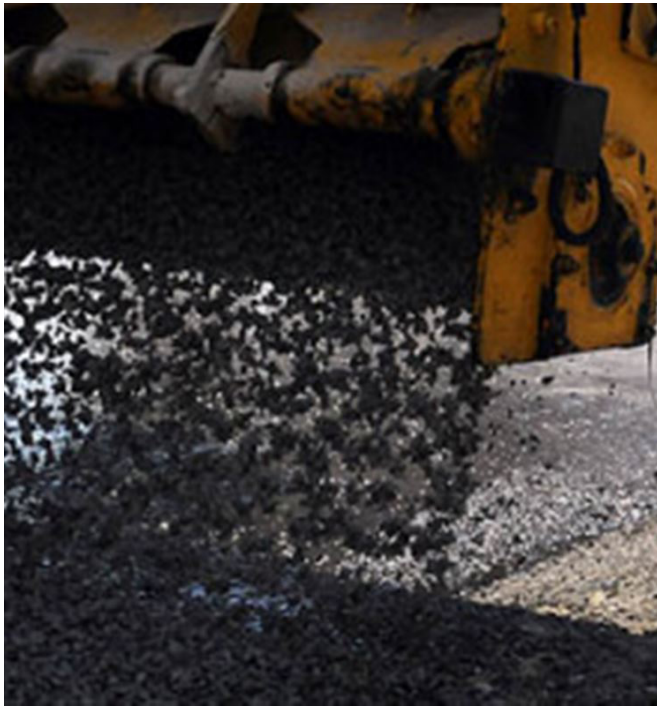
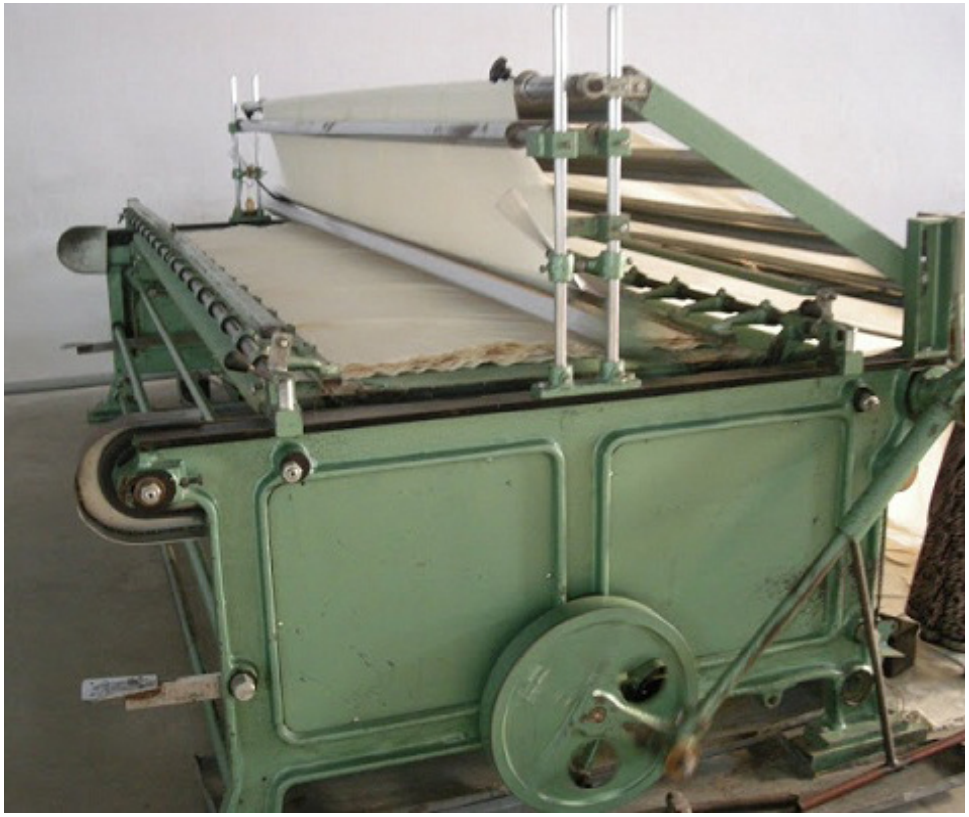
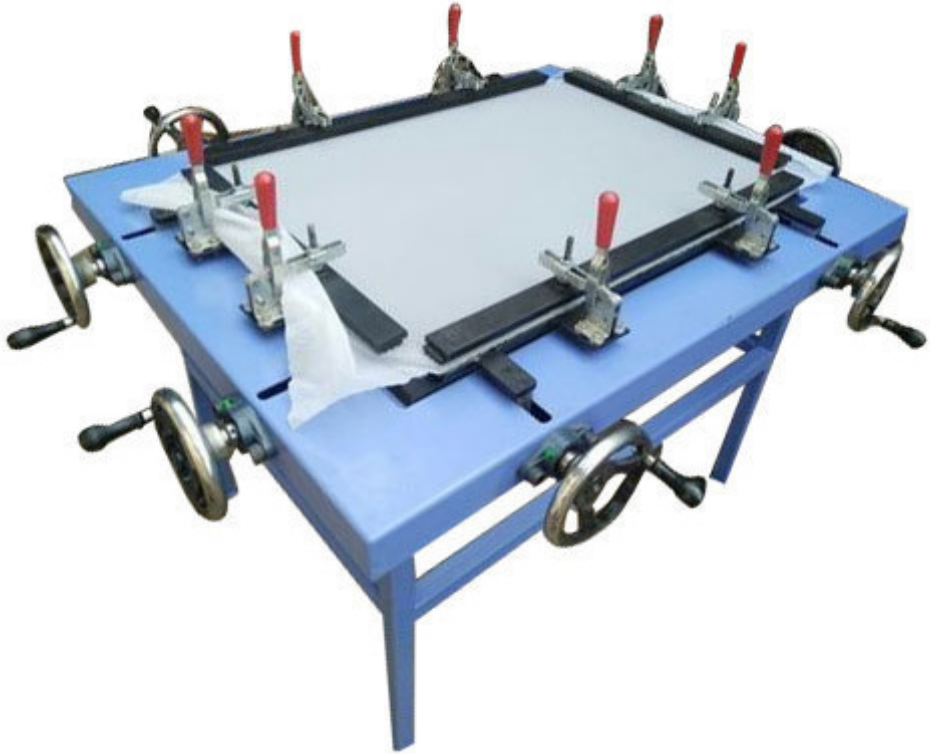
19
18



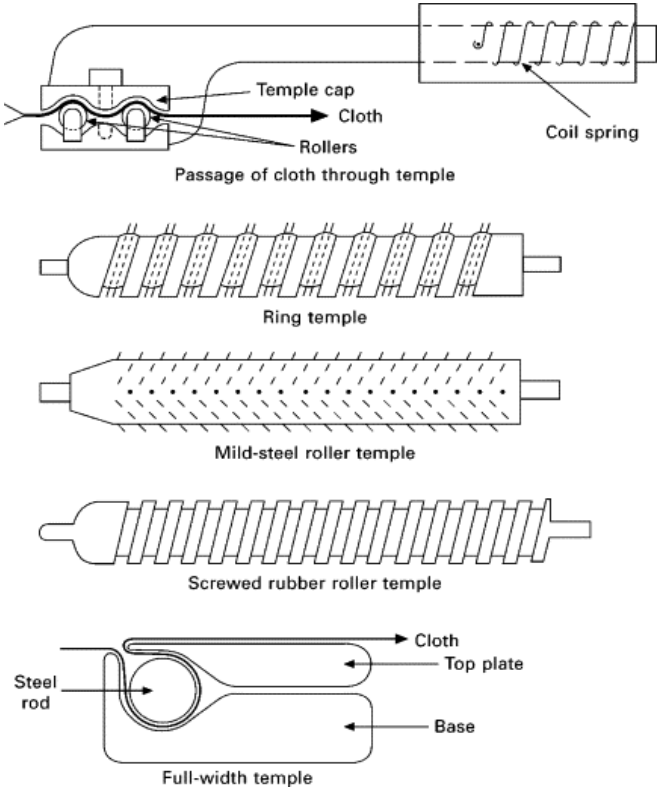
There wasn't much to go on in terms of a starting inspiration when it came to massaging, so my starting point was machines currently used in the leather and fabric industy in folding, stretching and other processes, but mostly the motion of massaging by hand, and the deatils of how that achieves the desired effect, and how best to mechanize it.

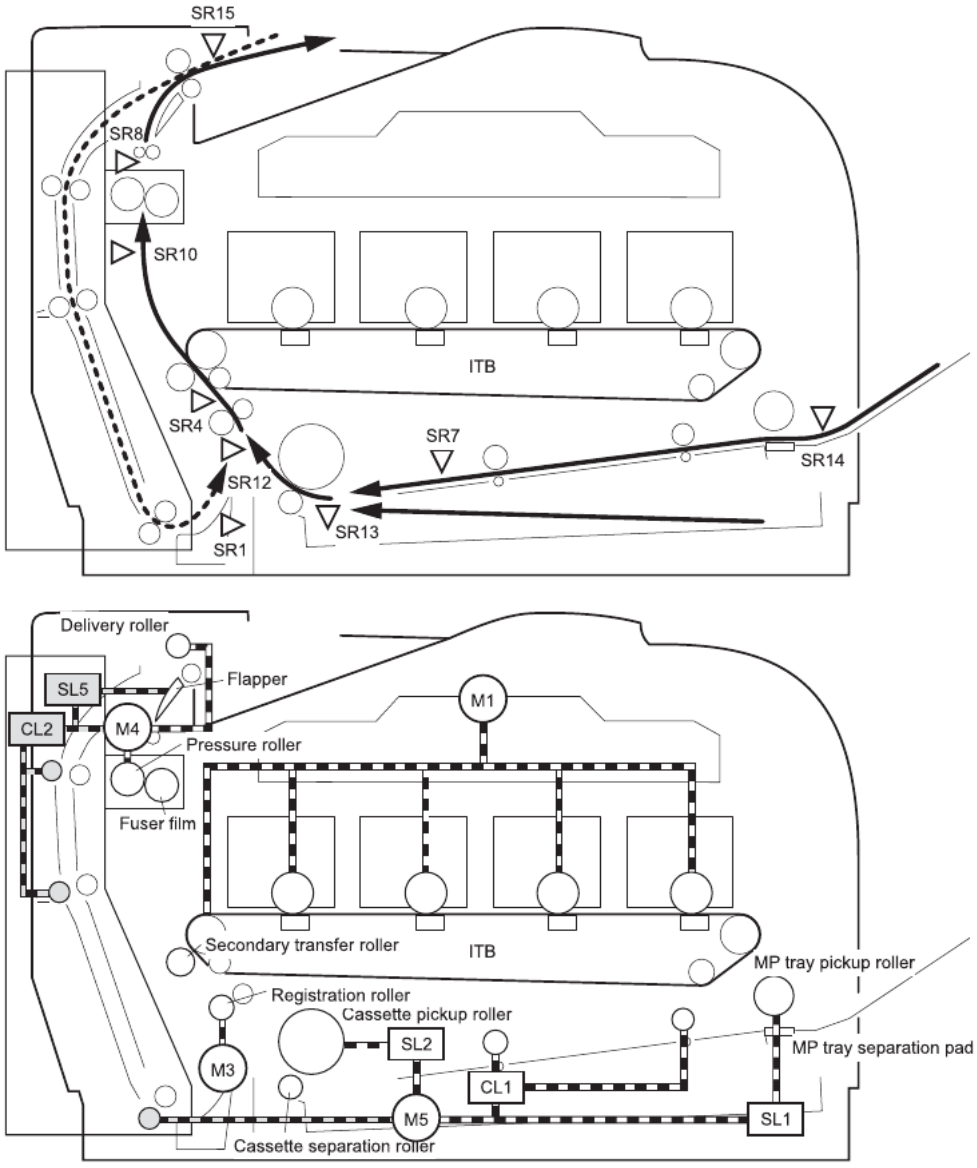
Stretching leather and fabrics:





Stretching tools in fabric weaving





Drawing of a printer, same side feed and output

List of Areas of intervention from observation and conversation

- Design Products to minimise abrasion since the material isnt abrasion resistant.
- Rebrand : should it still be compared to leather?
- If so, material design to make it more plyable and like leather.
- Products that work best for the material.
- Finetune the moulding process to make malai in various shapes.
- Pitch to a bigger company - will require higher yeild, better quality, and promise of delivery.
- Bring down the cost of Nata di coco, research other sellers, other sources of coconut water, possibilities of making it in house.
- Machine to cut time on coating.
- Machine to make the material more plyable.
- Inscrease life of the material - what products would keep it away from water and abrasion?

Area of intervention

A quick relook at the process of manufacturing:

Two processes are outsourced at the moment - Massaging and pressing/ironing.

Price of massaging = ₹100/sheet
Price of sheet **= ₹2400/sheet**
= 4% the price

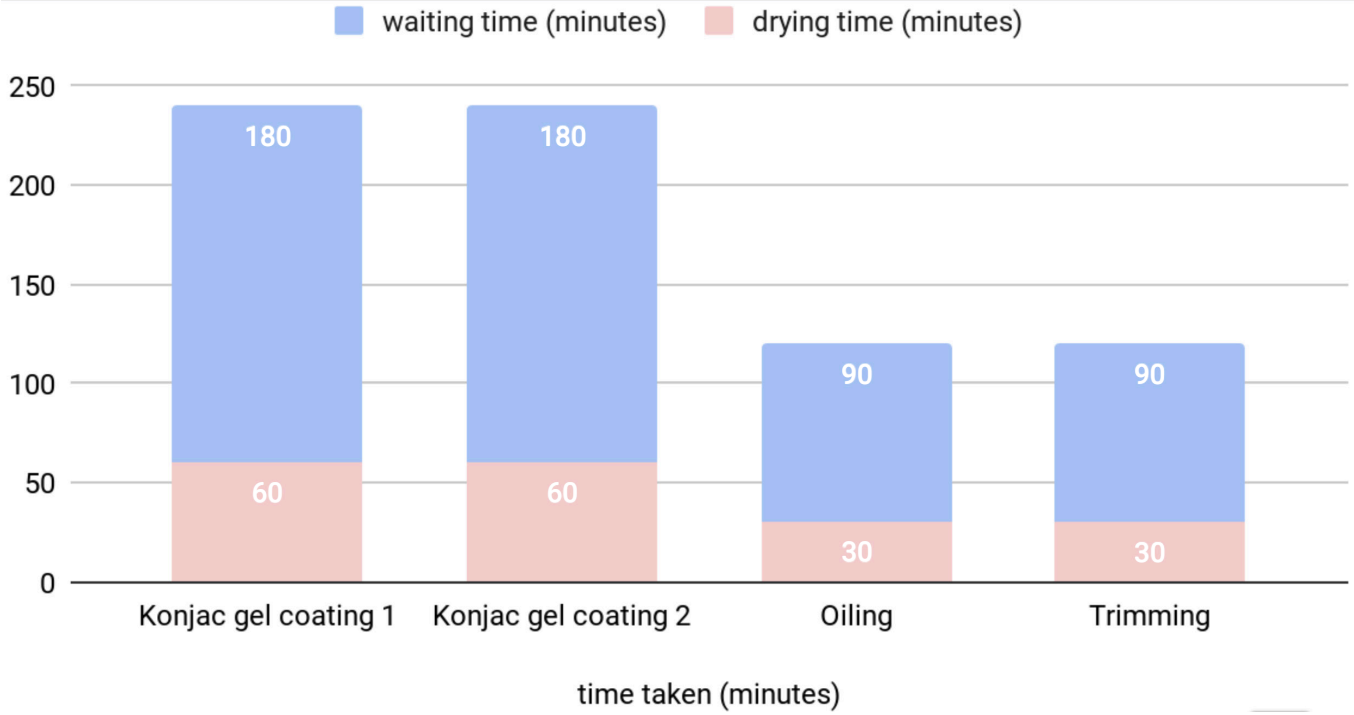
There is one boarding machine (used in the leather industry) that the startup possesses, and they have spent time and effort in altering it to fit their needs. So far, it does not produce the required result, so **the process is still outsourced, losing both time and money**.

Most processes are mechanized, but most of the post processing is done by hand, which involves several coats of plasticizers and water resistance, followed by trimming of the sheet. These processes take time, given that they are done by hand.

Between coating the two sides of the sheet, the sheet is left to dry so it can be turned over to coat again.

time breakdown for manual processes

Coating	Time (minutes)	Total time (minutes)	Drying time (minutes)	Wait time (minutes)
Konjac gel	8	8 * 30 = 240	60 minutes (max)	180 minutes
Konjac gel 2	8	8 * 30 = 240	60 minutes (max)	180 minutes
Oil	4	4 * 30 = 120	30 minutes (max)	90 minutes
Trimming	4	4 * 30 = 120	30 minutes (max)	90 minutes (before packing)
Total		720 minutes	180 minutes	540 minutes
		12 hours	3 hours	9 hours



Design Brief:

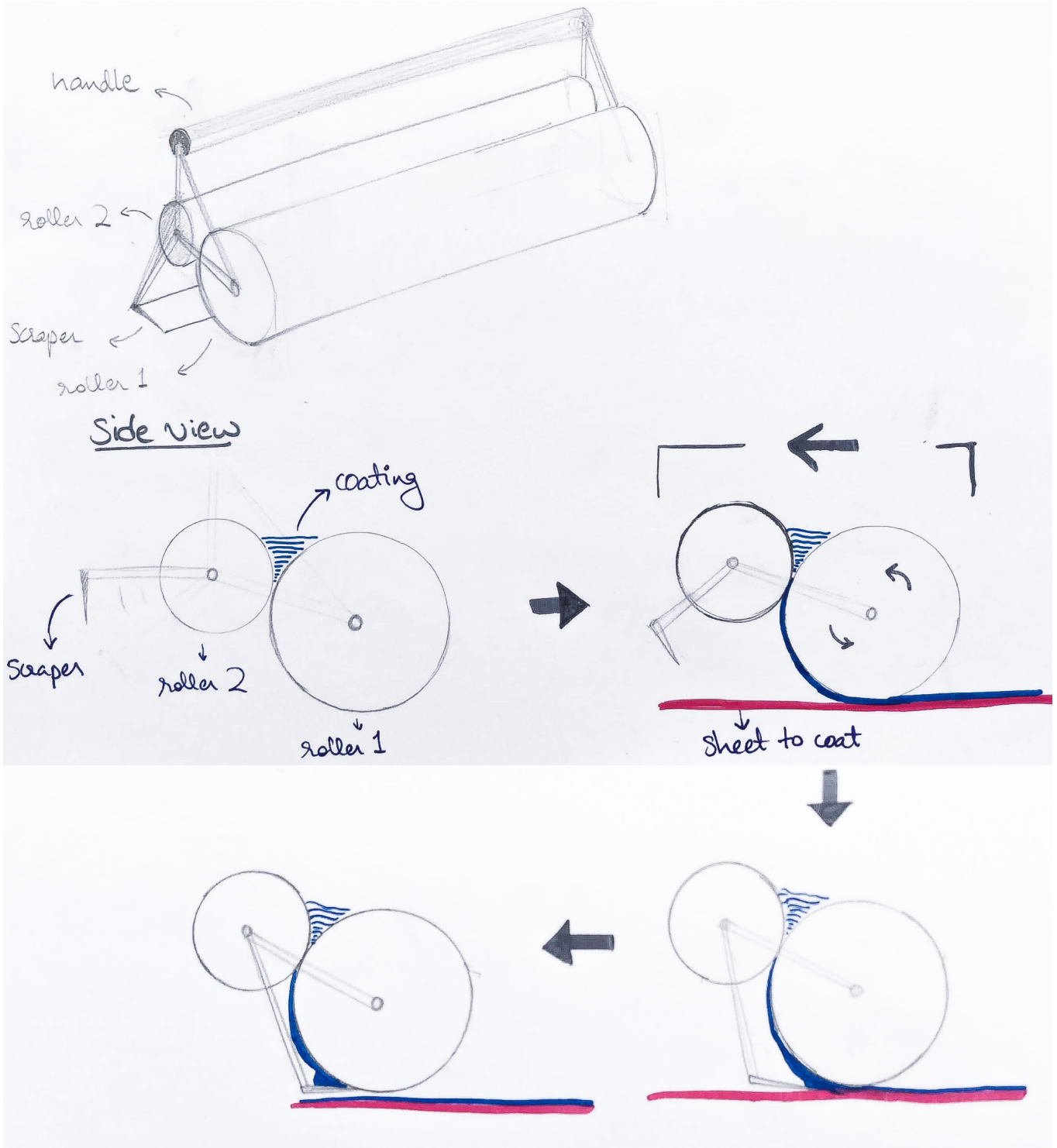
In what way might we develop an instrument or a machine or alter existing machines to make the tasks of coating or massaging quicker, more efficient, and reduce area for human error. Additionally, how will this solution potentially eliminate the need to outsource any of these processes, which at the moment adds to 5% of the cost.

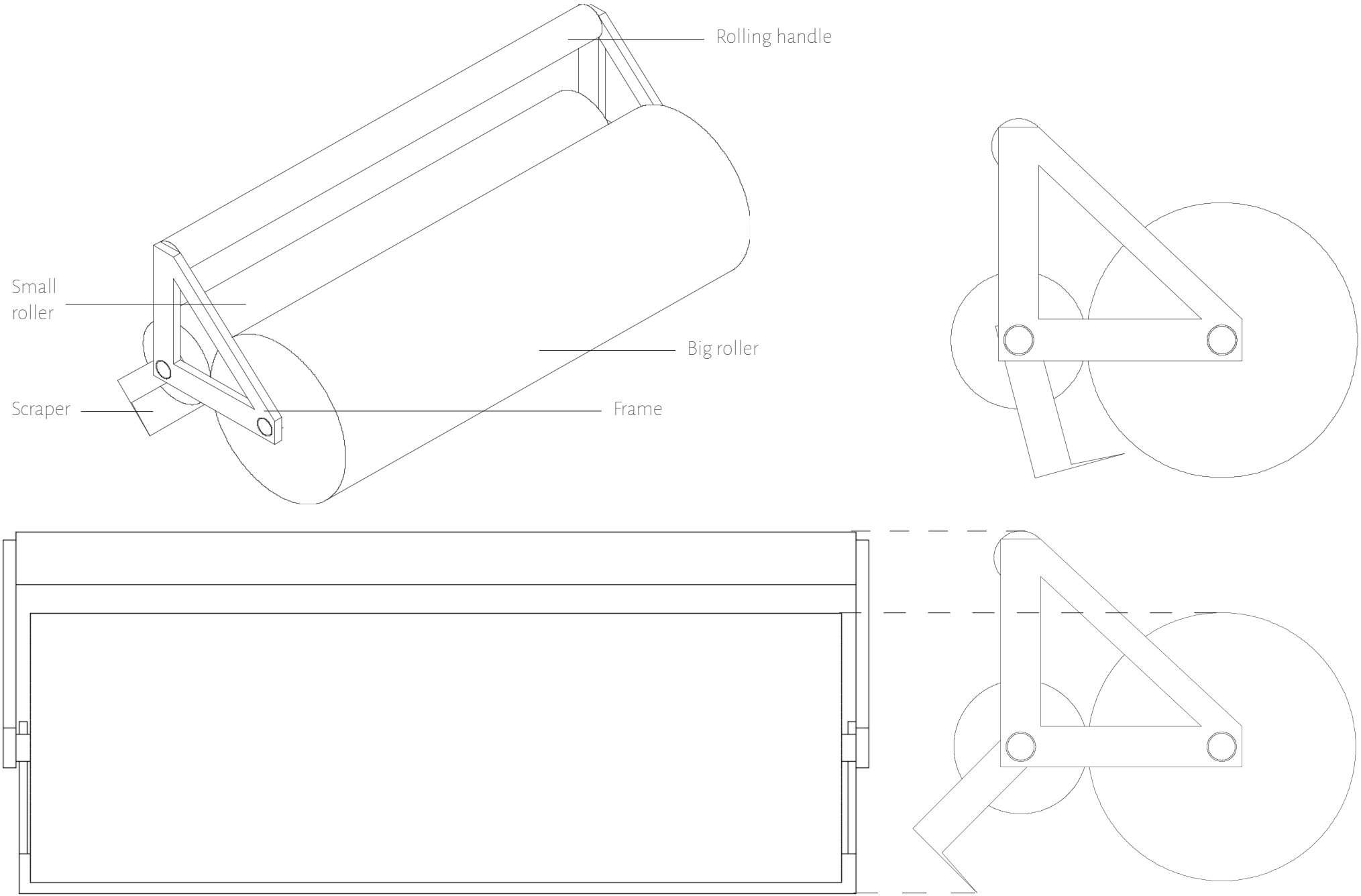
Ideation

The roller

Two rollers that dispense a fine layer of coating onto the big roller, that is then deposited onto the suface it rolls on. The coating is filled in the space between the rollers. In this case, that would be the sheet of malai. The continer will have adjustment capabilities for coatings of different levels of viscosity. The instrument has an attached scraper that can be pushed down to pick up any extra deposition of coating that may have accumulated at the base of the roller.

The instrument is held at the handle, on top of the sheet, farthest away from the user, and then pulled towards the user, rolling over the sheet.

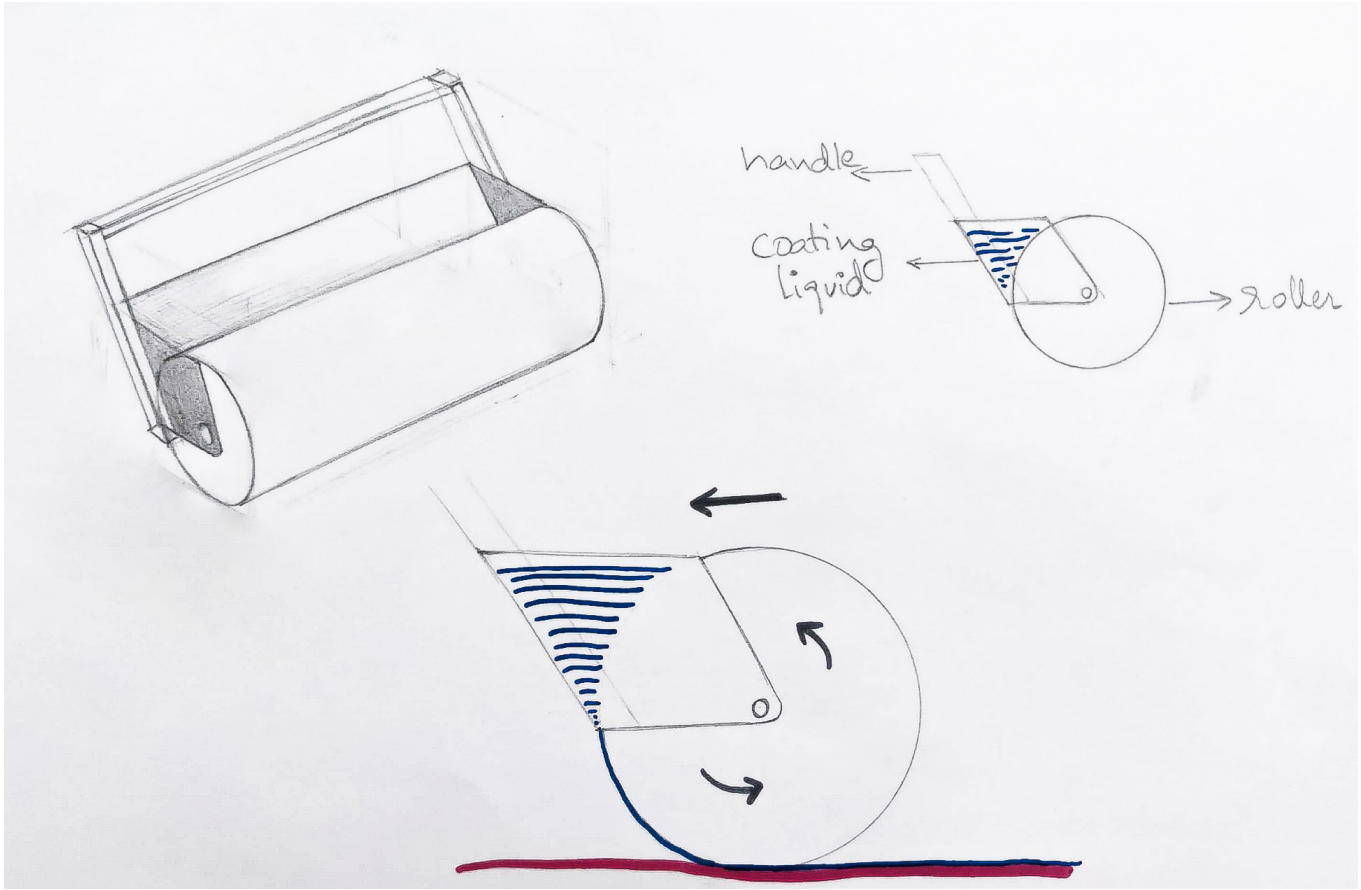


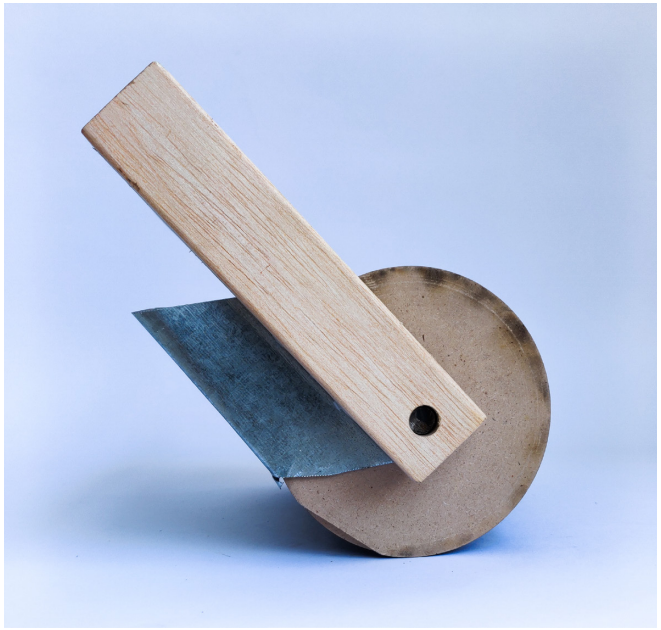

Rolling handle
Small roller
Big roller
Scraper
Frame

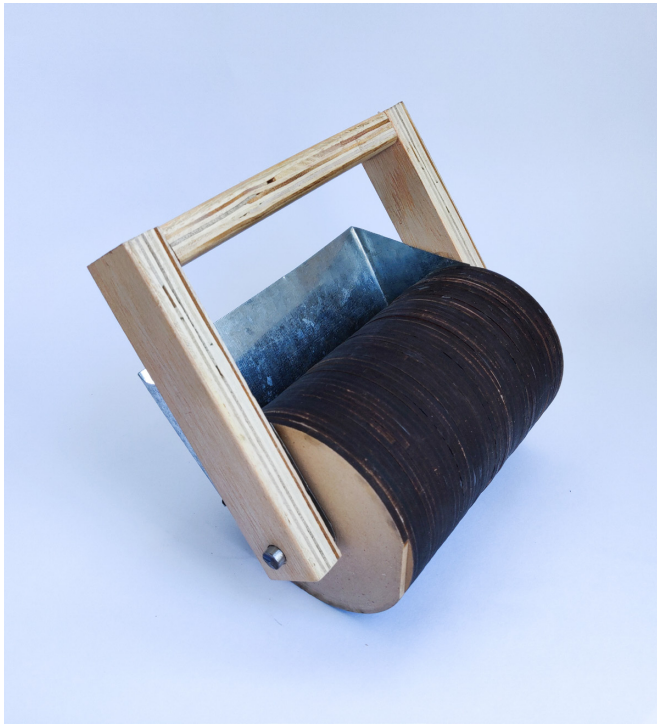
The roller - 2

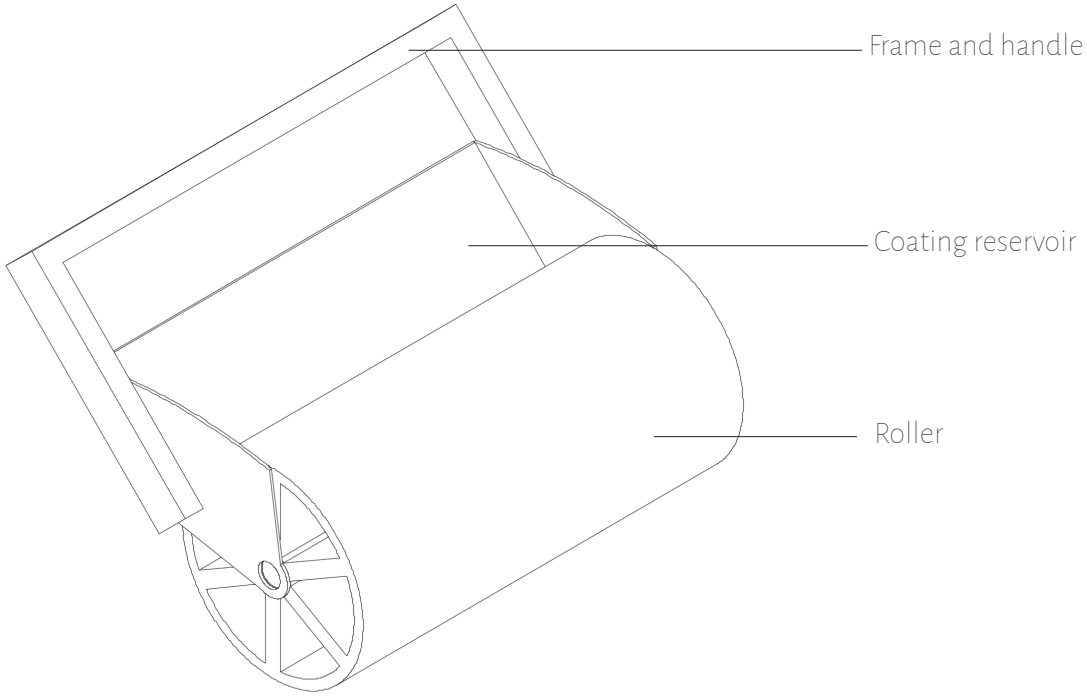
A roller with a container that dispenses a fine layer of coating onto the roller, that is then deposited onto the suface it rolls on. In this case, that would be the sheet of malai. The continer will have adjustment capabilities for coatings of different levels of viscosity.

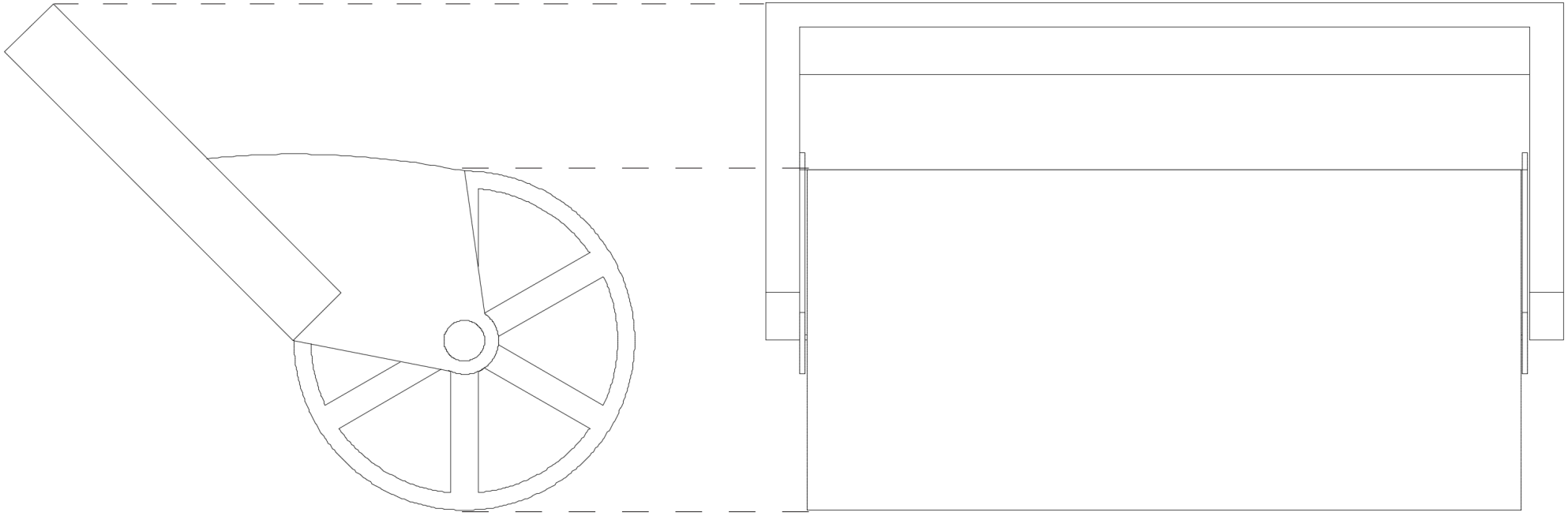
The instrument is held at the handle, on top of the sheet, farthest away from the user, and then pulled towards the user, rolling over the sheet.

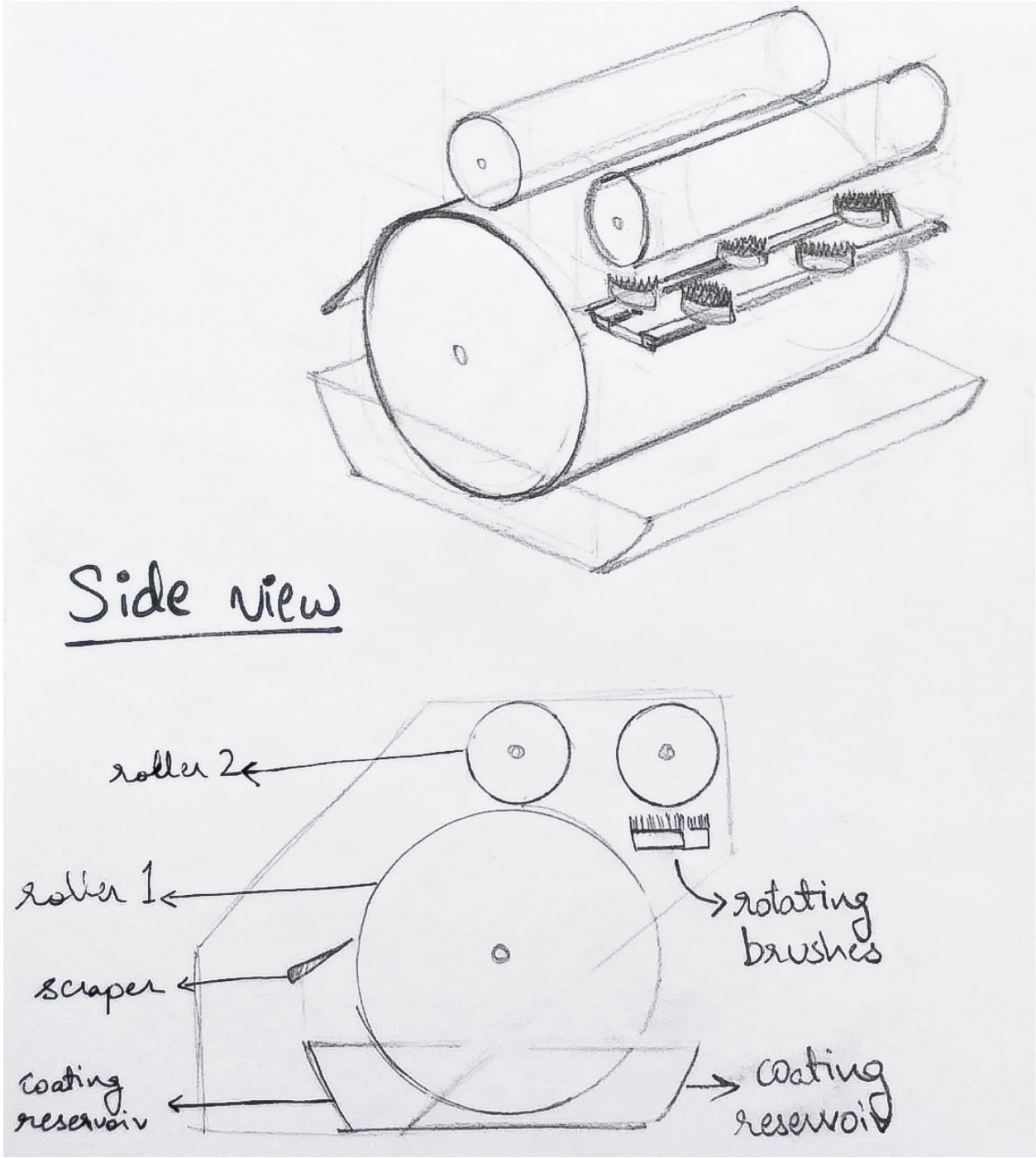






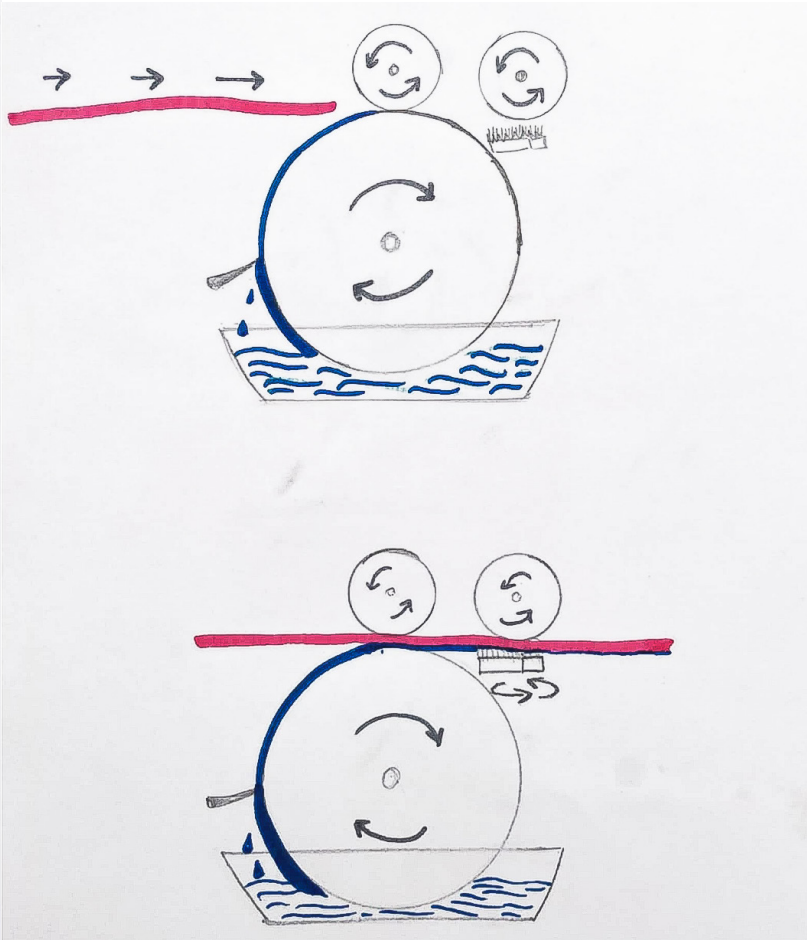

Frame and handle
Coating reservoir
Roller

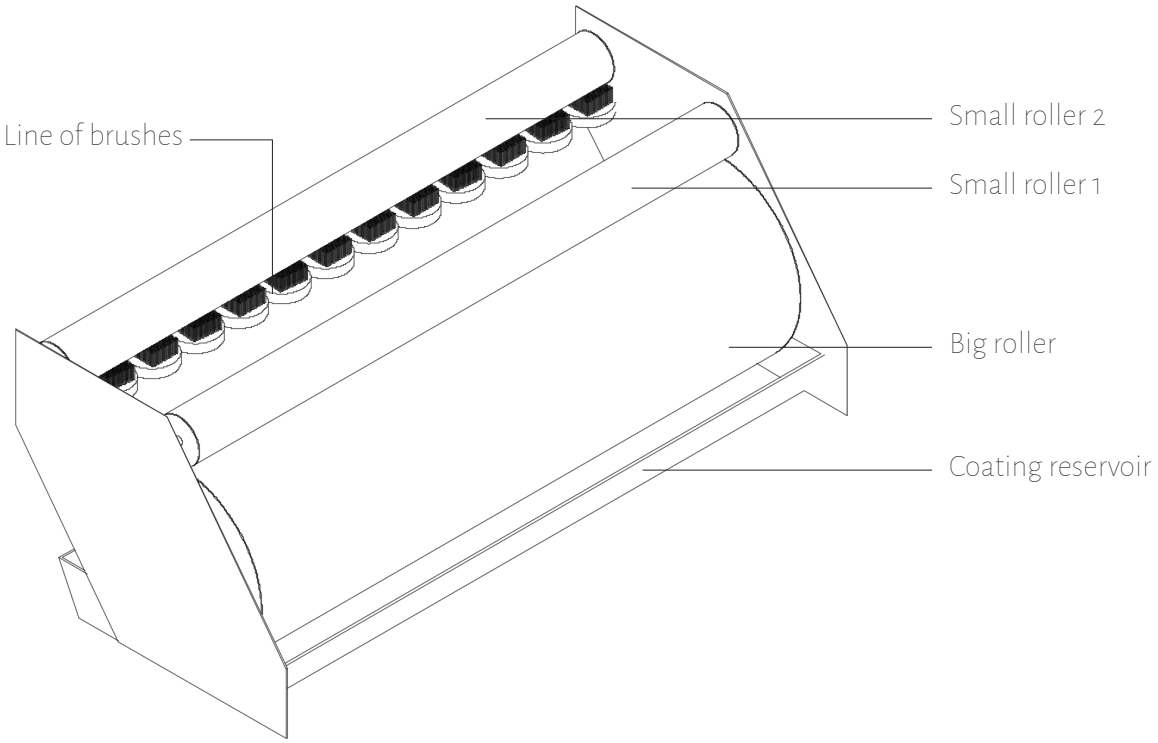


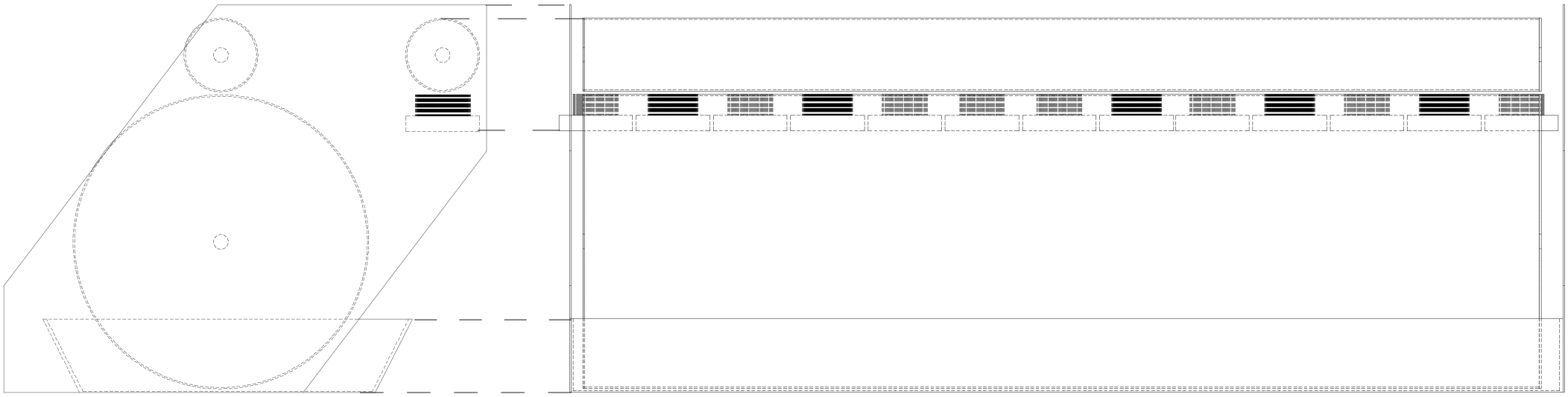


The tub

A big roller is set in a tub of coating, and picks up coating through every rotation. A scraper takes off excess coating on every pass of the roller. This big roller and a smaller roller on the same vertical axis hold a sheet fed into the instrument, and as it passes through the rollers, it picks up the coating from the bigger roller. The sheet then passes over a set of rotating brushes to massage the coating into the sheet.

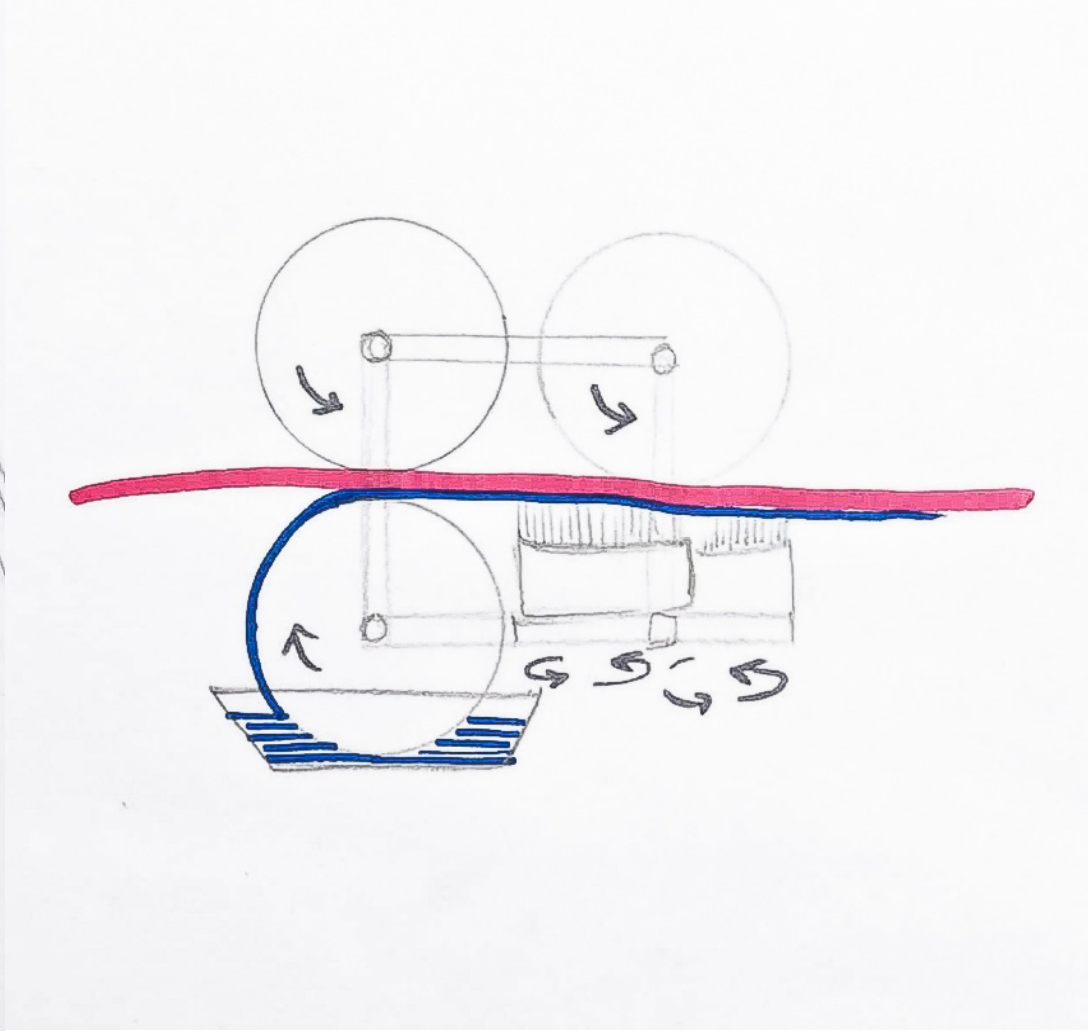


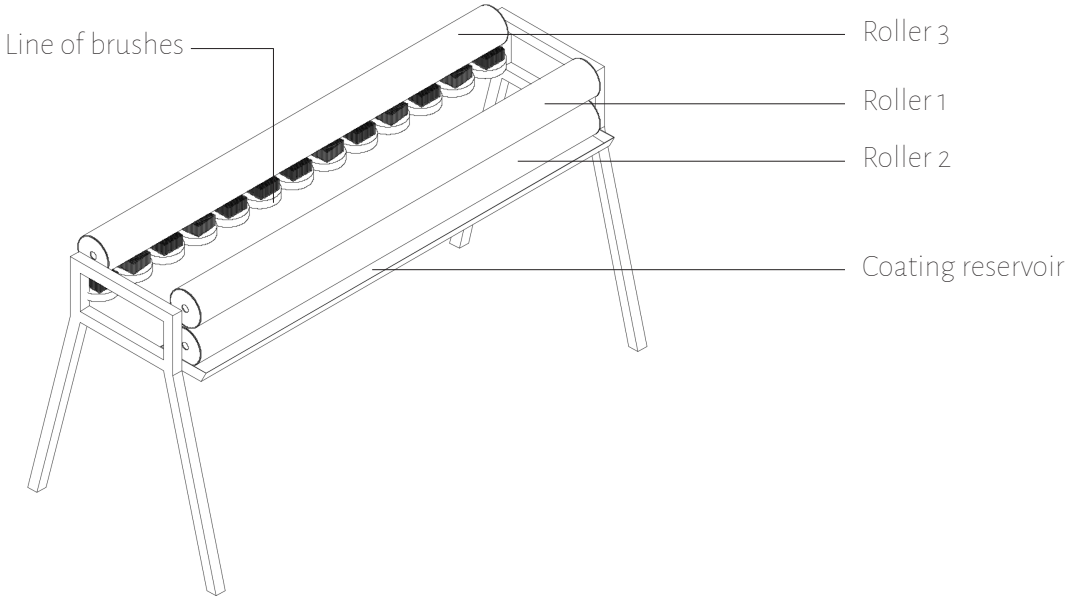

Line of brushes
Small roller 2
Small roller 1
Big roller
Coating reservoir

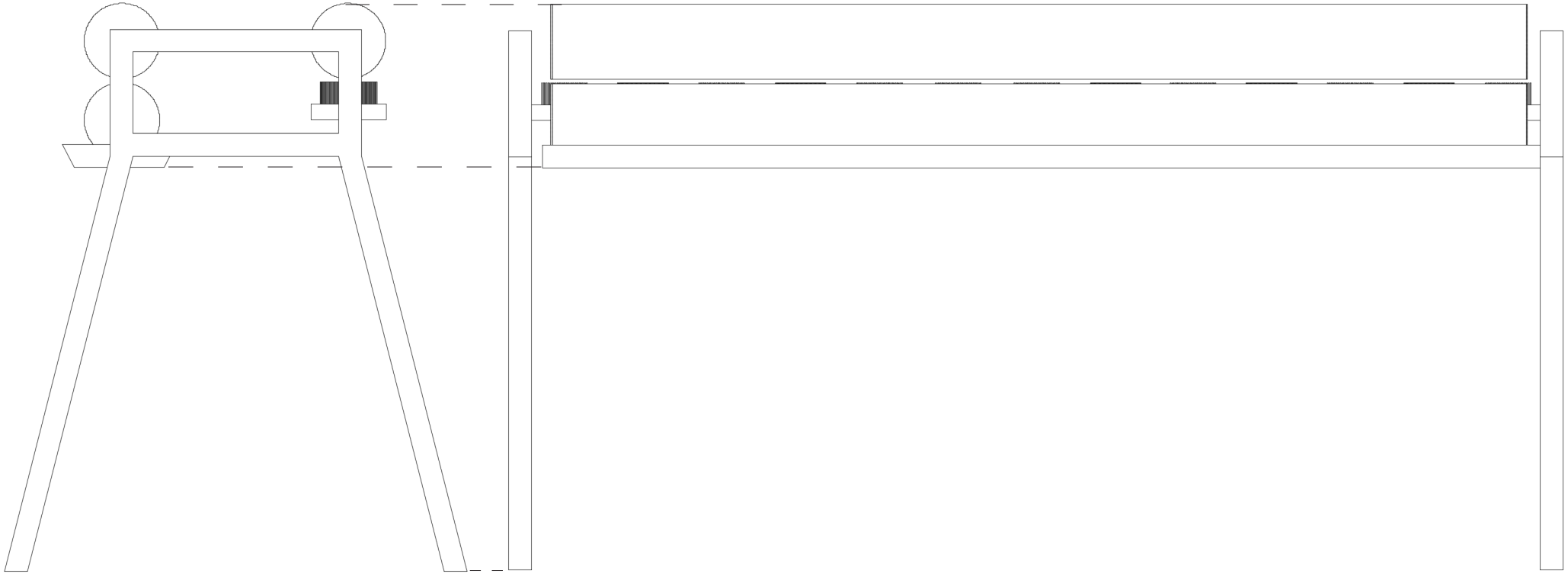


The mini tub

The sheet passes through two small rollers sharing a vertical axis, the lower one of which is dipped in a small but long container of coating, that it picks up with every rotation and deposits onto the sheet that is passing through the rollers. This concept is a varient of the previous concept, with a smaller coating reservoir whose weight can be supported by a standing structure, so that no stooping and bending is required to operate the machine.

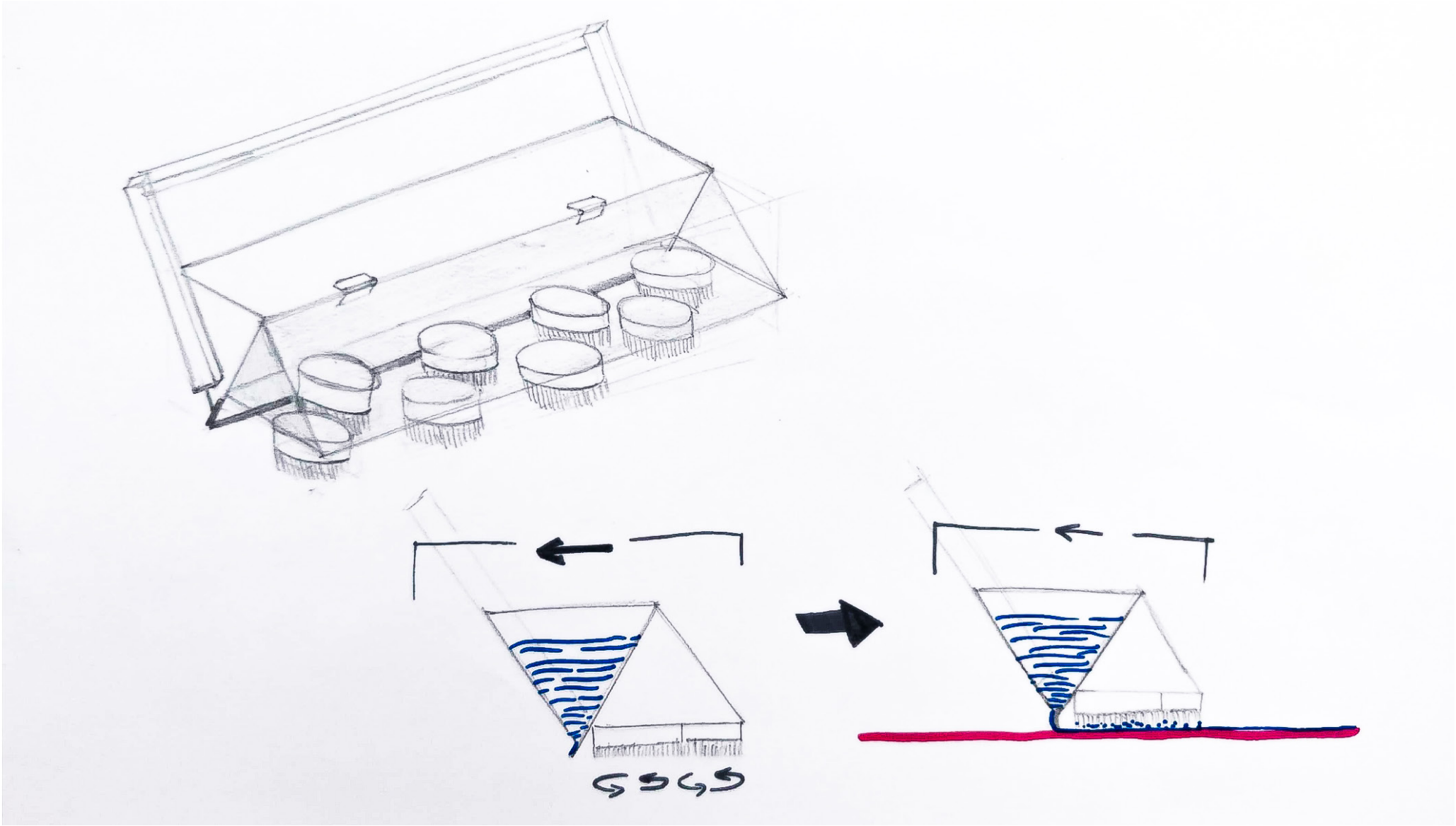


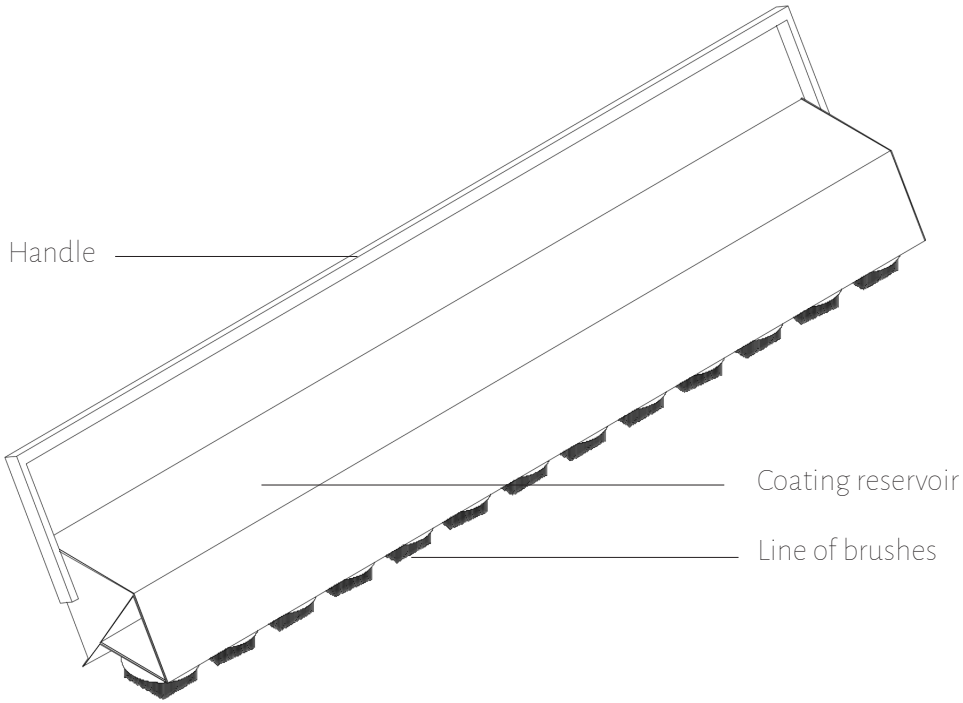

Line of brushes
Roller 3
Roller 1
Roller 2
Coating reservoir

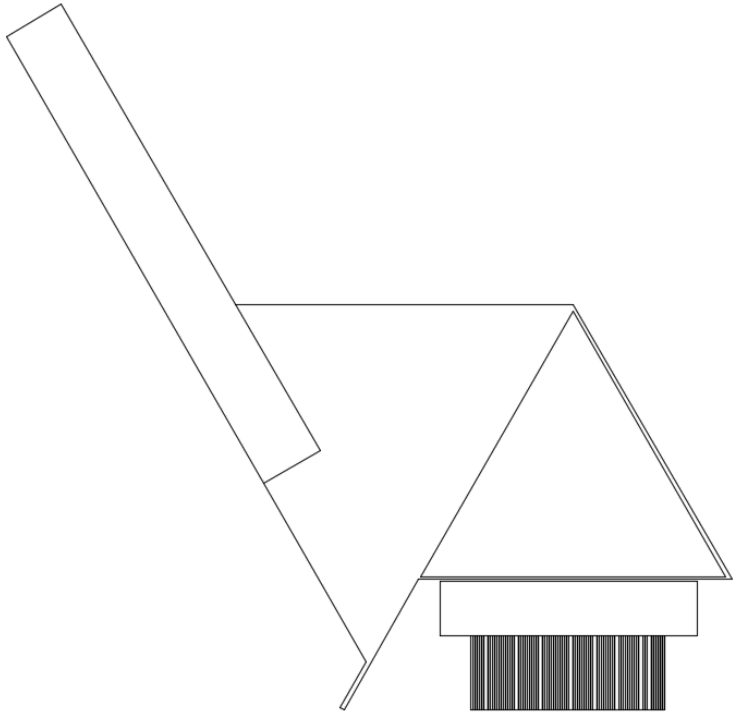


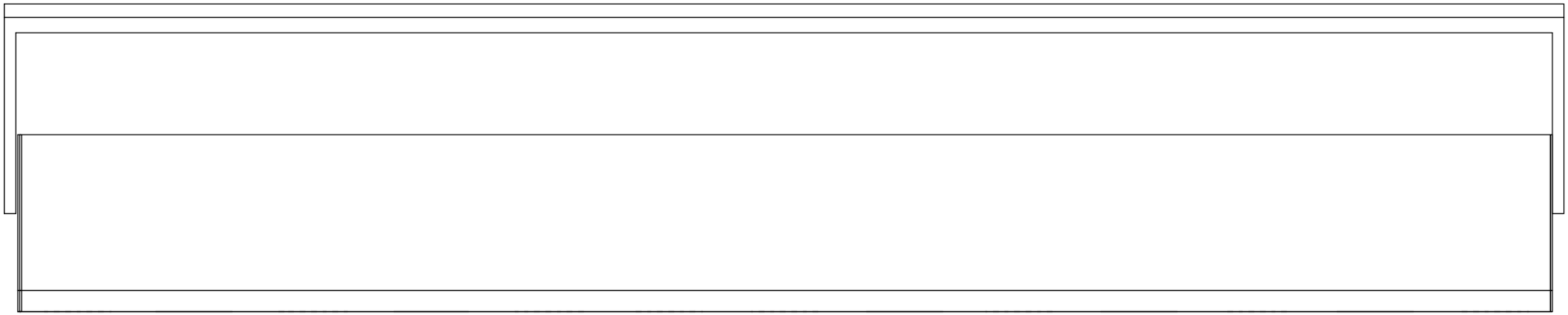
The Prism

An inverted prism that dispenses a fine, even layer of coating through its slit of an opening is connected to a handle that you can hold the instrument with, and two rows of rotating brushes that serve the purpose of removing any excess coating or massaging the coating into the sheet. the instrument is handheld and meant to be held farthest away from the user and pulled towards them.



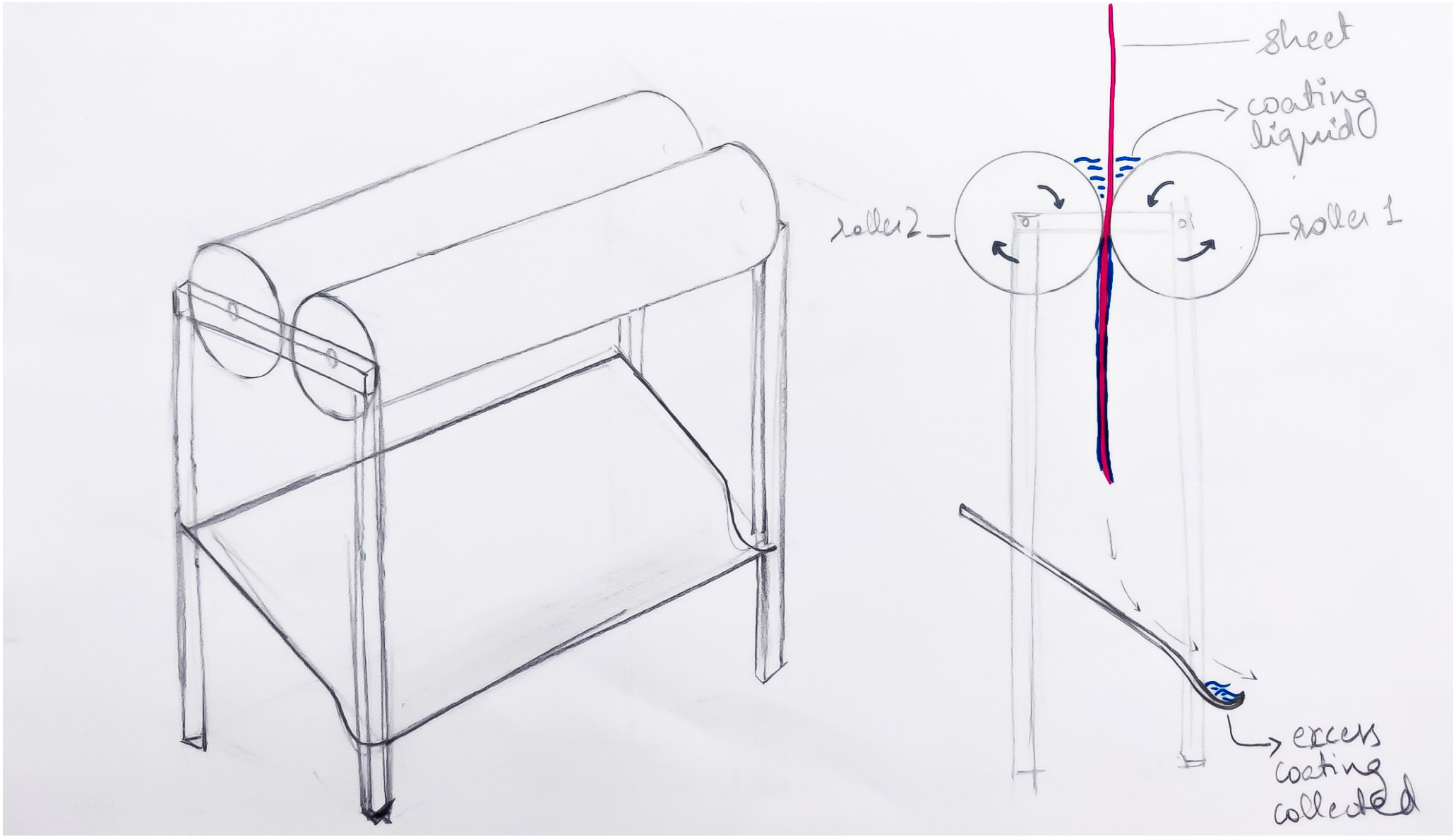

Handle
Coating reservoir
Line of brushes

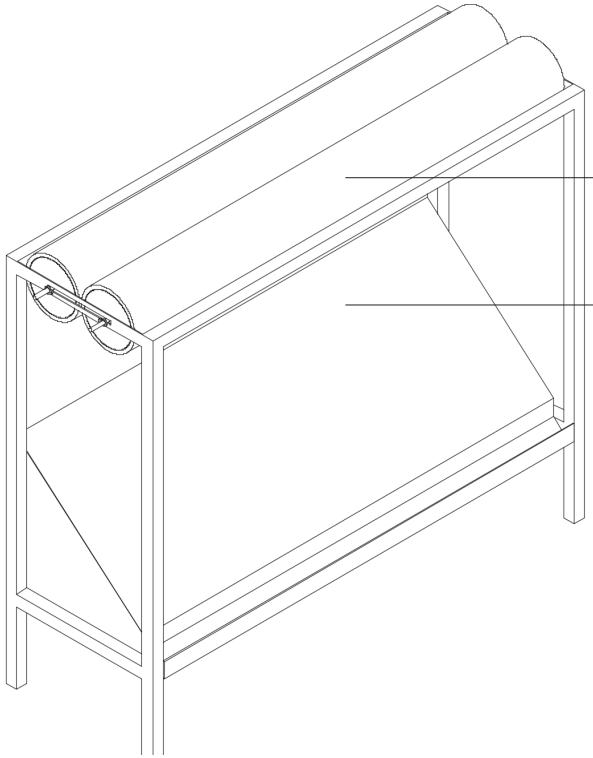


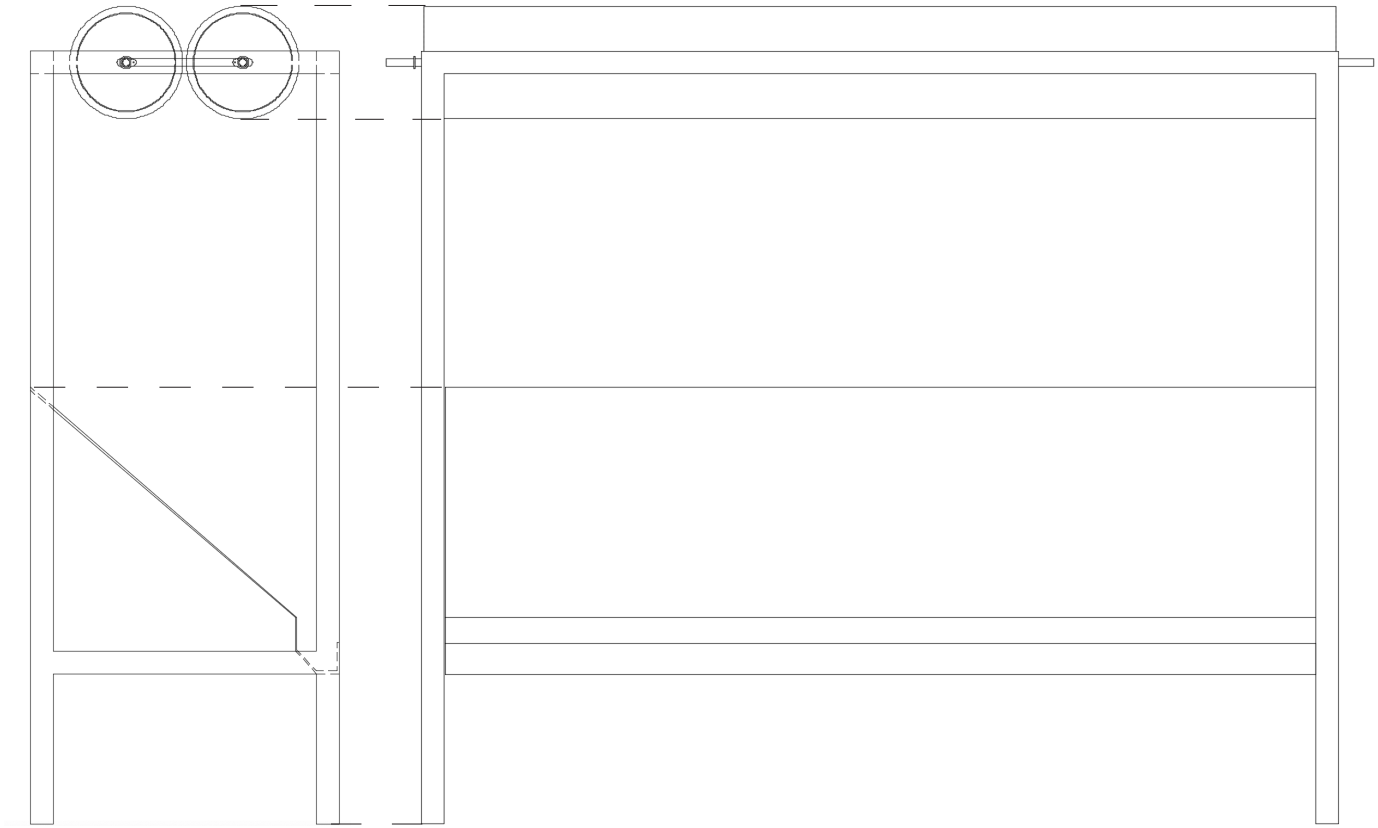


The roller reservoir

An inverted prism that dispenses a fine, even layer of coating through its slit of an opening is connected to a handle that you can hold the




Rollers
Landing pad



Narrowing down:

Since the prototyping phase was cut short due do uncertainity of the pandemic, I decided to set of another way of validating the ideas and deciding which would work the best.

Each of these complex ideas have been broken down into simpler process bits, which will be mixed and matched to see which works best

Coating

- deposite coating onto sheet
- distribute coating over sheet
- massage coating into sheet

List of user needs (from observation and conversation) and user wants (from direct questioning) →

- even coating
- remove excess
- avoid pooling
- avoid collecting in cervices (due to texture)
- massage into sheet

? Standing machine (not handheld

? dries sheet somewhat

? shifts sheet to a drying rack/mesh

? has a drying rack/mesh

Determining what mechanisms best match the requirement

Deposit and distribute

criteria-> Ideas v	Distribute coating	Avoid pooling	Massaging into sheet	Reach ends	Remove excess	Measured amount	total
Scoop, drop and scrape	1	0	0	-1	1	-1	0
deposit from container (graduated)	1	0	0	0	0	1	2
dip and remove excess	1	-1	-1	1	1	0	1
pass through liquid	1	-1	0	1	-1	-1	-1
pass through rollers (pool of liquid)	1	1	0	1	1	0	4
coating transfer from roller to sheet	1	1	-1	0	1	1	3
fill roller with mesh with coating	1	-1	0	1	-1	0	0

Distribute and massage

criteria-> Ideas v	Distribute coating	Avoid pooling	Massaging into sheet	Reach ends	Clear out of crevices	Start drying sheet	total
hard scraper	1	1	-1	-1	-1	0	-1
soft scraper	1	0	-1	-1	1	-1	-1
line of bristles	1	0	0	1	1	0	3
line of rotating brushes	1	1	1	1	1	1	6
pass between massaging rollers	1	1	-1	1	-1	1	2
pass between series of tight rollers	1	1	-1	1	0	1	3

The winning combination seems to be passing through rollers with a pool of the coating liquid, and then rotating brushes to finish.

The chosen concept

Through rollers and coating pool

+

Rotating brushes

Description

- The sheet is passed through the rollers, vertically from the top, as the sheet gets first dunked in coating and the passed through the rollers hence squeezing out the excess coating, taking a total of a maximum of five seconds.
- As the sheet emerges on the other side of the rollers, slowly rotating brushes serve the function of massaging the coating into the small crevices of the sheet, while removing or evenly distributing the coating over the sheet for better absorption.
- Once passed through the rollers, the sheet hits a diagonal landing pad that gives the opportunity for the sheet to fall onto a waiting mess drying rack that can be instantly carried away, or for the sheets to stack up neatly at the base of the machine and be carried away to dry.
- In the event of the manufacture of a more elaborate drying system, a simple contraption could be made to connect the two, or transfer from drying racks to the drying machine seems reasonable too.

Concept model

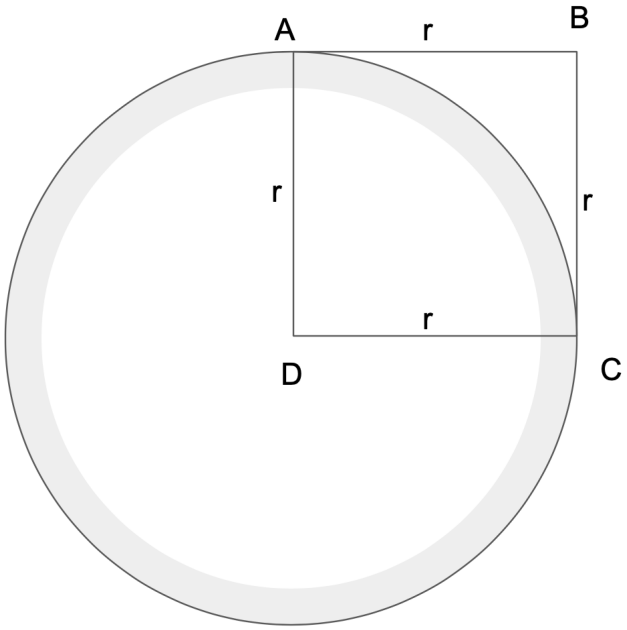
This concept checks most boxes in terms of user needs, but calculation and further thought revealed that it has some drawbacks:

- The volume of coating it can hold is too little, and would require refills every 4-5 sheets, which defeats the main purpose of the machine - to save time.
- To feed in a sheet vertically would not be comfortable, especially for a short person, and if the machine were low enough then collection of the sheet would be uncomfortable.
- There would always have to be a seperate container on hand/ by the machine to refill it

All this indicated the need for an alternate concept to be chosen.

Calculations

Volume of coating between rollers:



= Length of rollers * 2 * ($Area_{ABCD}$ - $Area_{ADC}$)

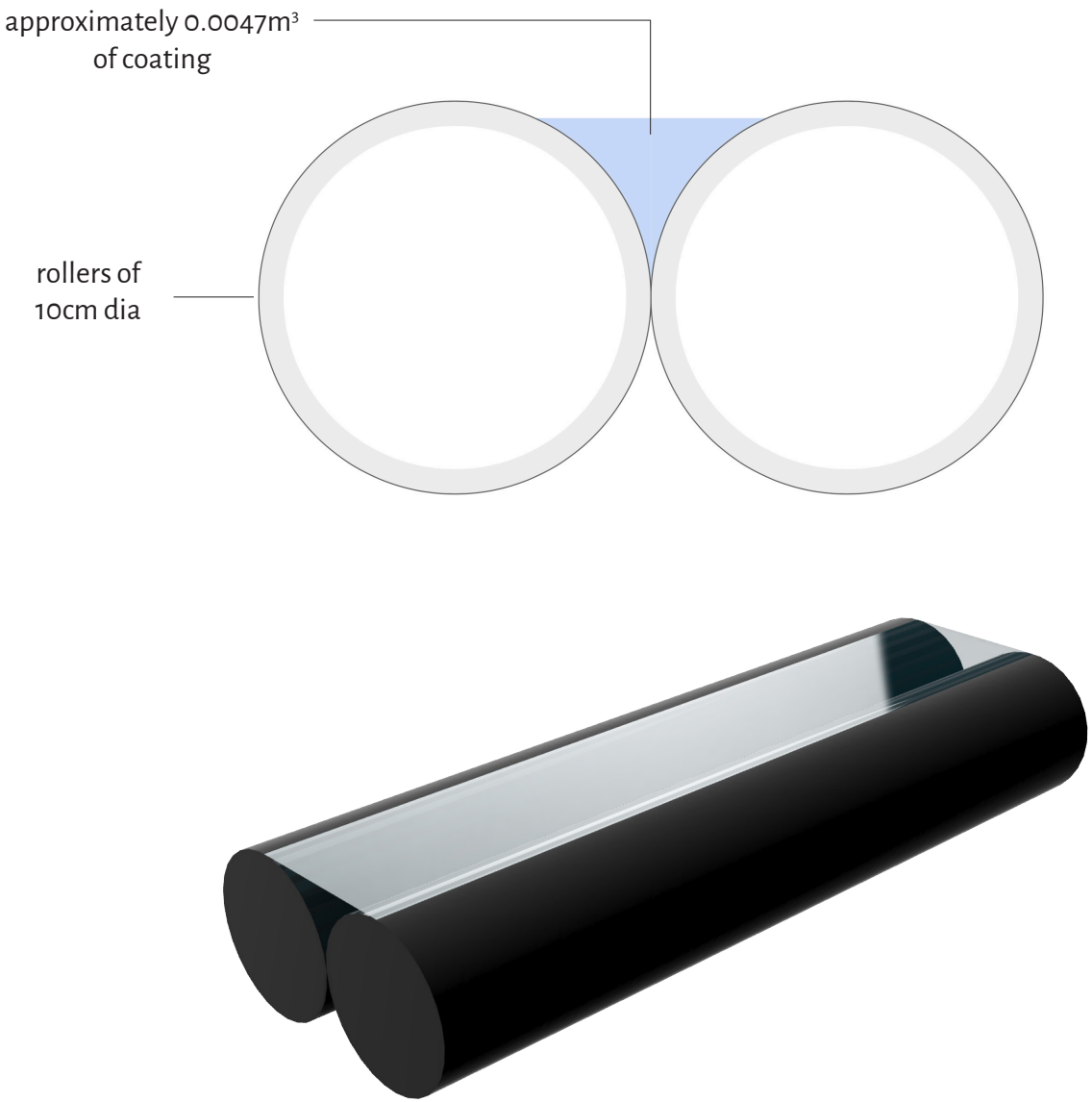
= Length of rollers * 2 (r^2 - ¼(πr^2))
= Length of rollers * 2 ($4r^2$ - πr^2)/4
= Length of rollers * ¾r^2

If length of rollers is 1100mm
Volume of coating = 33/10 $r^2 m^3$

if r = 10cm (radius of roller)

$V_{coating}$ = (33/70 * 0.1 * 0.1) m^3
=0.0047m^3 - a little off the top
(coating of approximately 5 sheets)

Bigger rollers would be too heavy to move easily, and that would hinder the adjustability of the gap.



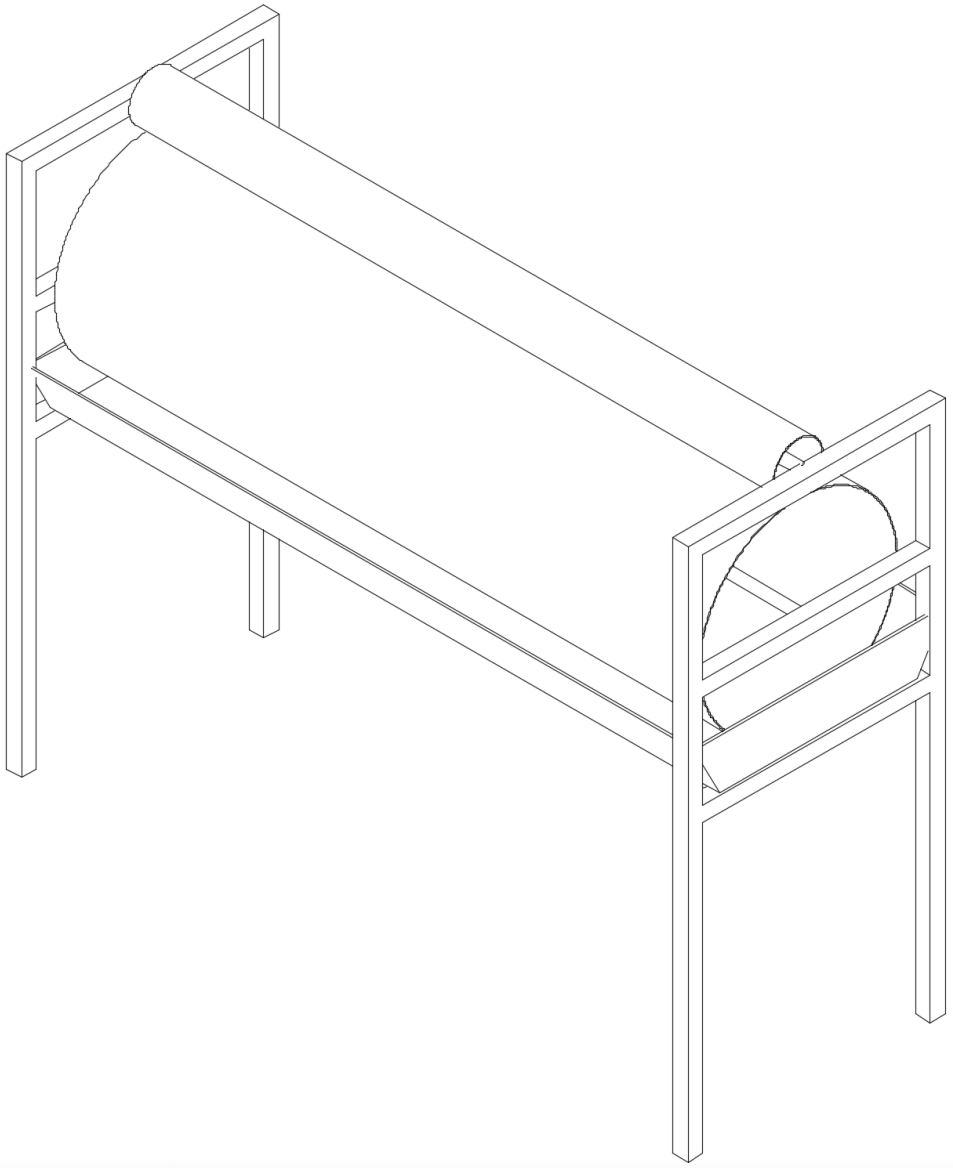
A 3D visualization of the amount of coating the two rollers can hold

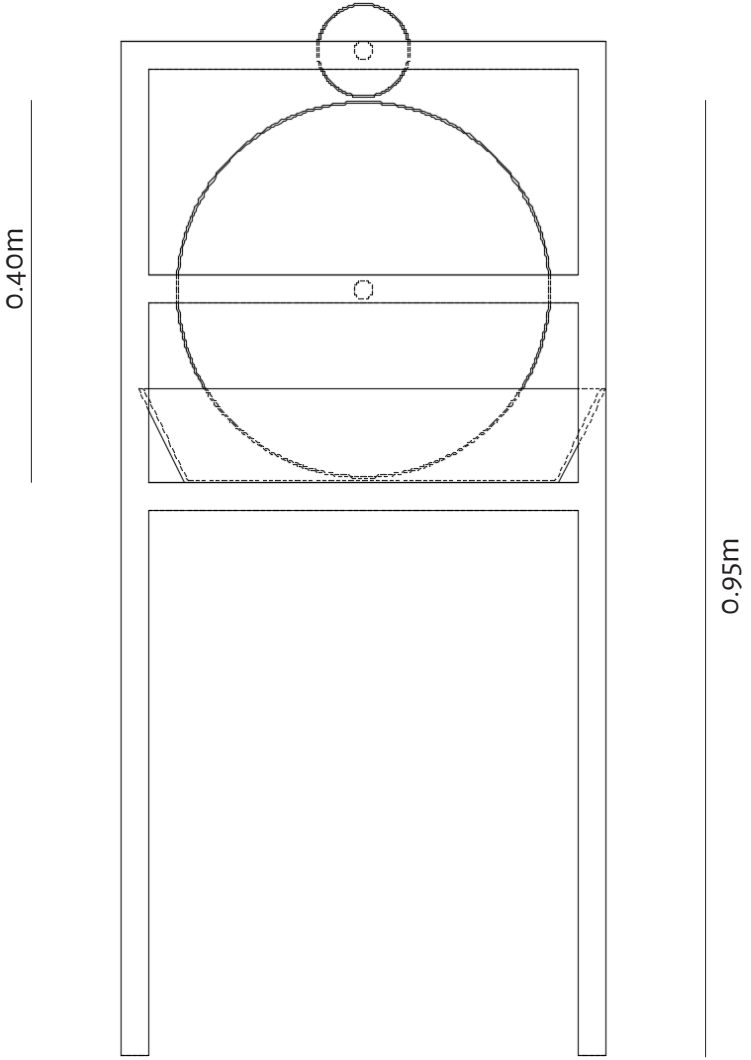
Second pick of concept: The Tub

The biggest problem with the Tub is that while there is sufficient capacity for the coating, the machine is too low to be comfotable to use, and the mini tub just doesn't have the capacity for enough coating.

A combination of the two concepts has been considered for the final concept.

Elevating the mechanism gives it a comfortable height along with a good volume of coating.
For a 5 and a half foot tall person, the sheet should now be at a feeding height around the elbow.





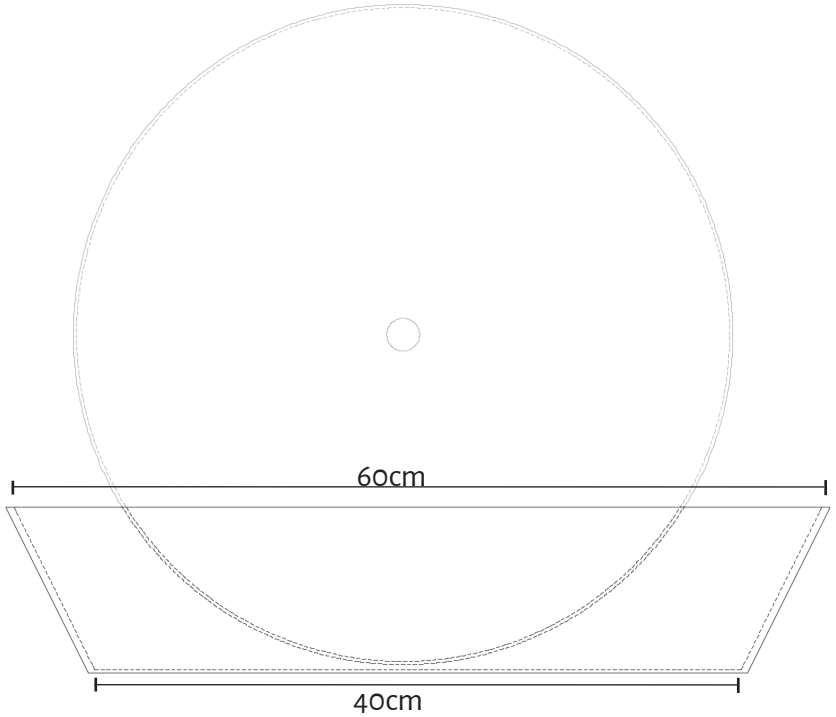
Volume of tray $= 55 * 10 * 110\ cm^3$
$= 60{,}500\ cm^3$

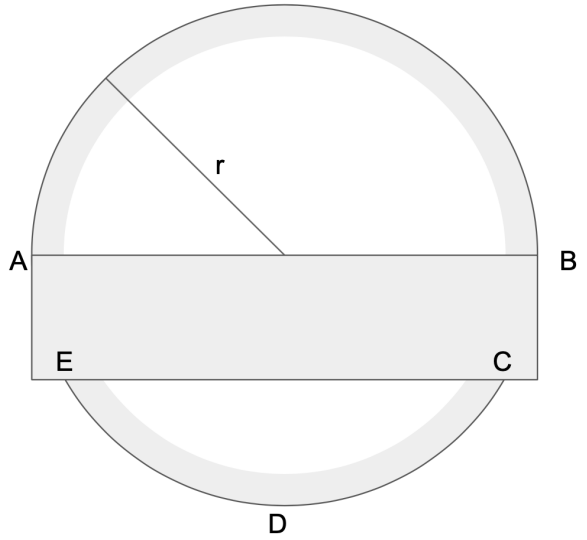
Volume of coating $= V_{tray} - V_{roller}$

V_{roller} = Volume of CDE
$\approx (½ (\pi r^2) - Area_{ABCE}) * \text{length of rollers}$

$r = 20cm$
$V_{roller} \approx ((400\pi)½ - (r/2 * 2r)) * \text{length of rollers}$
$\approx (200\pi - r^2) * \text{length of rollers}$
$\approx ((200 * 2\,2 - 400 * 7)/7) * \text{length of rollers}$
$\approx ((200 * 2\,2 - 400 * 7)/7) * \text{length of rollers}$
$\approx 1600 * 110 / 7$
$= 25{,}142.9\ cm^3$

$\therefore V_{coating} = 60{,}500\ cm^3 - 25{,}142.9\ cm^3$
$= 35{,}357\ cm^3$
(Enough to coat about 40 sheets)



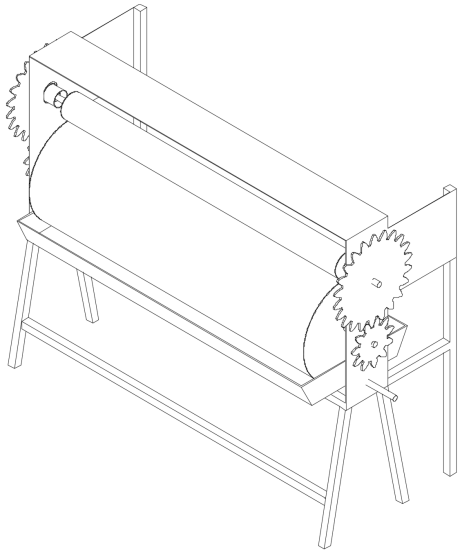


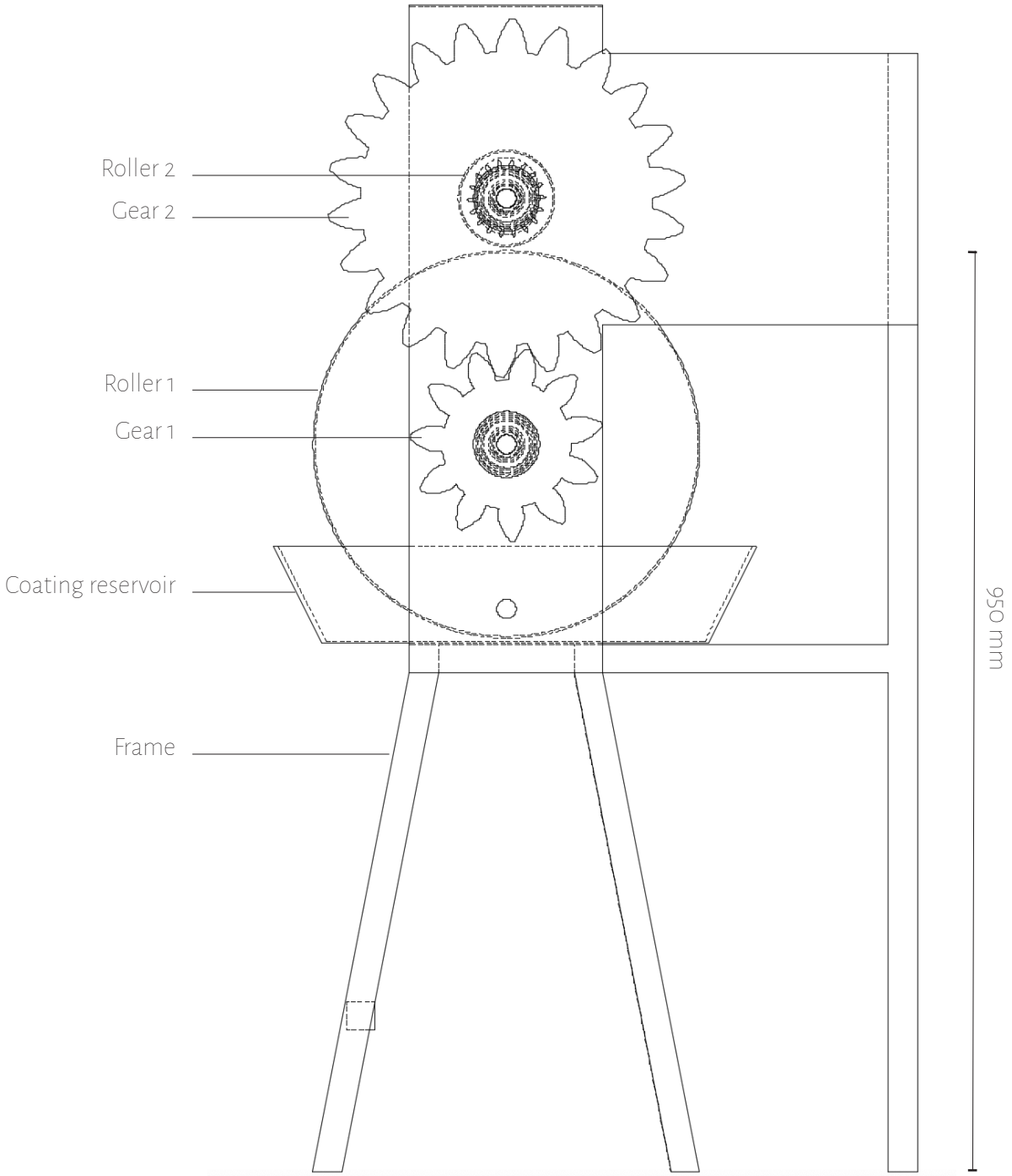
Detailing

The rollers

Gear 1 is run by a motor at 75 rpm, and is attached to Roller 1, which starts to rotate at the same speed. Gear 1 drives gear 2 (at half the speed) which makes roller 2 rotate at half the speed of roller 1, this keeping the speed of the surfaces same, relative to each other.

The feed height of the machine is at 950m, which is around elbow height for the 50th percentile of the Indian population.

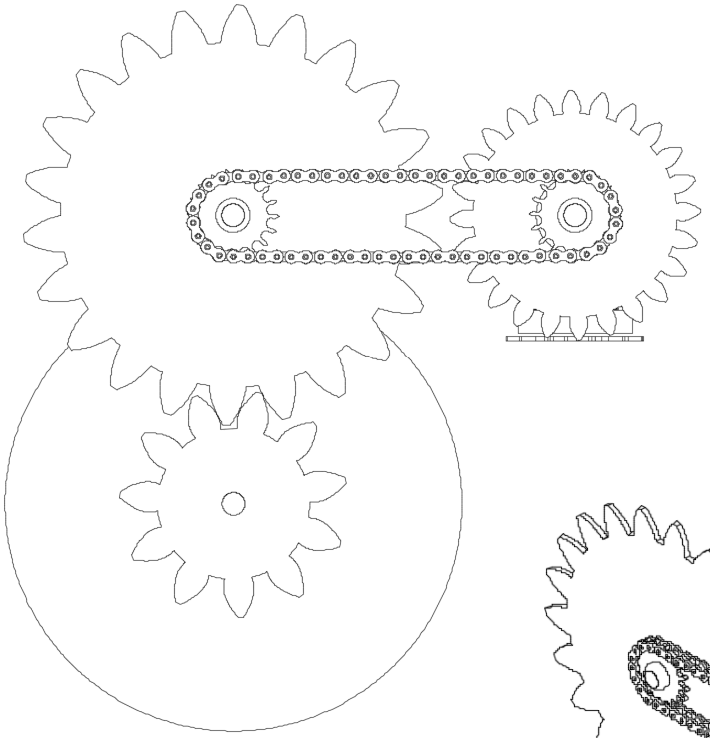


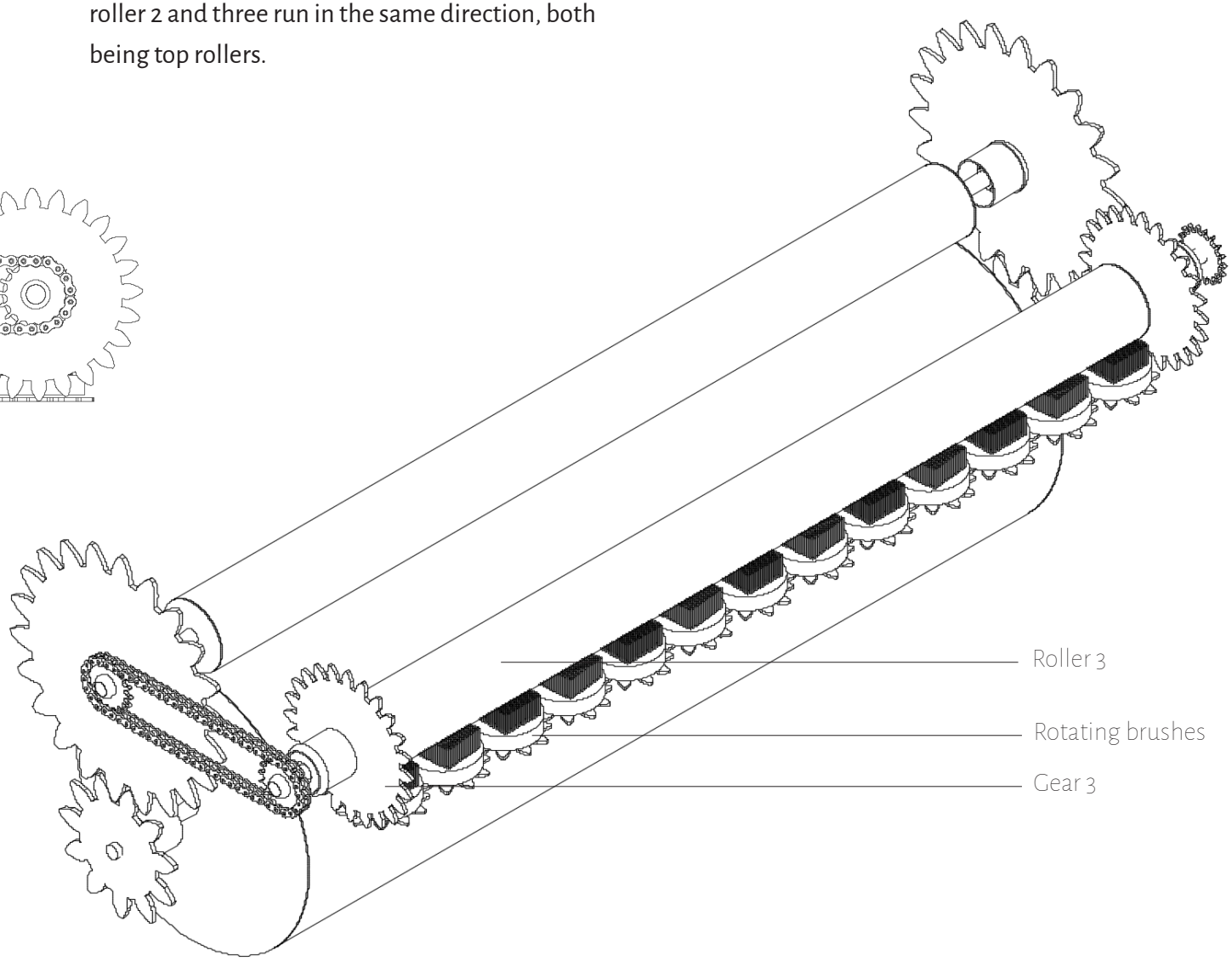


The brushes

The rotatory motion is carried further by connecting the motion of roller 2, using a cycle sprocket and chain links, to roller three and thus driving gear 3.

Gear 3 drives several smaller gears, in turn, that are connected to small (cleaning) brushes at a 90 degree angle. Rollers 1 and two run in opposite directions to allow the sheet to pass through, and roller 2 and three run in the same direction, both being top rollers.

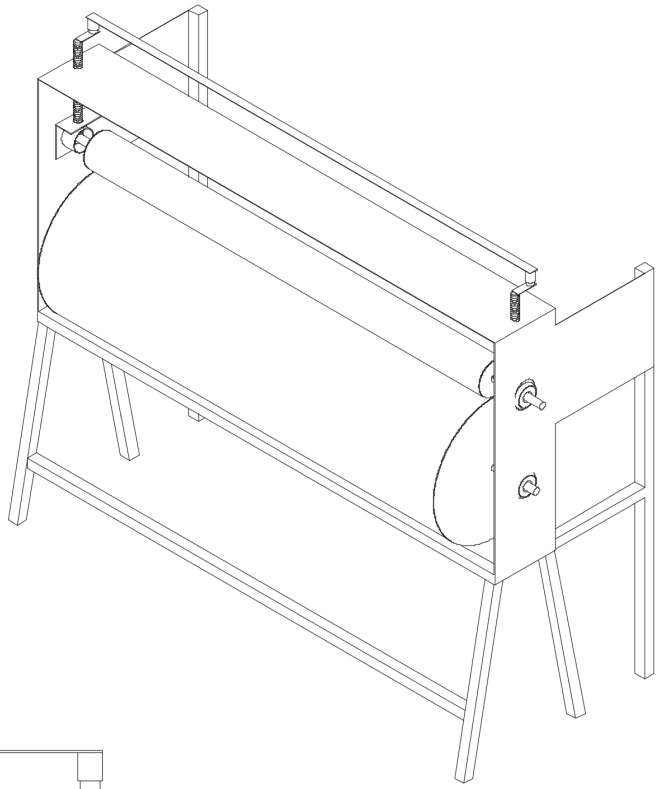


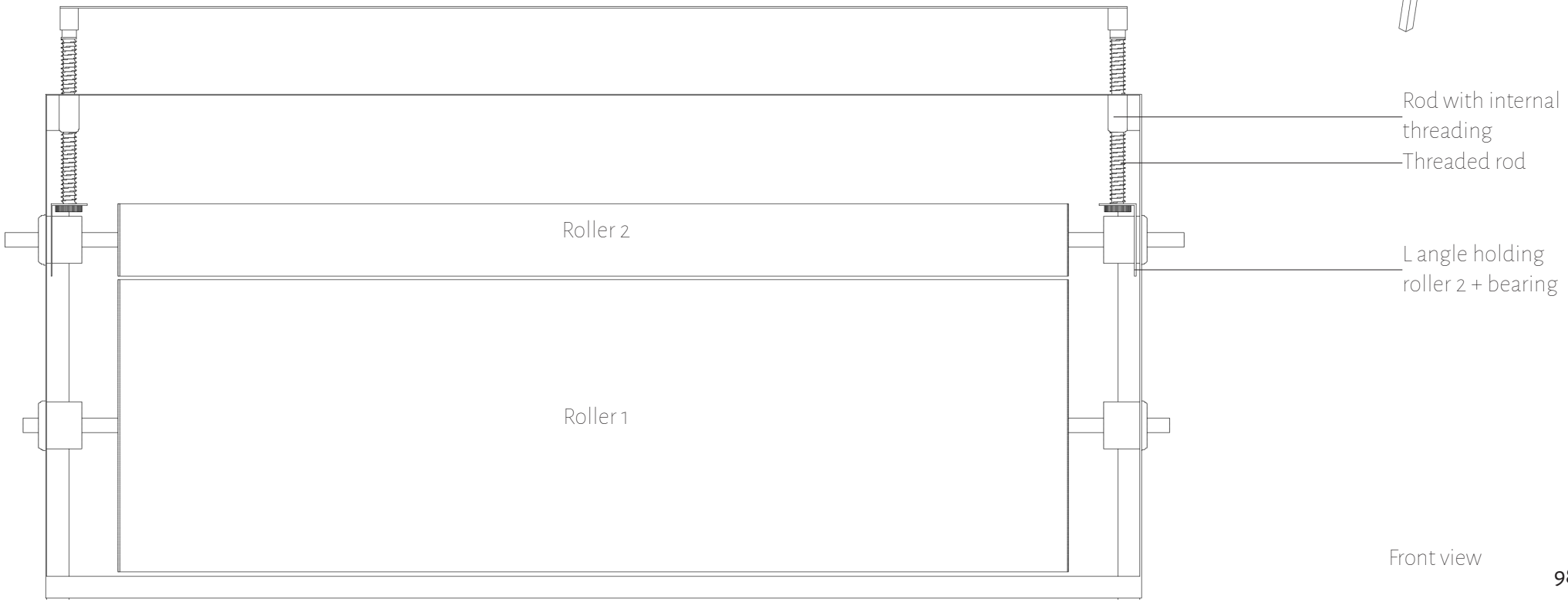


Adjustability

Roller two can be moved up and down by a 1.5cm margin to accomodate different GSMs of sheets.

The roller is not fitted to the frame directly, it us held in place by L angles that have threaded rods passing through them. these rods can be screwed in to push the roller down, and screwed out to pull the roller up. The threaded rods end with small horizontal rods that hold a connecting rod. This connecting rod can be rotated to easily screw in and out the threaded rods.

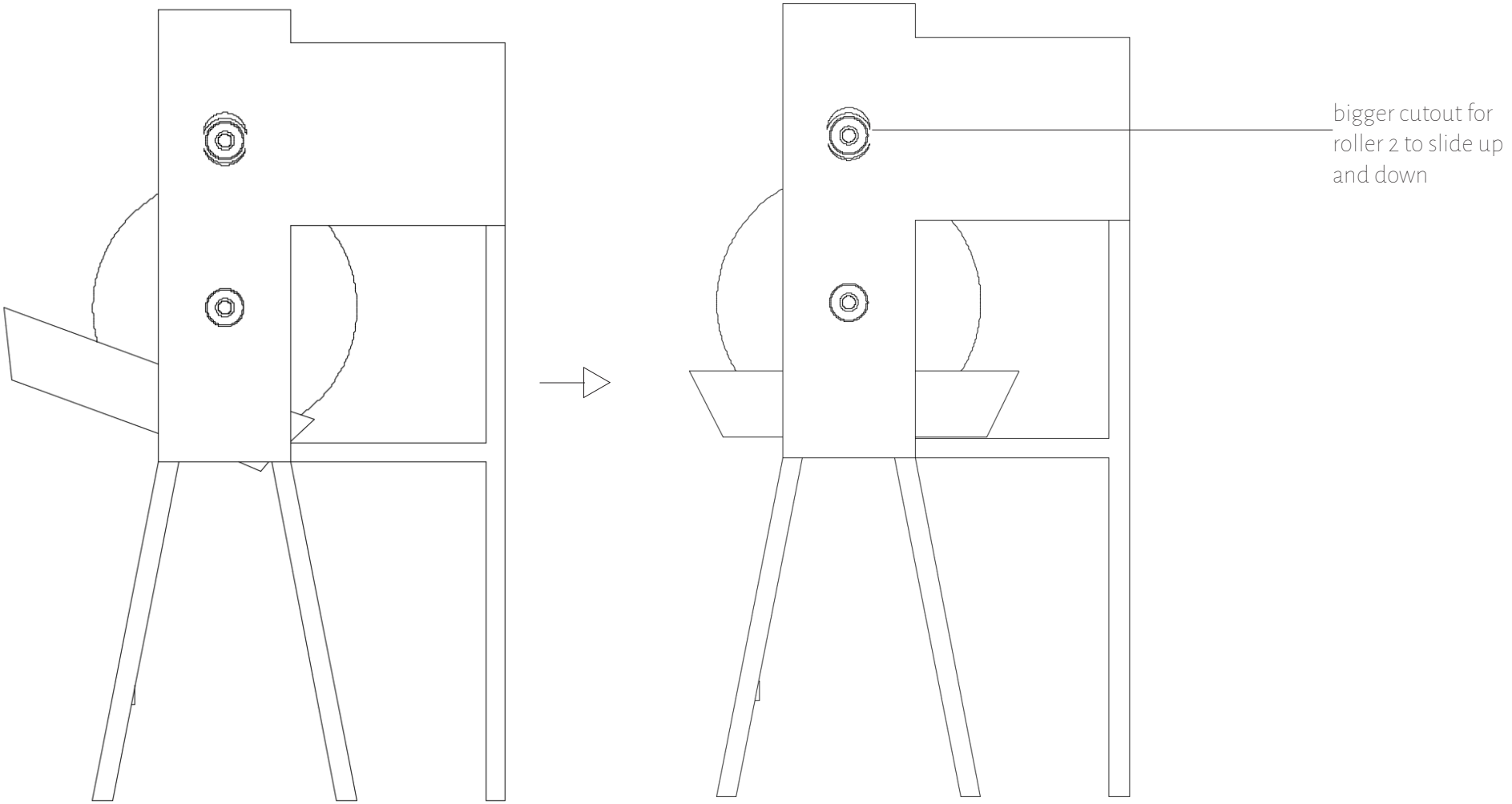




Front view

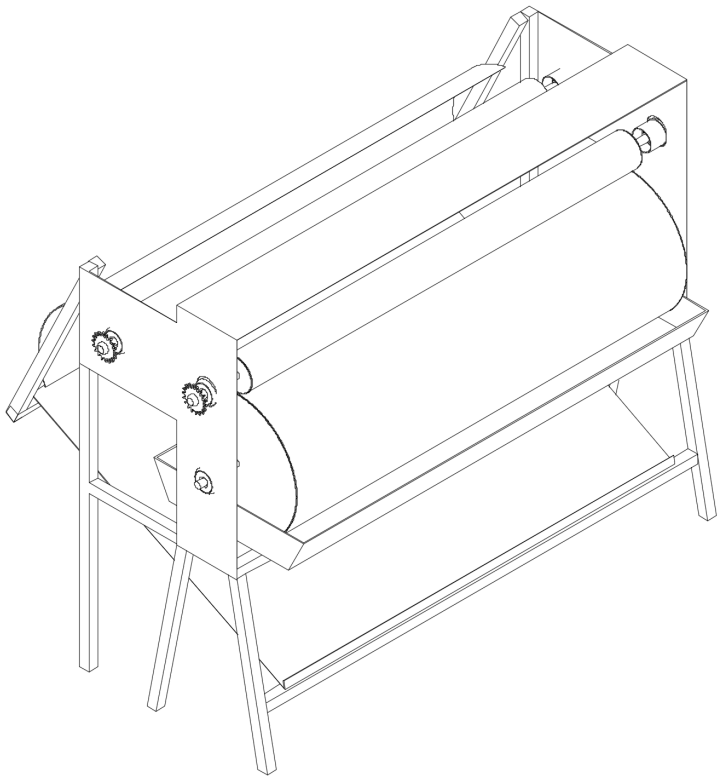
The tub

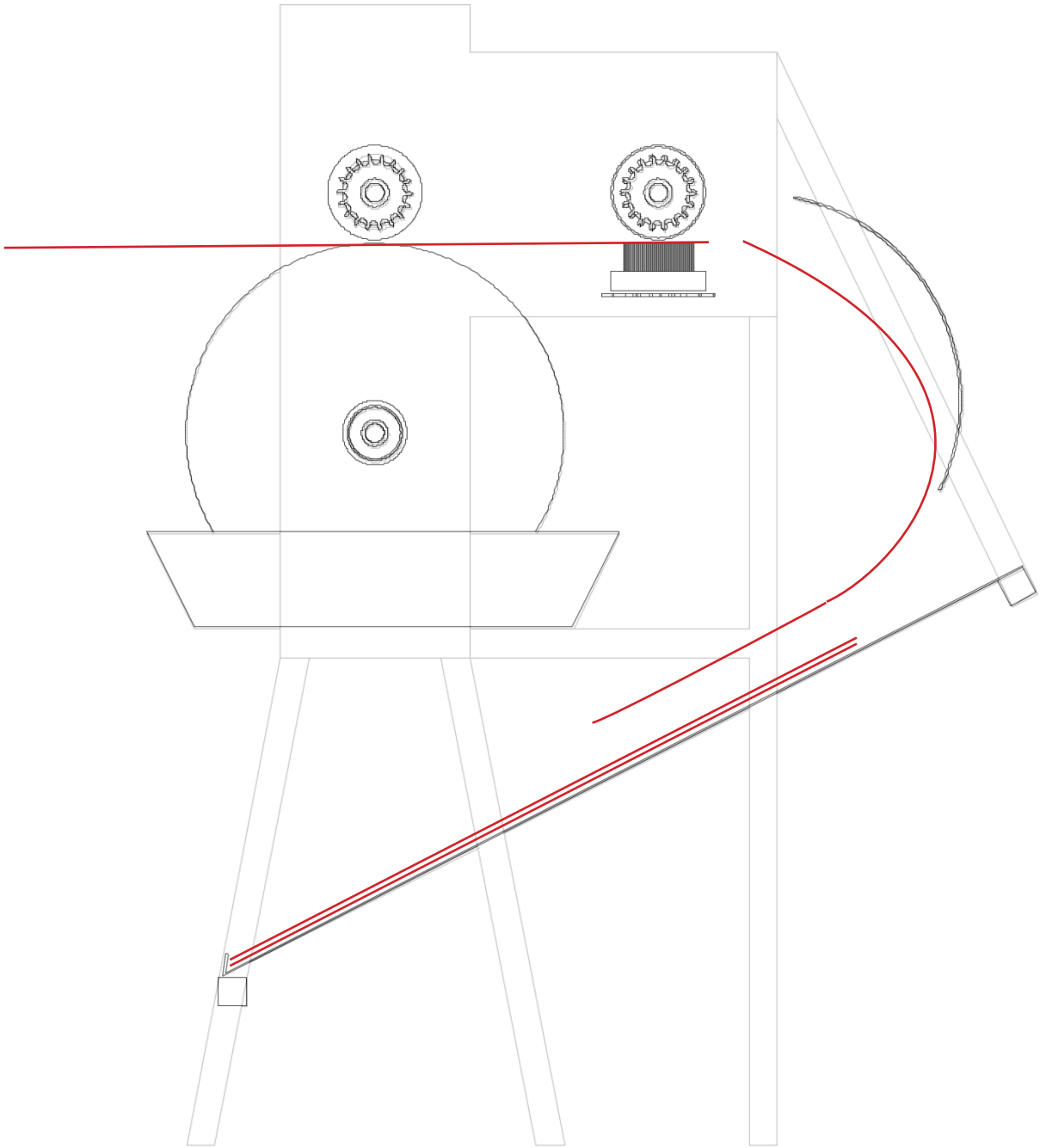
It rests on the base of the frame, and can be easily slid in and out, manually. This makes cleaning easy.



Landing pad

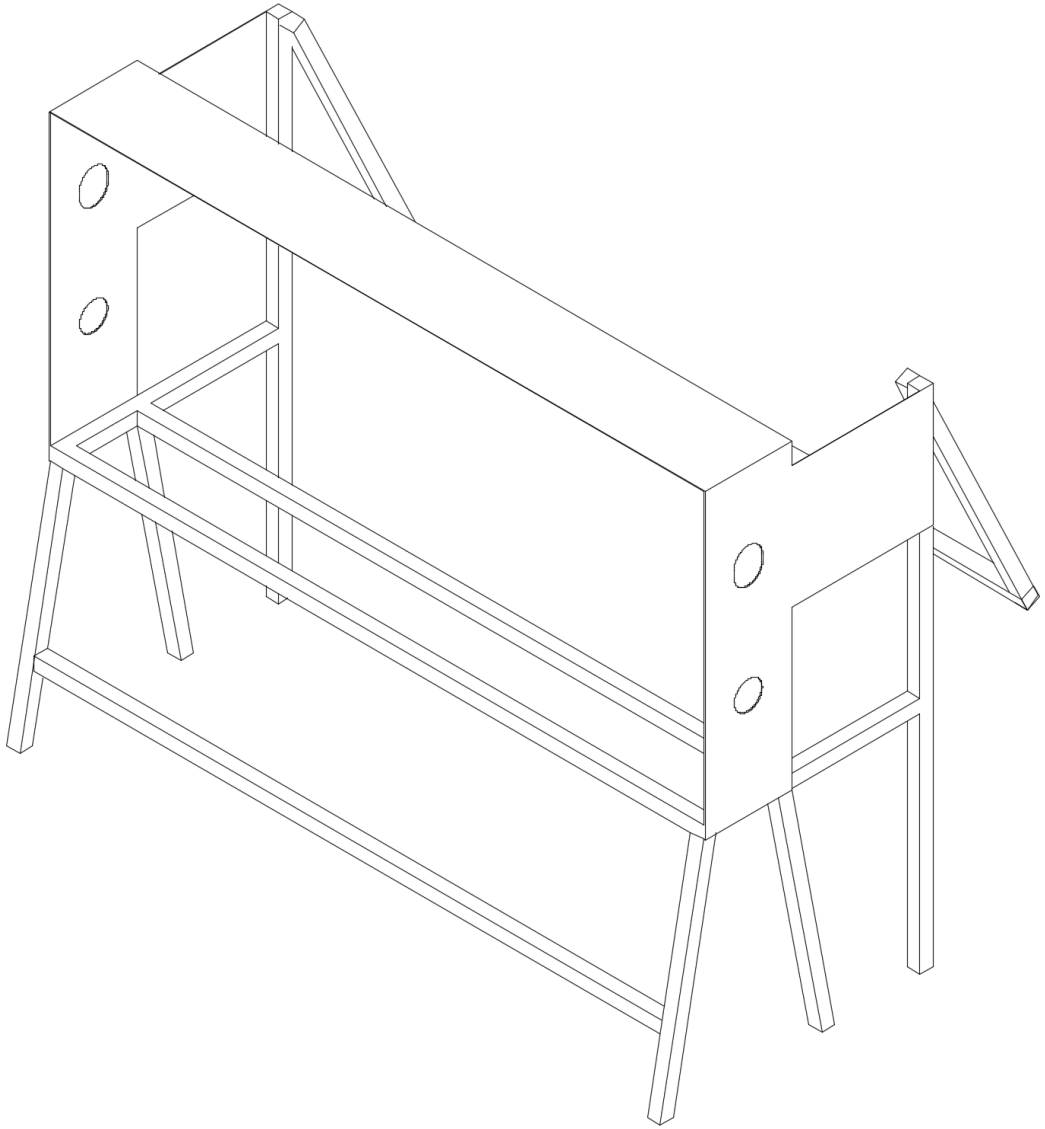
The sheets once coated hit a downward surface, and finally settle on a landing pad. Sheets can be collected here or can be picked up after one side is coated, and refed into the machine to coat the other side. Same side output reduces time lost in movement and allows the machine to be easily handled by one person.



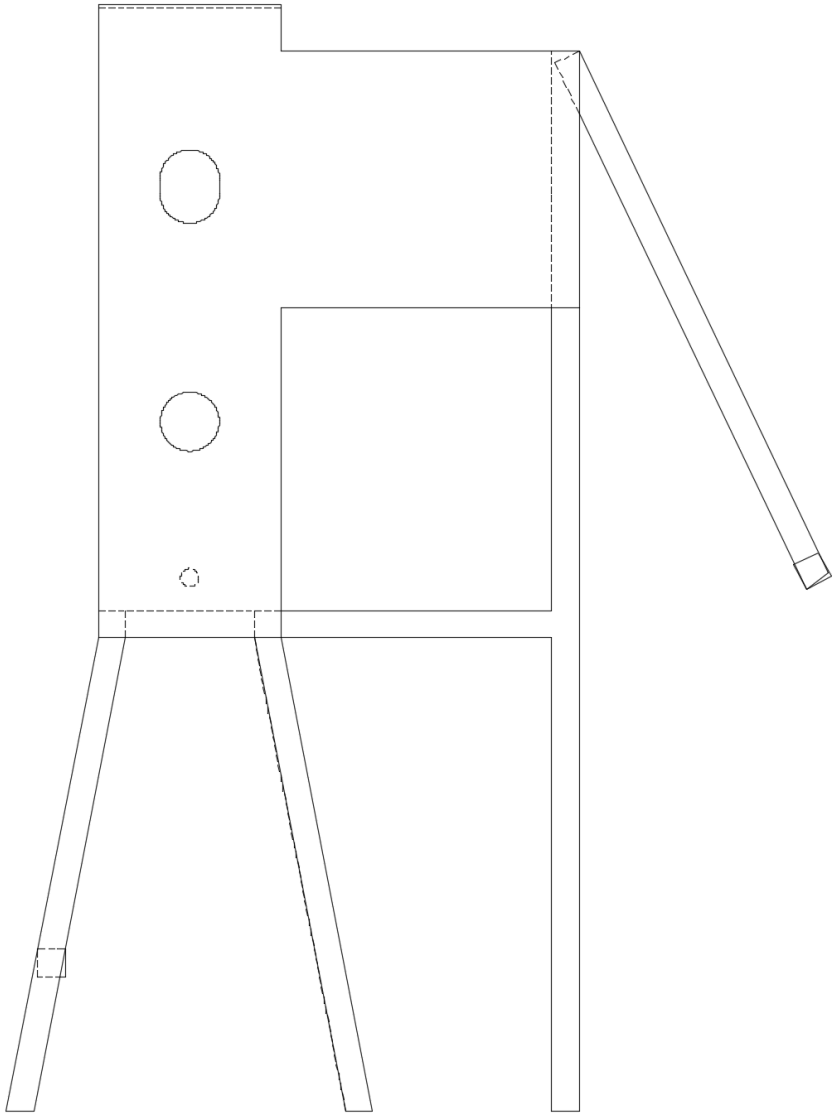


Frame

Isometric view

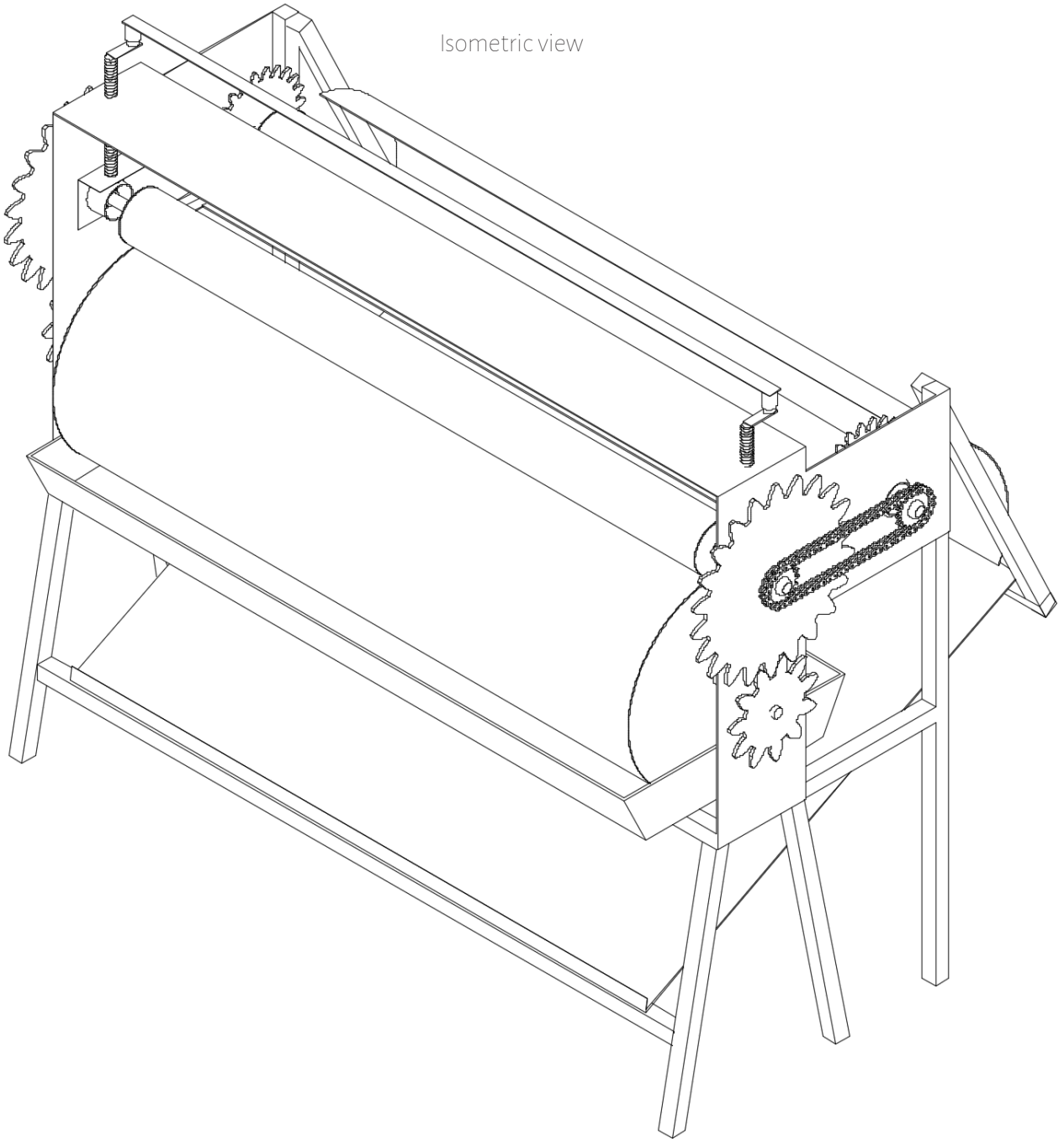


side view



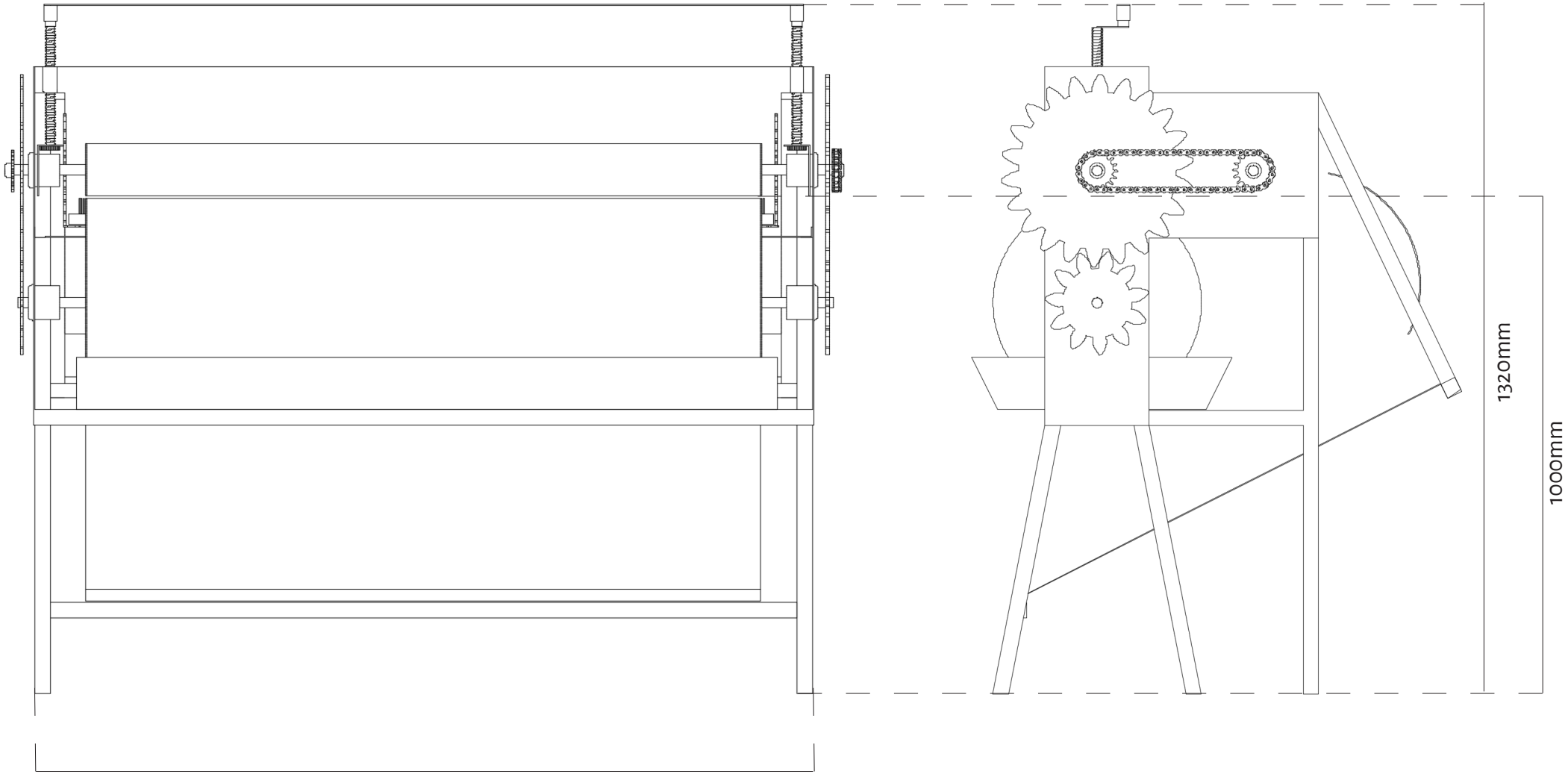
Final concept

Isometric view



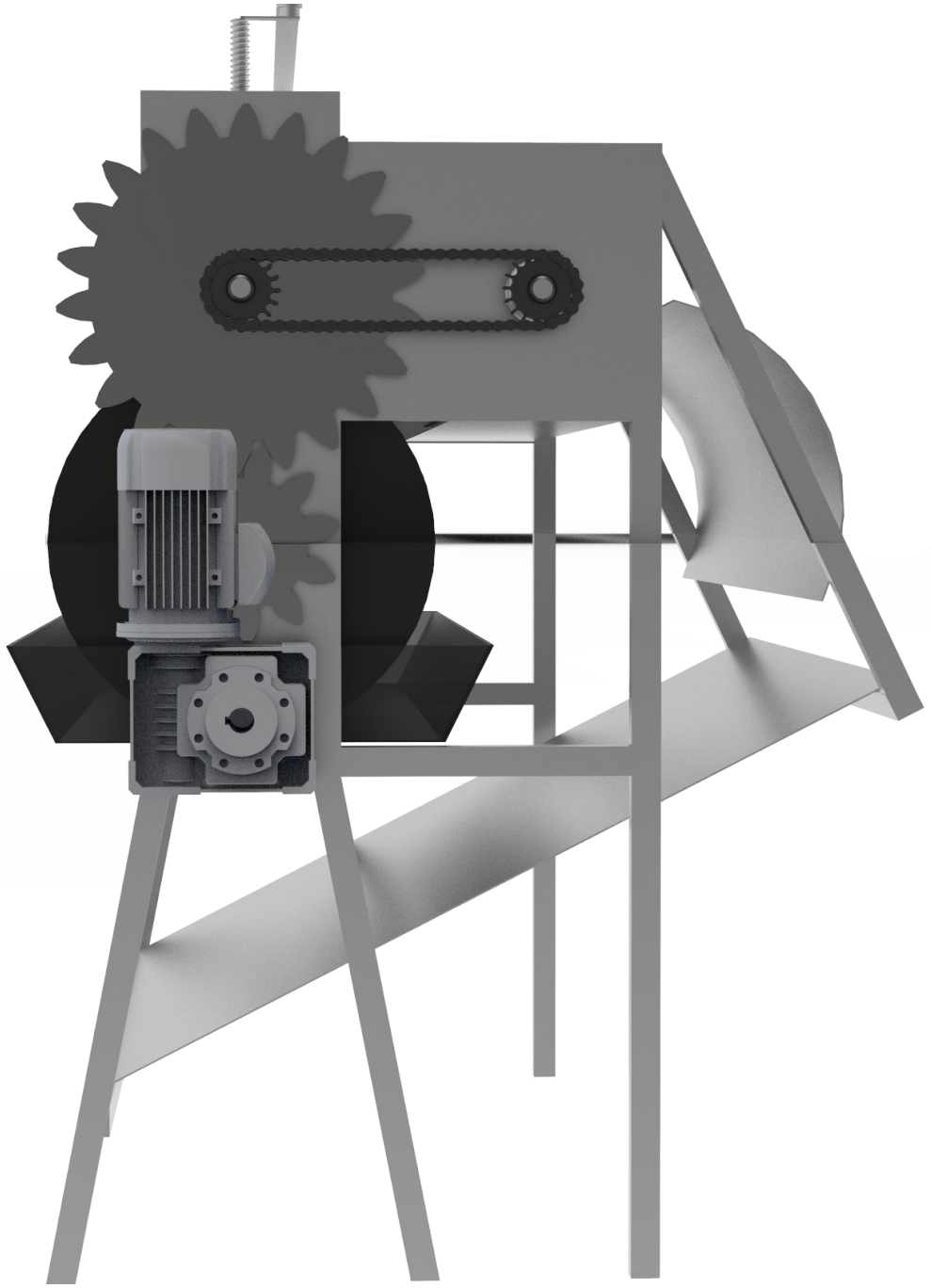
Front view

Side view



Scale - 1:8

Concept 3D model



Concept 3D models

Massaging

An interesting process developed by malai that breaks the material like you would the spine of a book, and makes it a lot more plyable and leather like. In addition to this, it gives the material that skin like surface texture, making it look more like leather.

This is done by pulling one corner or edge of the material over to the opposite corner or edge, pressing down on the fold with your palm and pushing the fold, moving it across the sheet to the edge or corner you start with.

The process of massagiong is outsourced at 4% of the material's cost right now. There is one boarding machine (used in the leather industry) that the startup possesses, and they have spent time and effort in altering it to fit their needs. So

far, it does not produce the required result, so **the process is still outsourced, losing both time and money**.

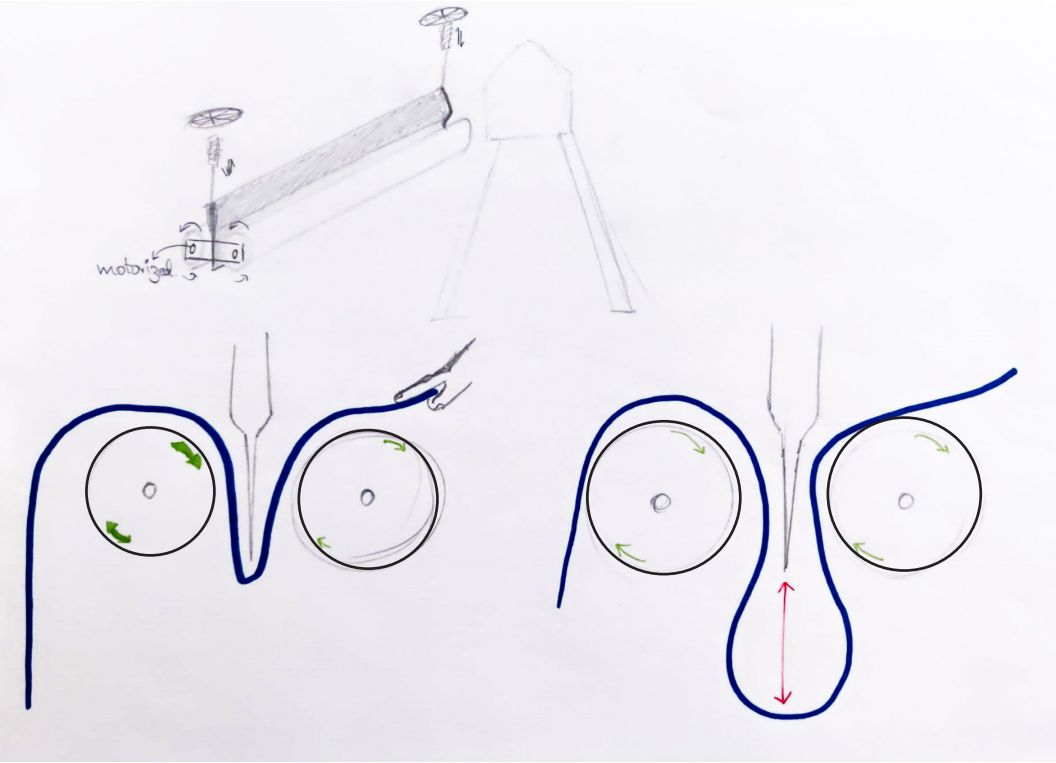
The machine

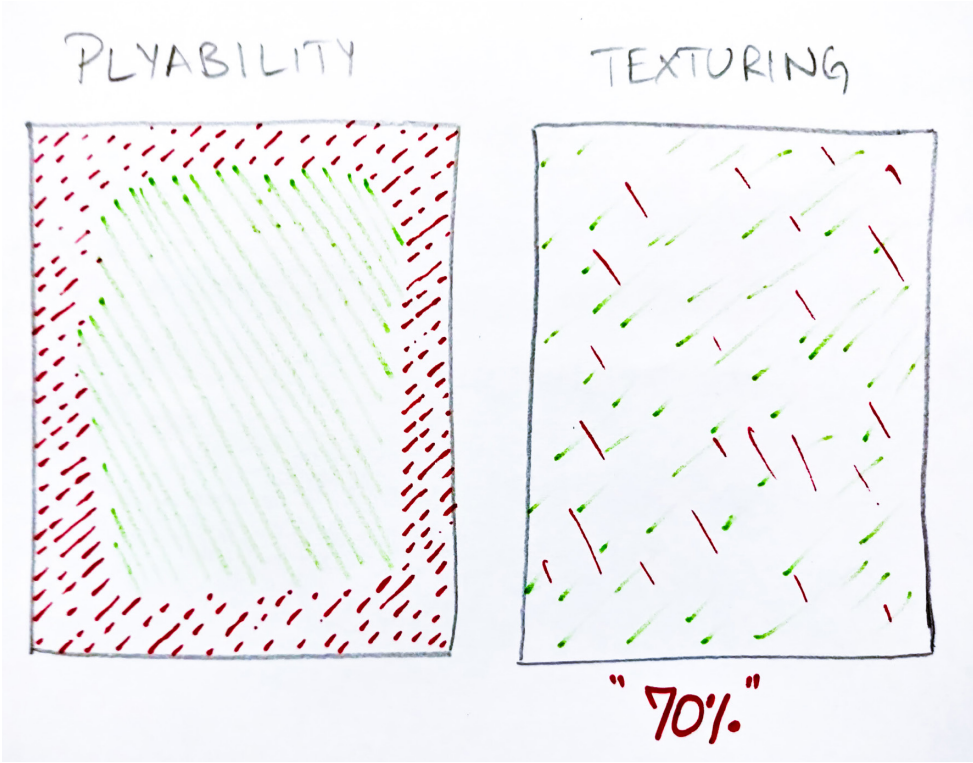
Two rollers, coated with rubber to hold the sheet by friction, about two centimeters apart, the moving fold is added in the middle of the two rollers where a blade is lowered to hold it in place. This partially gives the required effect, but does so by running a blade across the surface, since there is no pressure on the fold.

The machine presently requires two people at a time, to hold the sheet taut againt the blade, reversing polarities as the sheet reaches an end.

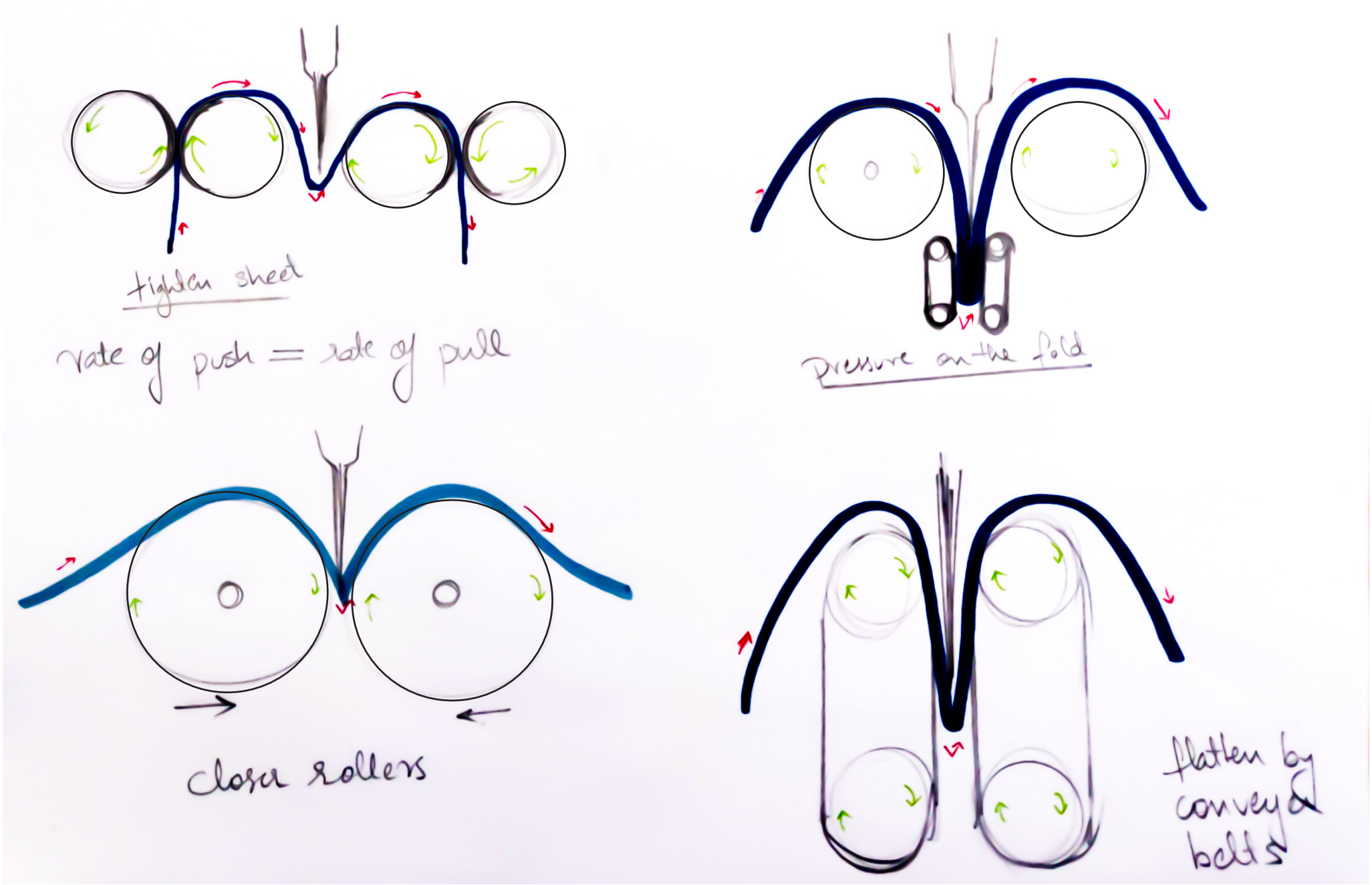
Often, in this process of pulling and reversing polarities, the sheet gets folded in a place it isn't supposed to and that fold gets pressed into the sheet. If there aren't two people free and the sheet isnt being held on both sides sags at the fold, thus defeating the purpose. Besides all this, the machine is a little dangerous, given that there is a blade and a moving roller with enough place to suck a users hands into the gap.

As a first pass for a machine, it ticks most of the boxes, but does not give the level of texture of plyability malai would like. The edges get left out, the texture cannot be fully achieved unless there is a moving fold, and adequete pressure on the fold without friction between the actual two surfaces holding the two sides of the sheet. So far, the best results seem to be coming from hand massaging, which costs both time and money. The following page has some ideas for how the machine can give a better result.





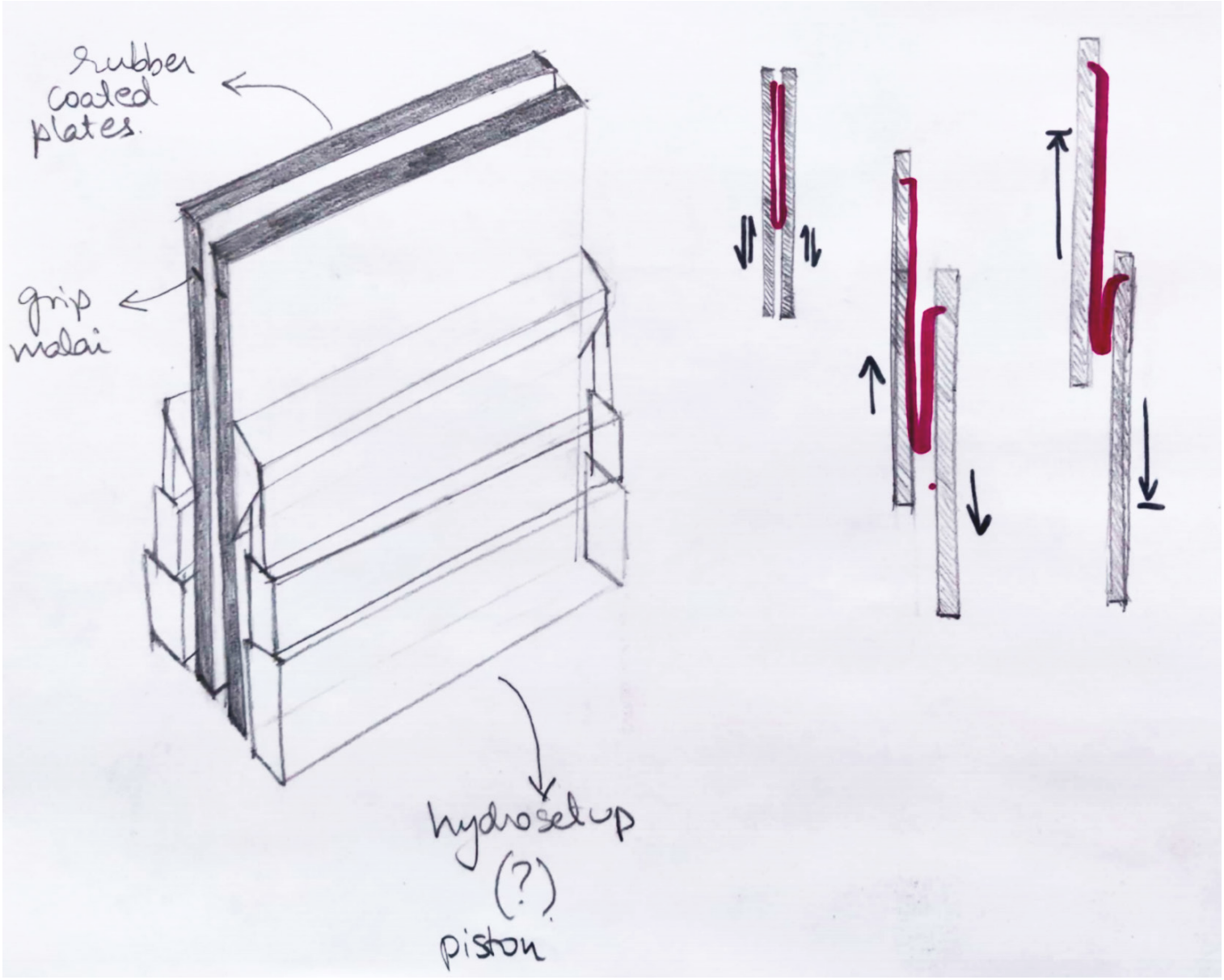
Ideas to alter the original machine



Ideation

Concept (a)

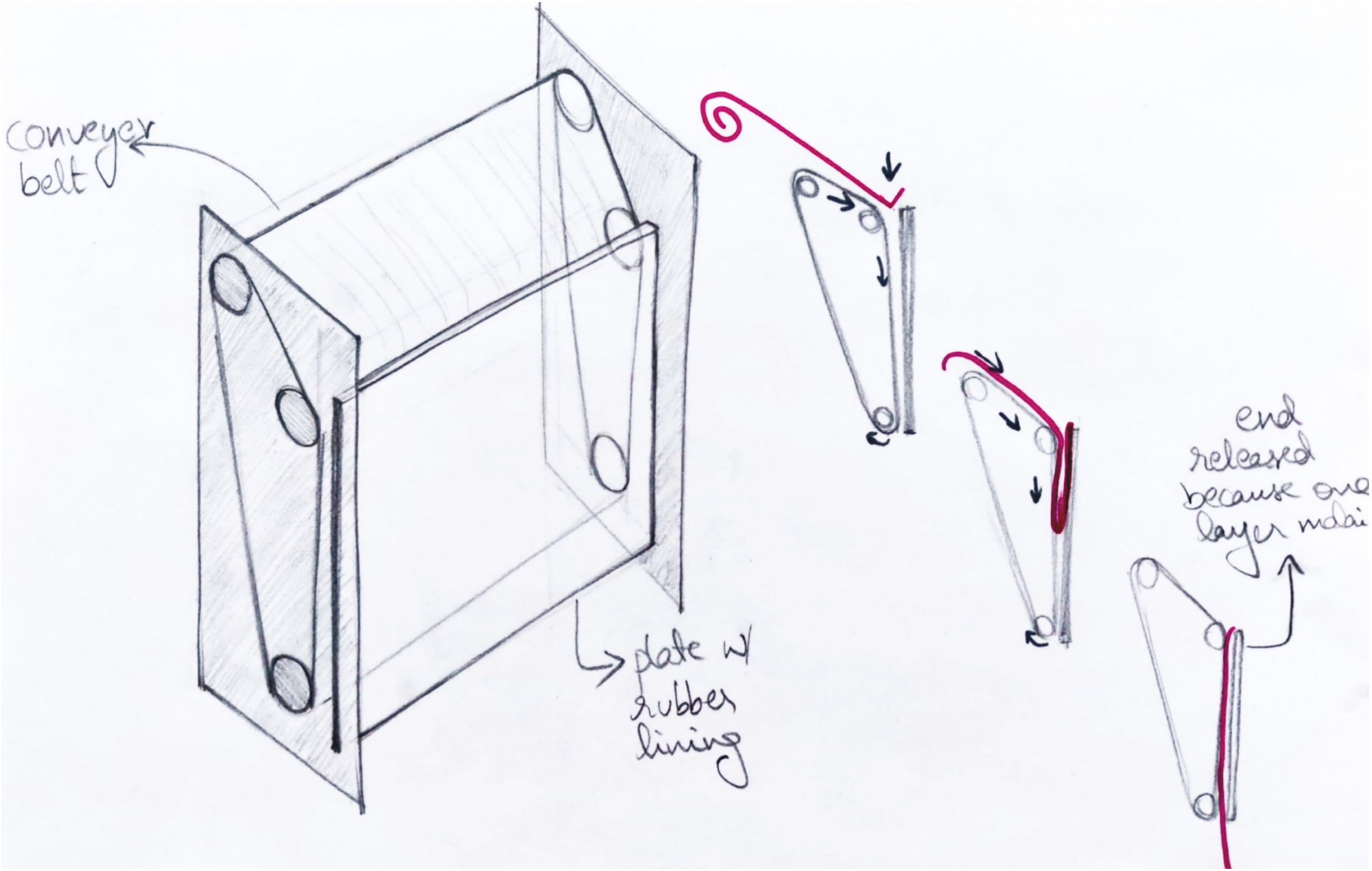
Two rubber coated plates, moving parallel to each other, back and forth with a folded sheet in between them.

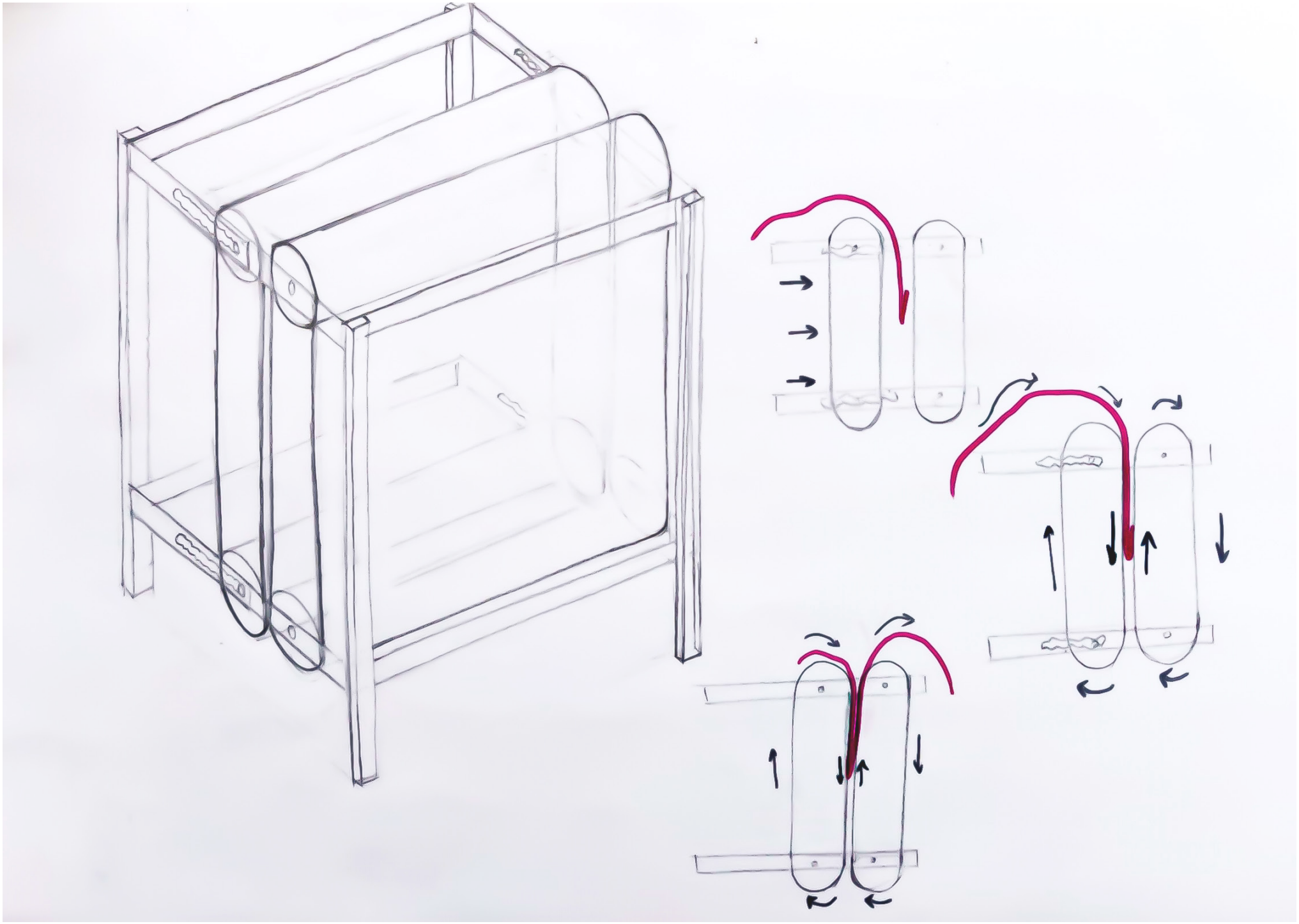


Concept (b)

One roller/conveyer belt and one rubber coated plate of variable thickness

(Prototype unreachable, locked in a room in N5)



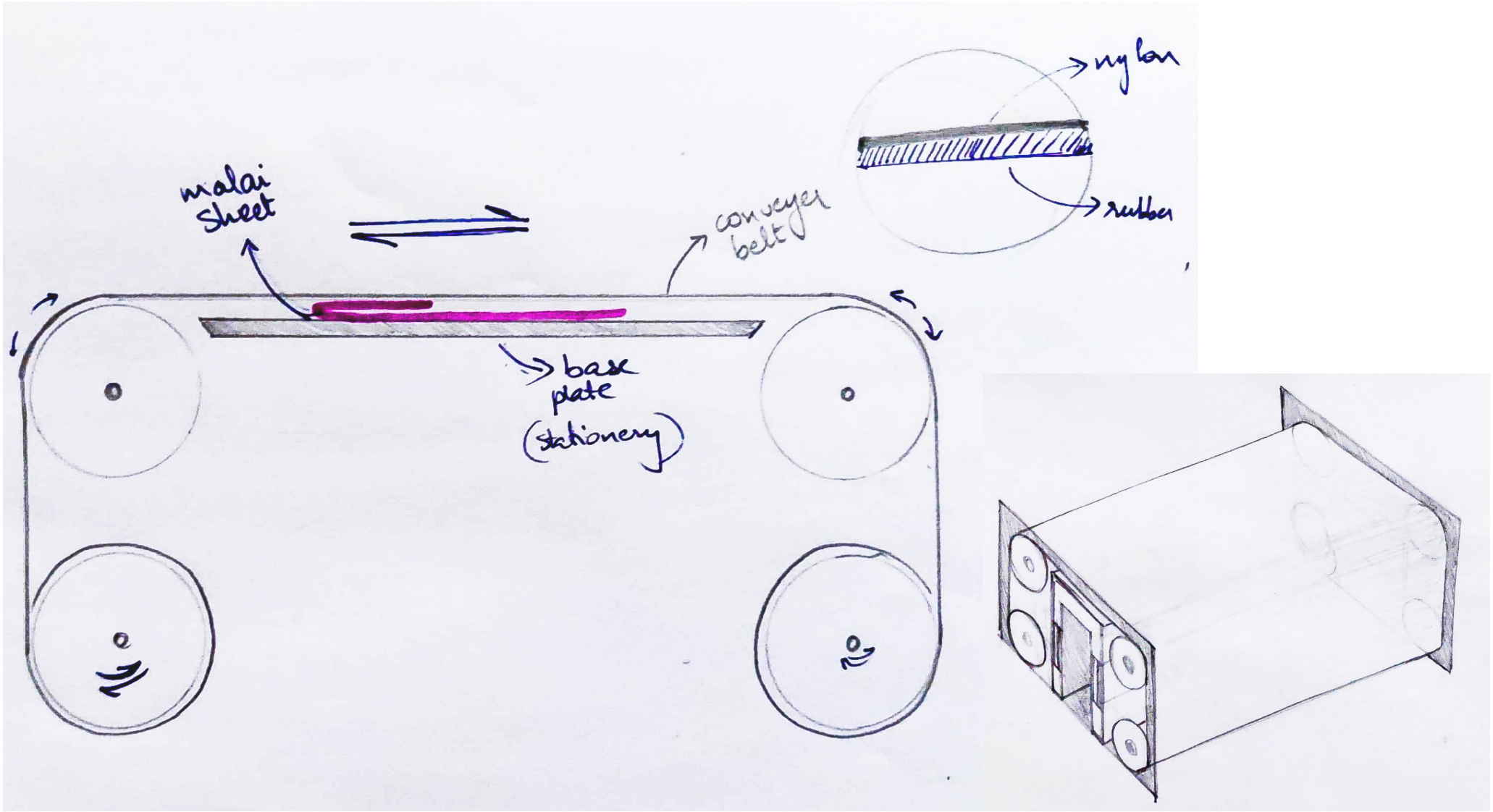


Concept (c)

One pulls the sheet in, the other pushes it out, both at the same rate. If the fold is in the middle of the two belts, it stays there, and the sheet moves, and the fold moves across the sheet. This concept is a variant of the fourth idea to fix the existing machine.

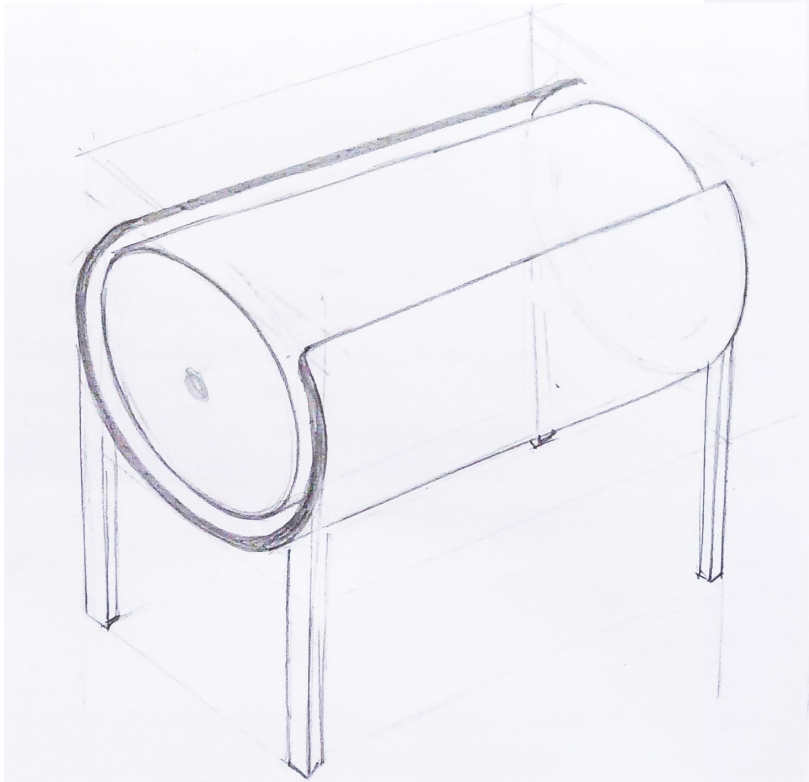
Concept (d)

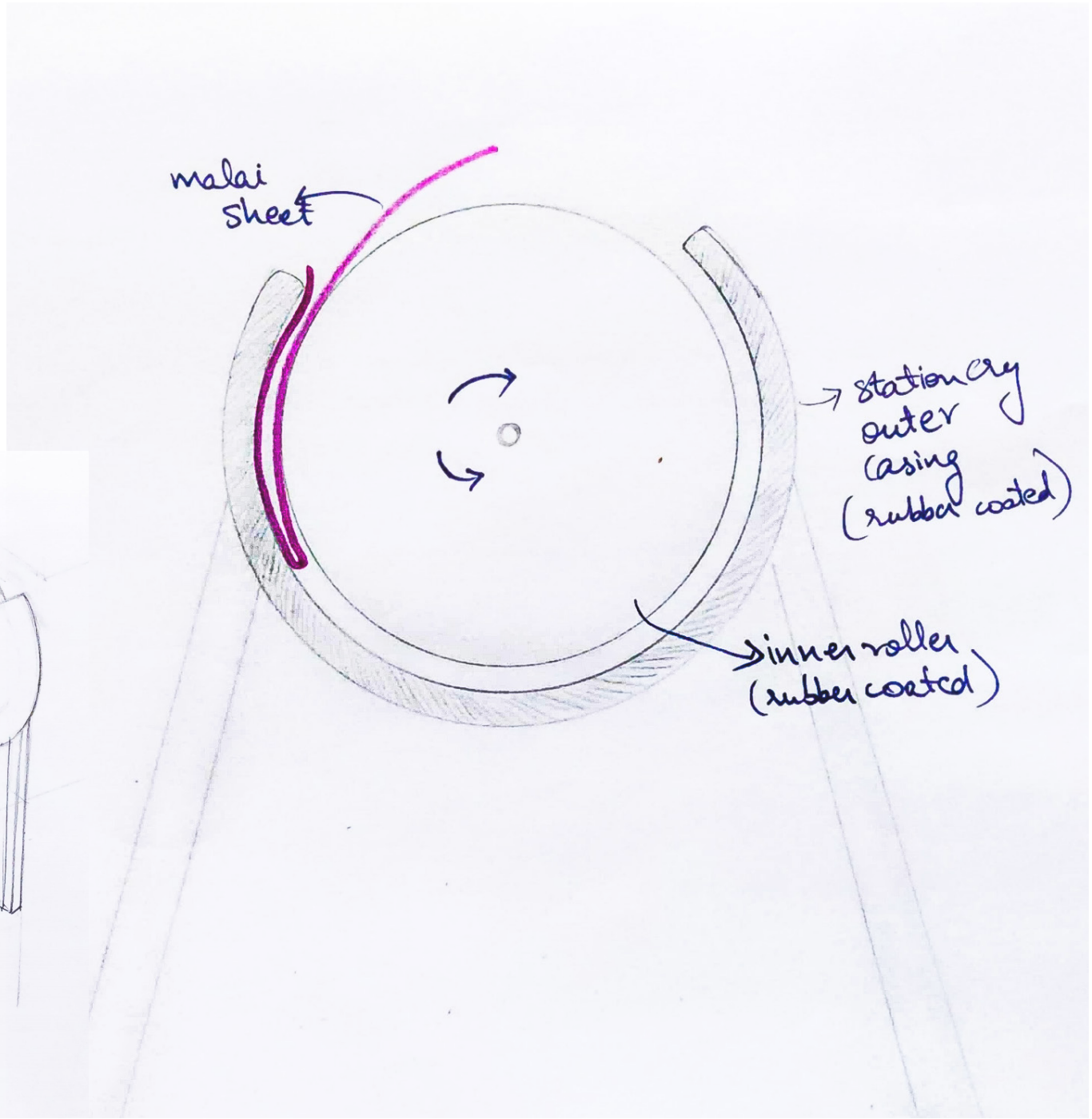
In any case of converyer belts, the back of the belt will have to be up against a solid surface to maintain a pressure on the fold. This continuous friction between the belt and the surface could cause a lot of wear and tear. This concept was developed to avoid that wear, if possible. The belt is pulled acros a surface but the sheet is in between, cutting any friction and thus any damage.



Concept (e)

Another crazy concept where the two surfaces are wrapped aroun each other to cut down the space taken by the machine. One big roller, circumference 4/3 of the length of the sheet, with a solid surface wrapped around it, both inner surfaces coated with rubber. a sheet with an edge folded is introduced into the gap, and the fold moves through and across the roller and throws out a sheet that has gone through one round of massaging.





List of user needs (from observation and conversation) and user wants (from direct questioning)

- a moving fold
- pressure on the moving fold
- fold travel to the end
- should allow sheet in multiple axes
- shouldn't press unnecesary folds into sheet
- less manual requirement

? Standing machine (not handheld)
? ergonomic
? is quick

criteria-> Ideas v	Moving fold	Pressure on fold	Ease of multiple axes	Reach ends	Avoid unnecessary folds	Less human involvement	total
Two rollers	1	0	1	1	1	0	4
Two plates	1	1	1	-1	1	0	3
One roller, one plate	1	1	1	1	1	0	4
Barrel	1	1	1	1	0	-1	3
Roll over base	1	1	-1	1	-1	-1	0

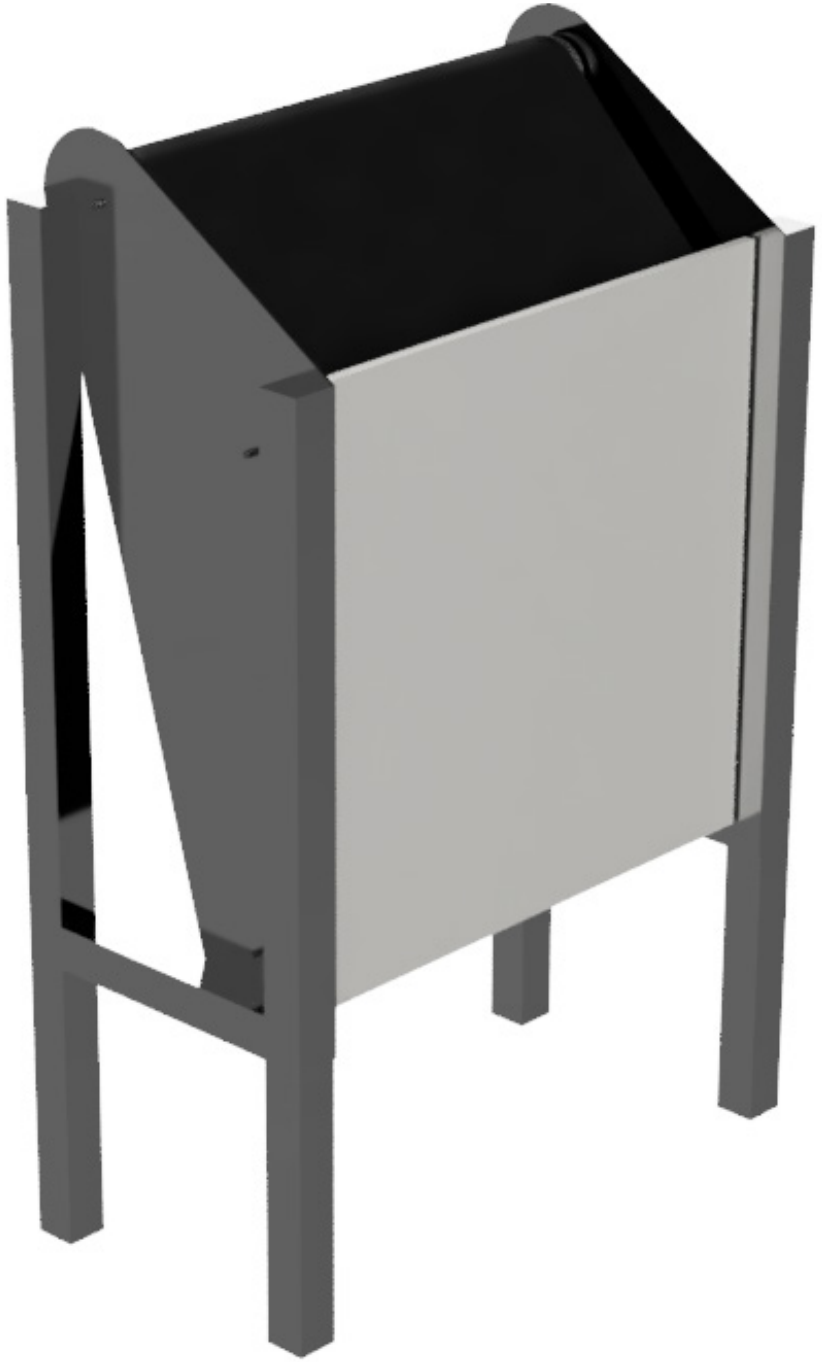
Both ideas have been taken forward and considered.

One roller, one surface

Concept (b), one rolling converyer belt against one surface of variable thickness, with a folded sheet in between. As the fold ends, the sheet is thinner than the gap (the gap is big enough to accomodate the folded, sheet, twice the thickness) and the sheet falls through.

Problems with this concept:

- There is a possibility of the two surfaces scraping against each other, oweing to the fact that the they would have to be very close together because there isn't a surface behind the conveyer, and the pressure on the fold depends entirely on the tautness of the belt.
- The Surface would have to be a little over the dimensions of the sheet, since the fold moves across the machine instead of staying in one place. This would take up more space than is necessary and would require more material, adding to the material cost and the weight, if the machine were ever to be moved.



Two rollers

Concept (c), Two conveyer belts going in the same direction, the fold is in the same place as the machine presses the fold back and forth, moving through the sheet.

Potential problems with this concept:

- Adjustability of the distance between the belts without any delicate/expensive mechanism may be difficult.
- The danger of two moving conveyer belts at 70rpm, not too high but high enough.

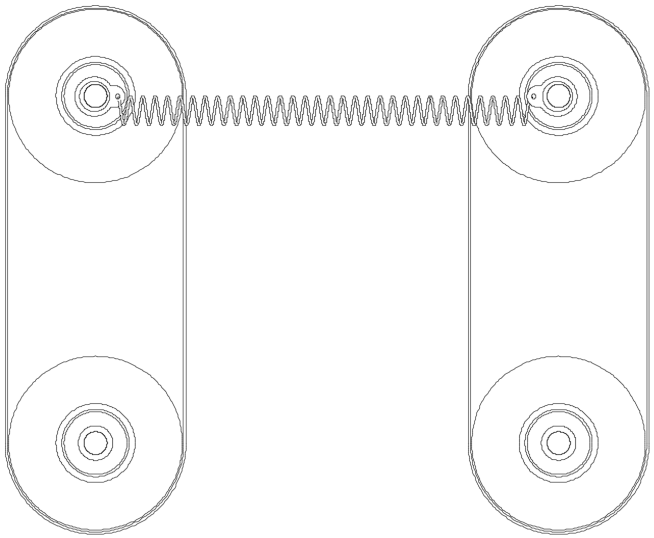
Adjusting

The two sets of rollers/belts need to

- Be adjustable to allow for the different GSM's of Malai
- Be able to open enough to easily insert a sheet.
- Be sturdy enough to support and move four meter long rollers.

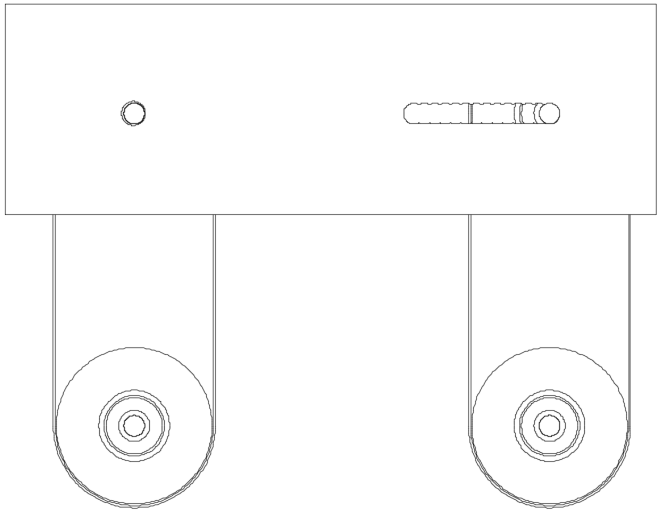
Springs:

Metal springs to keep the two parts together unless manually forced apart, may need another person to feed sheet while first person holds it apart.



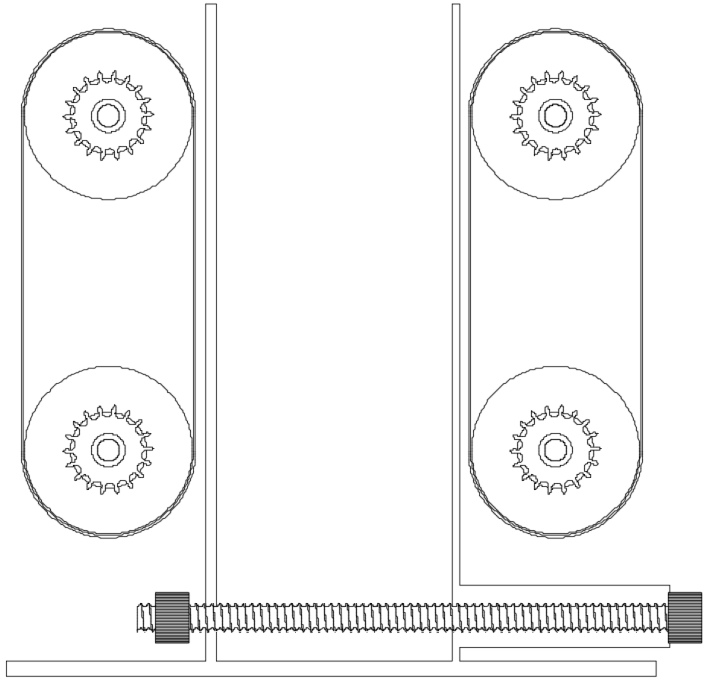
Steps:

Might add an unnecesary jerky movement , may require extra force.



Screw and slide:

Screwing brings the rollers closer, unscrewing pushes them apart, minimal effort and smooth movement.

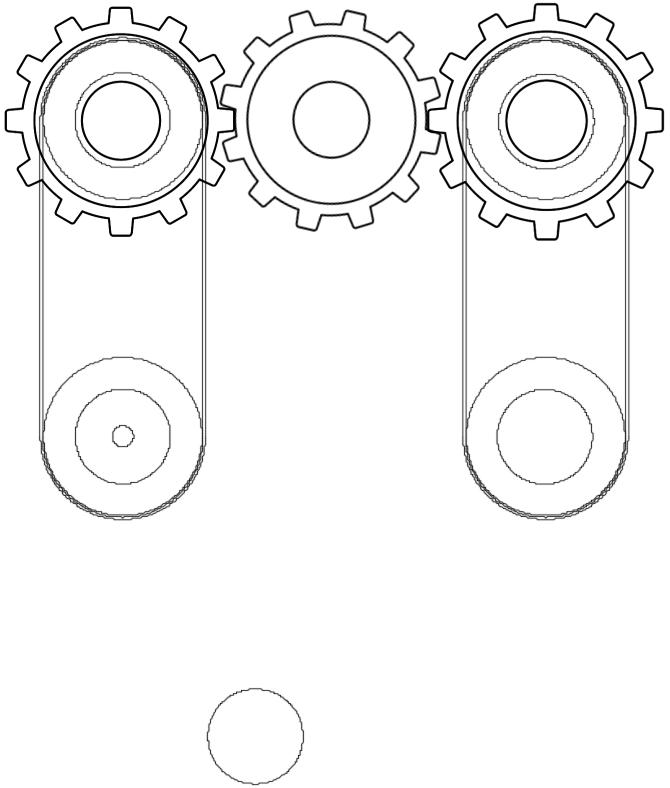


Propulsion

The two conveyer belts need to be moving in the same direction, so it should be easy to connect their motion with no chence in direction.

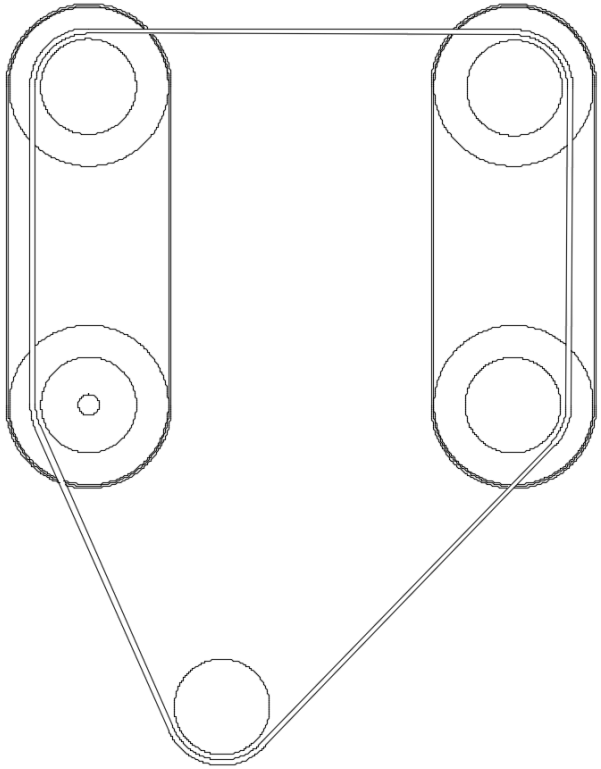
Gear system:

Simple and neat, doesnt allow for adjustment of gap.



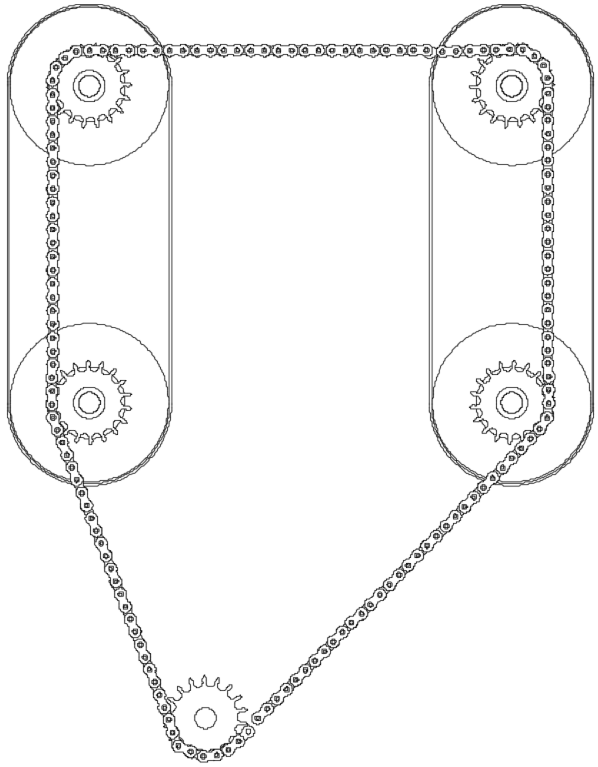
Rubber belt:

cheap and light solution, chances of slipping and failure are high.



Chain links:

cheap and light solution, chain guards can be added to avoid the jumping of chains.

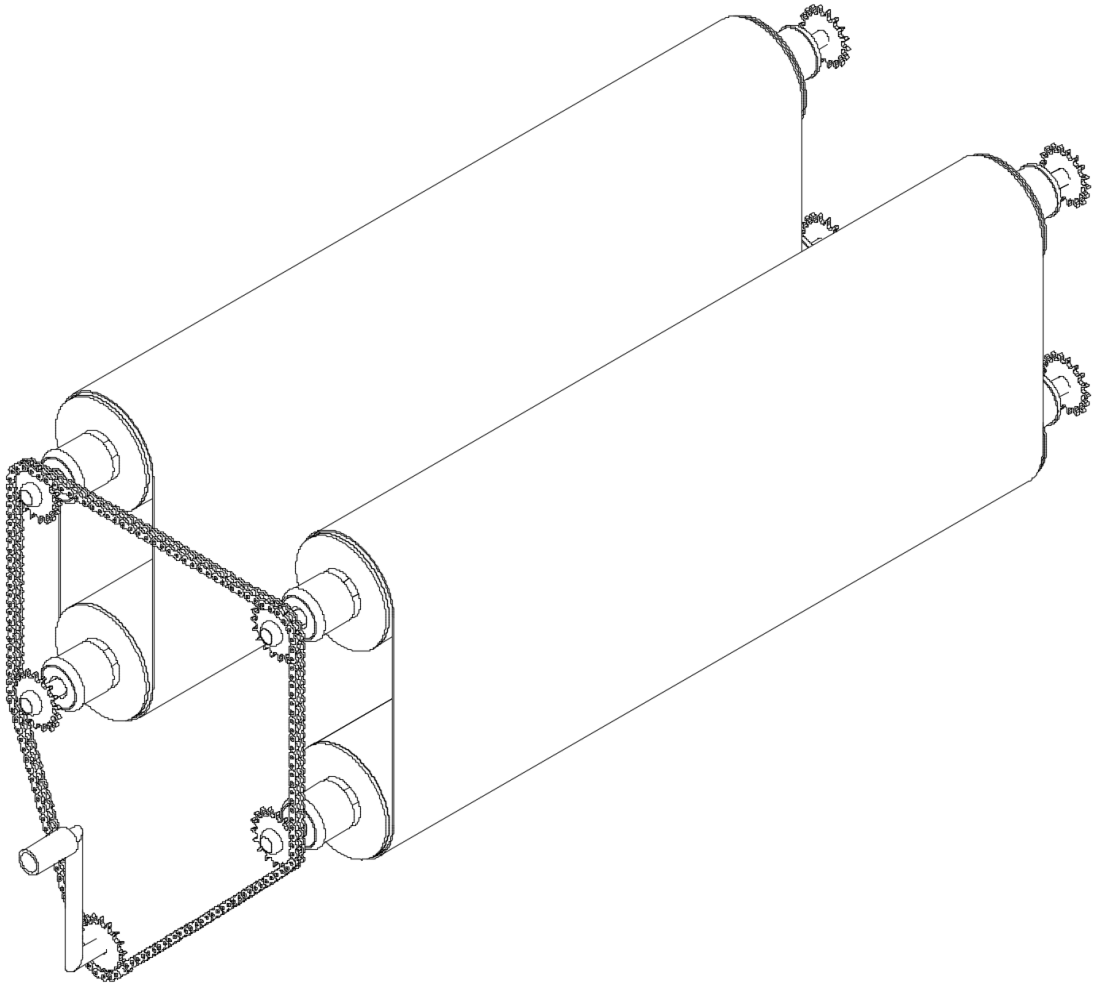


Propulsion

The machine could be hand cranked or mechanized, but a hand crank would require extra effort and mean lost time, in addition to adding more workers on the single job.

The machine will be Electrically powered, and propelled by a 1500 rpm ac motor, connected to a gear box (around 1:40) to bring down the rmp of the rollers to 75. (A similar setup to the one currently part of the folding machine at malai)

Handcrank - concept

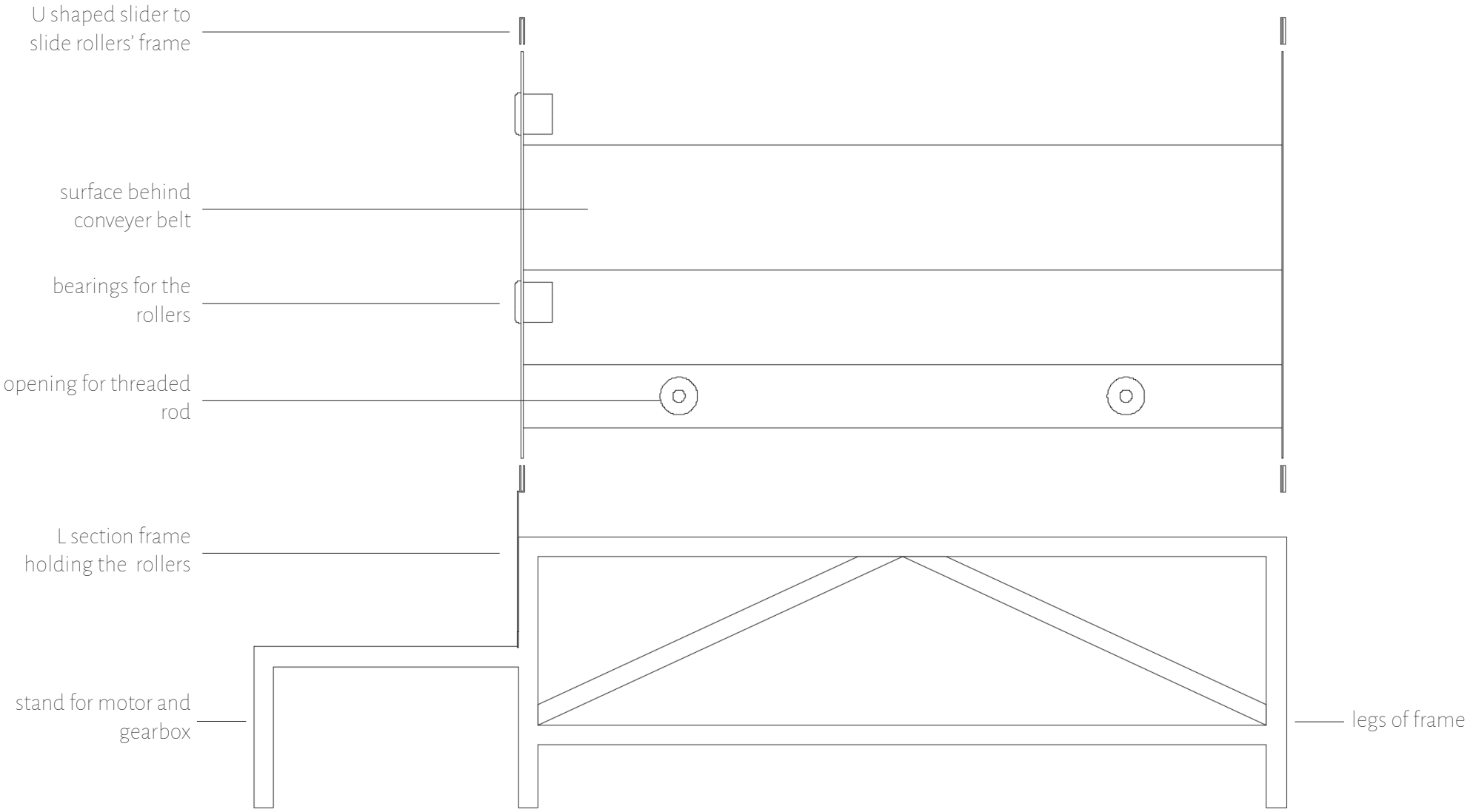


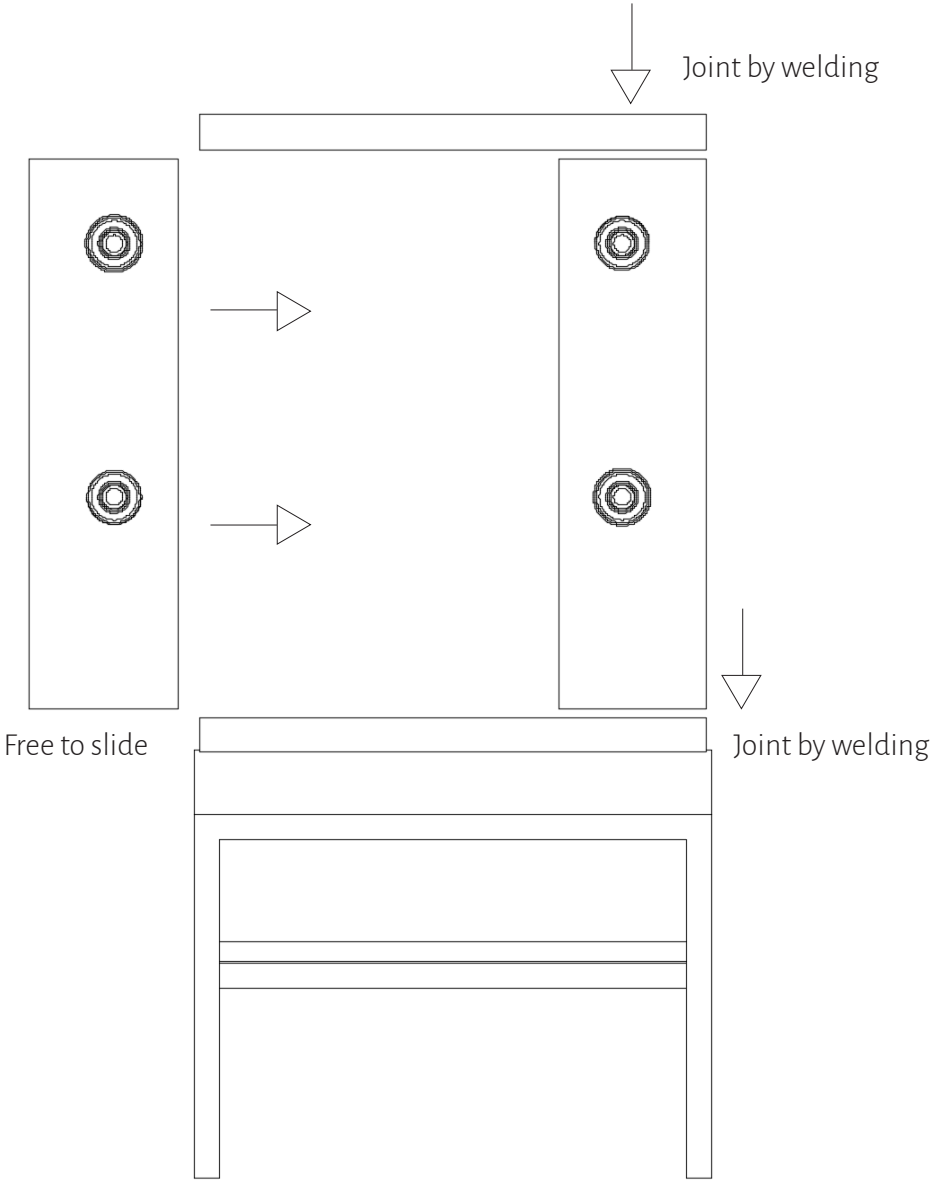
Motor: ₹5000

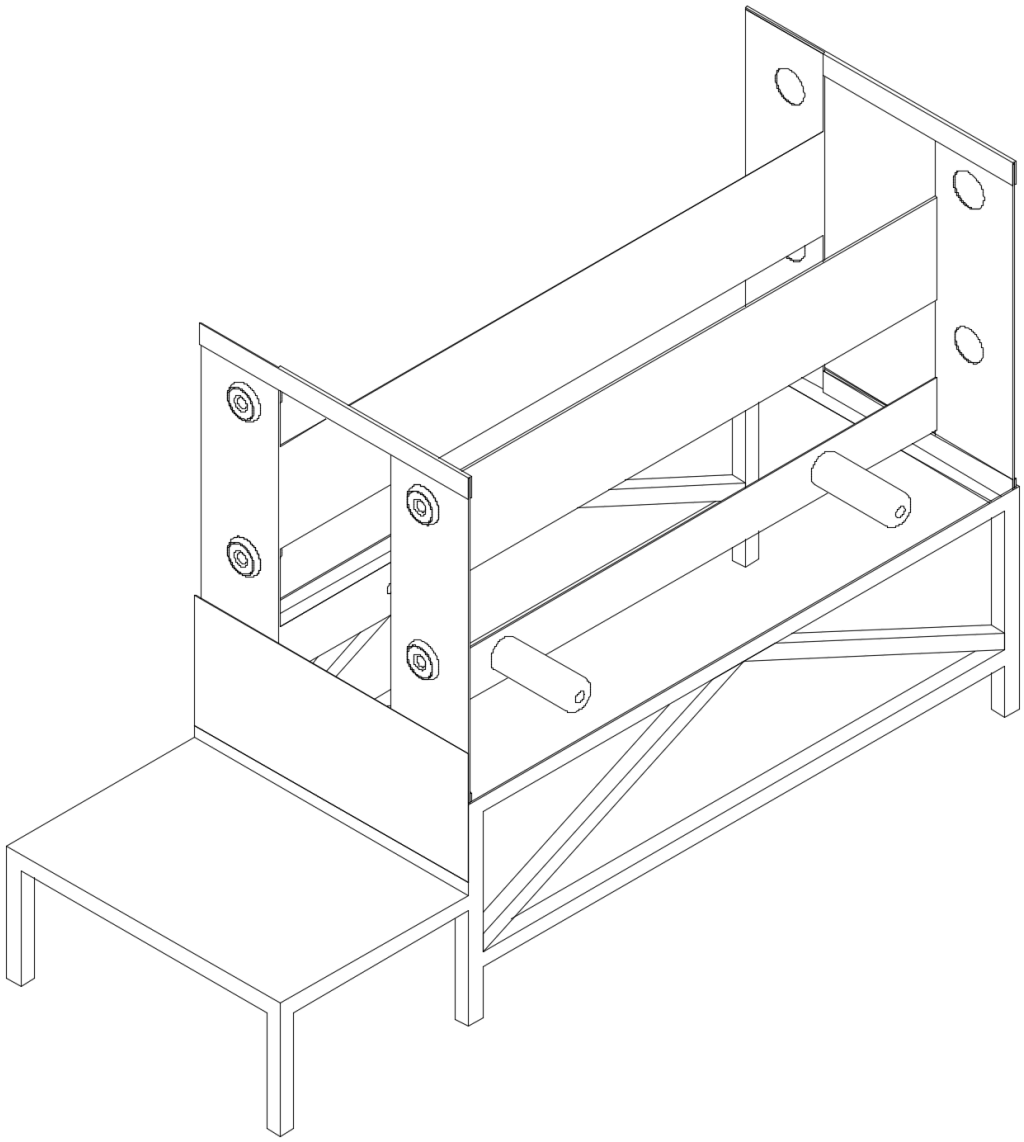
Bharat electrical motors

Gearbox: ₹3000

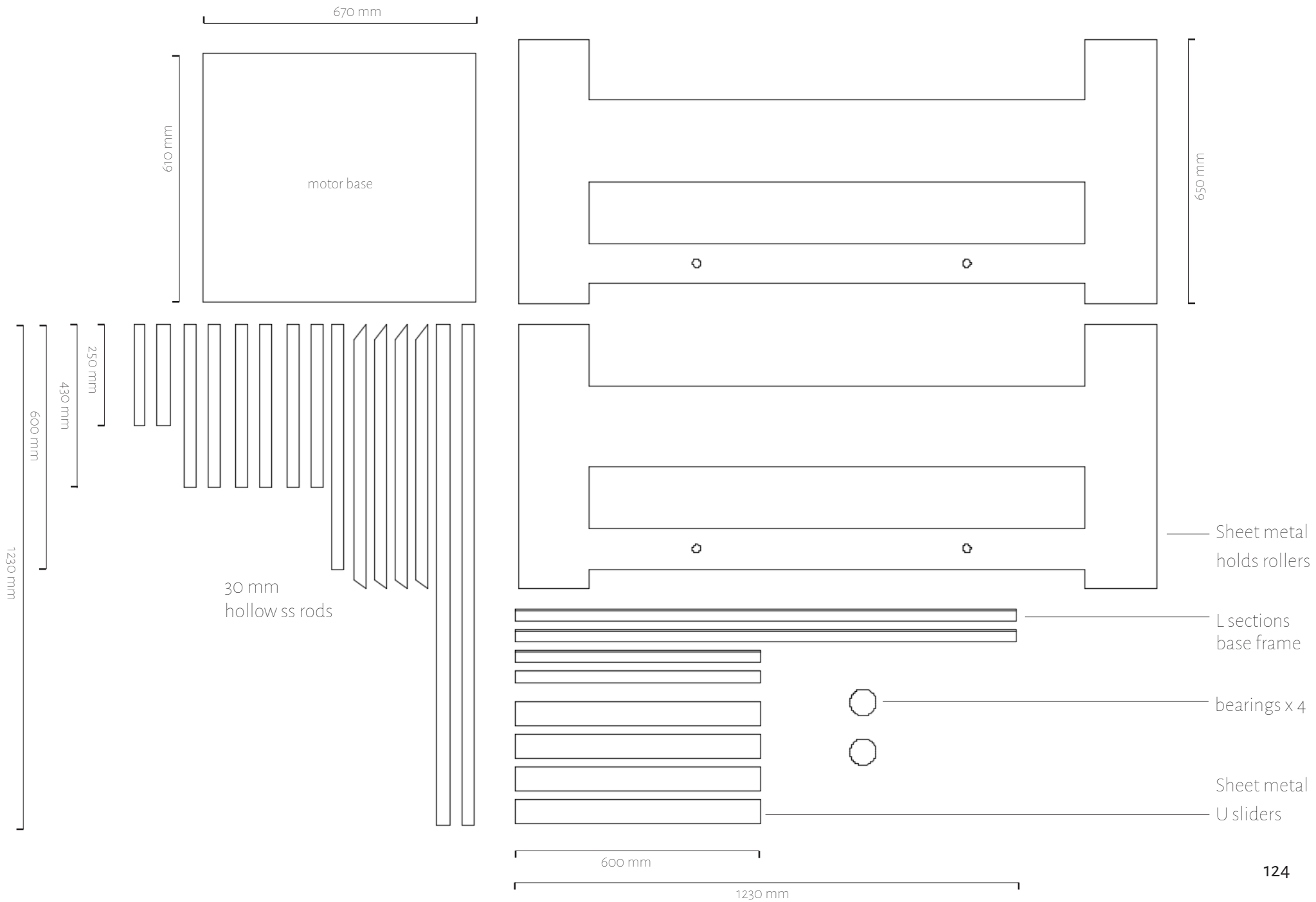
Frame


U shaped slider to slide rollers' frame
surface behind conveyer belt
bearings for the rollers
opening for threaded rod
L section frame holding the rollers
stand for motor and gearbox
legs of frame

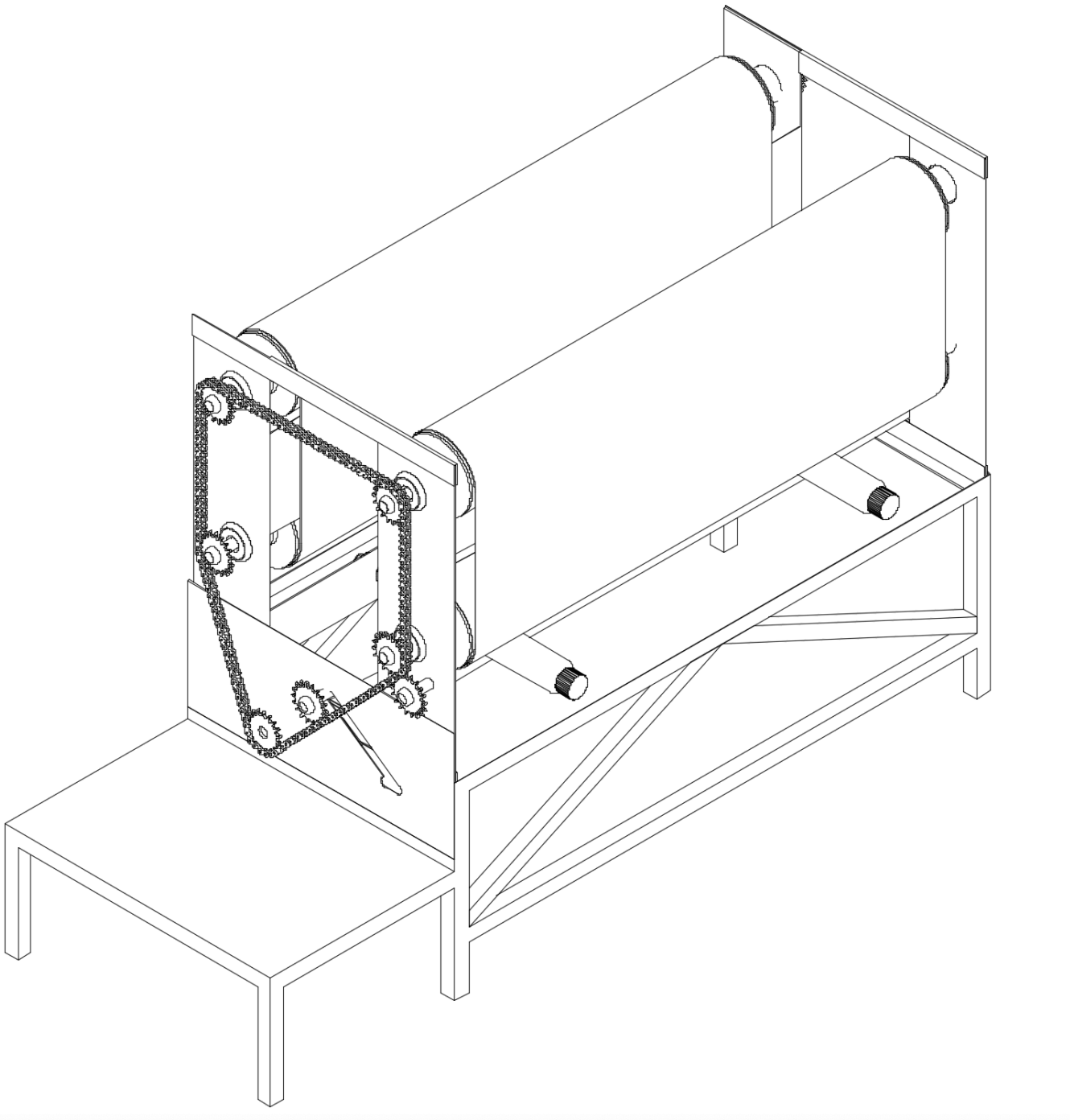

Joint by welding
Free to slide
Joint by welding



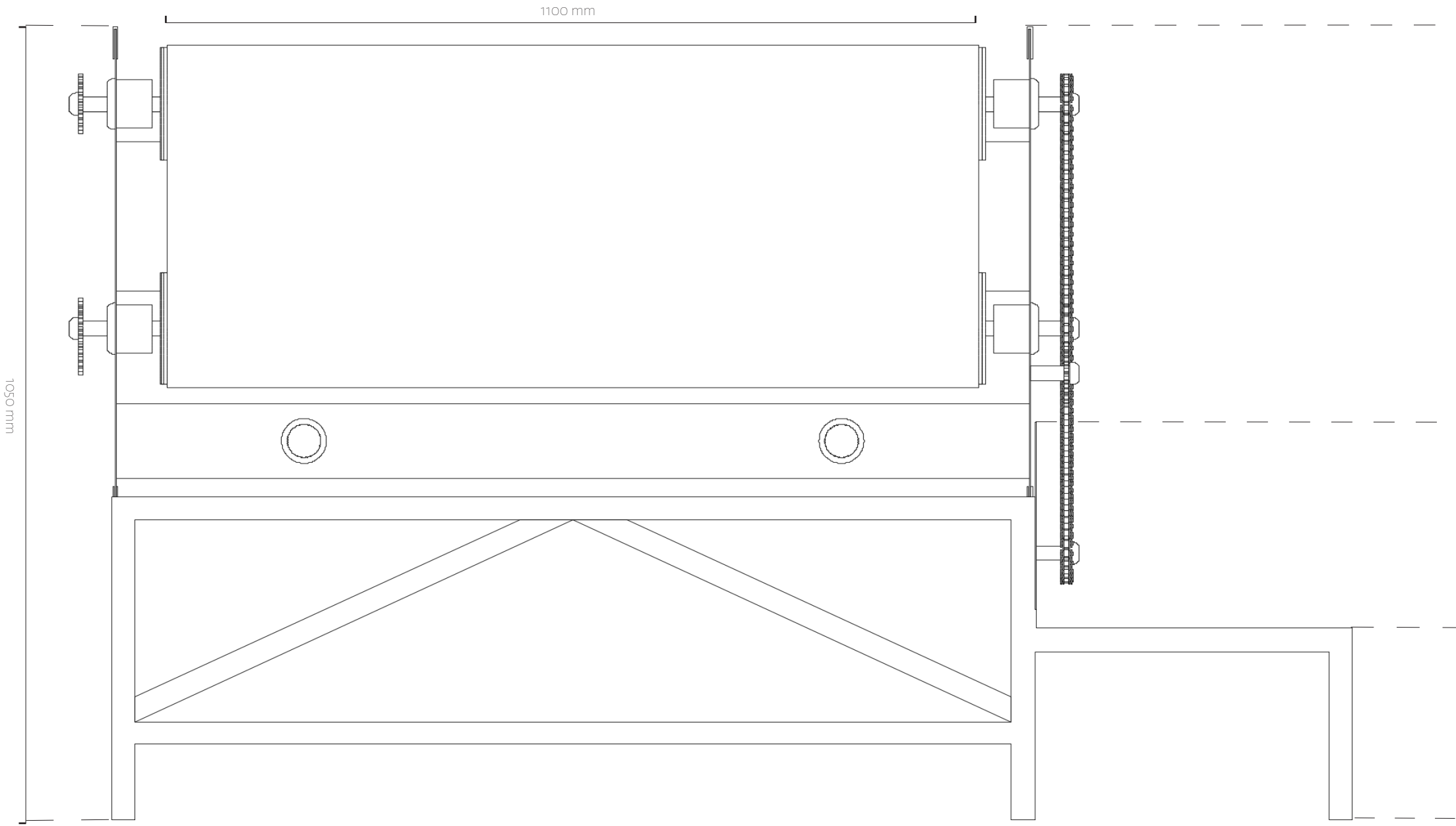
Materials for frame



Isometric View

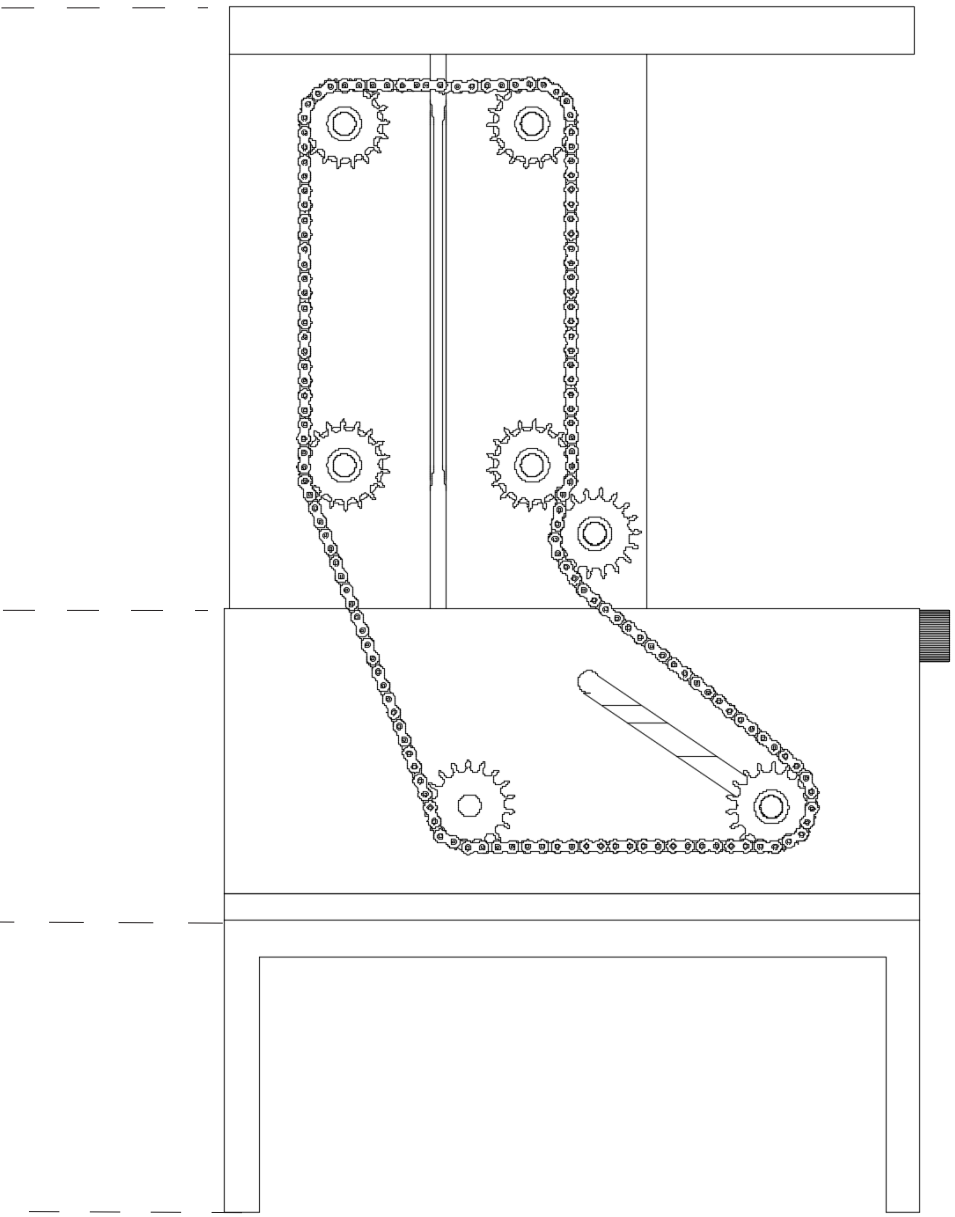


Front View

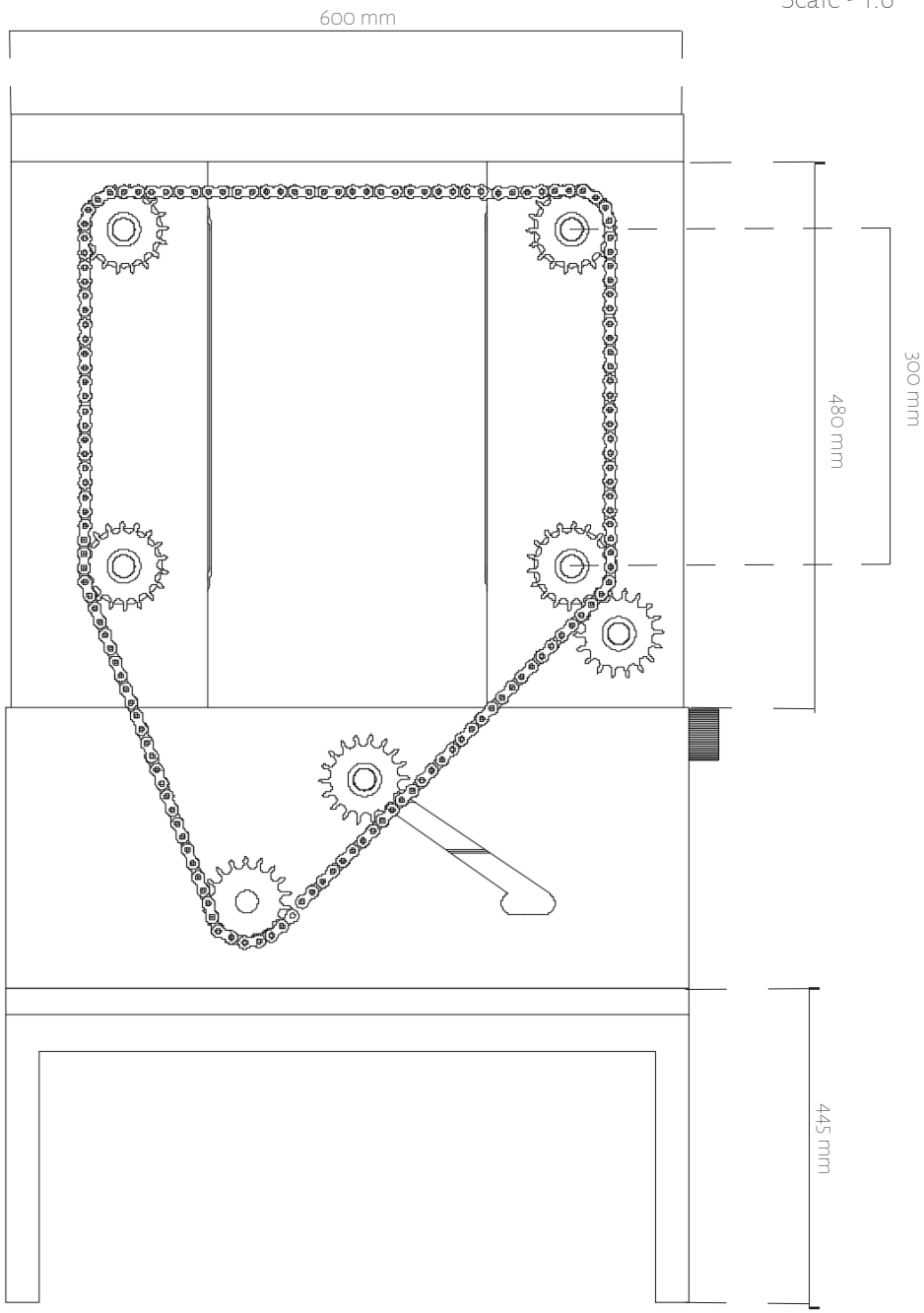


Side view

Scale - 1:6



Closed

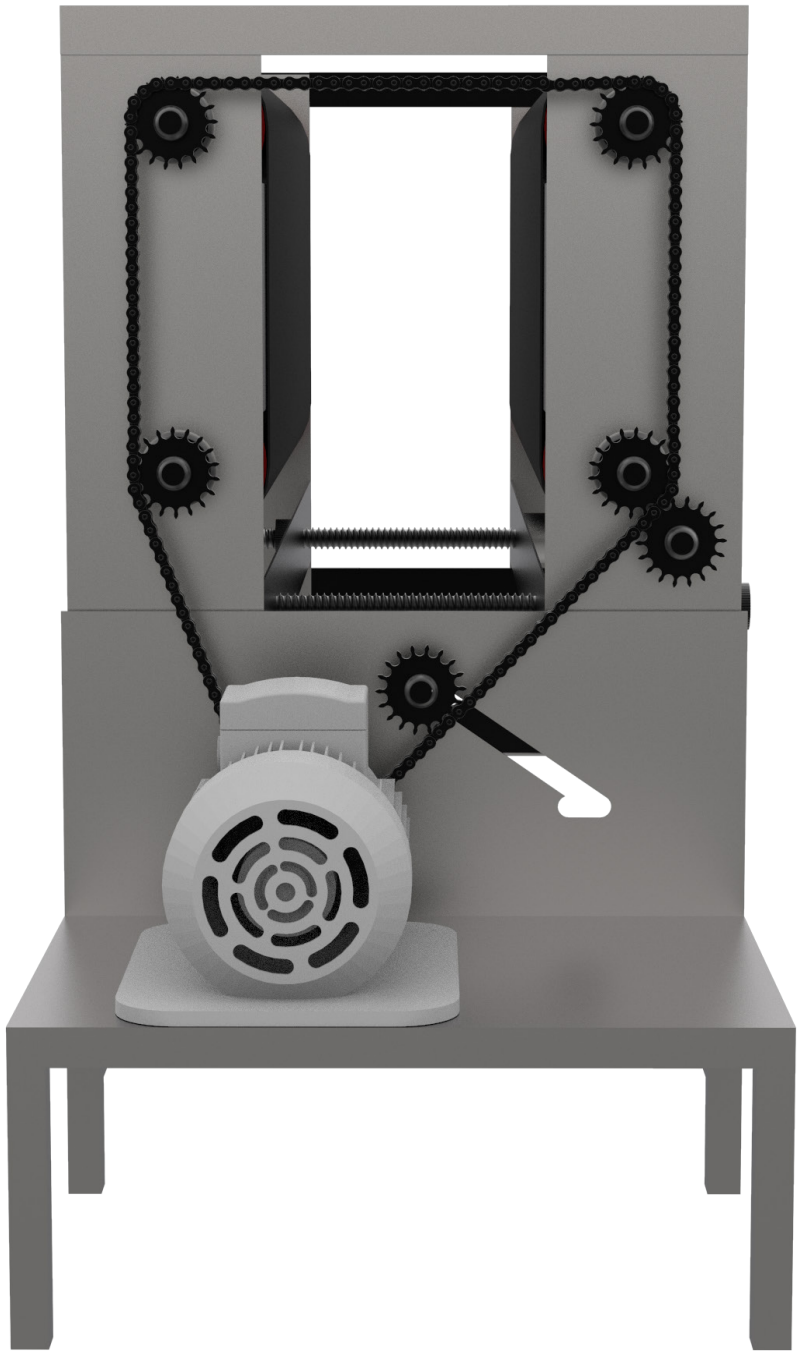


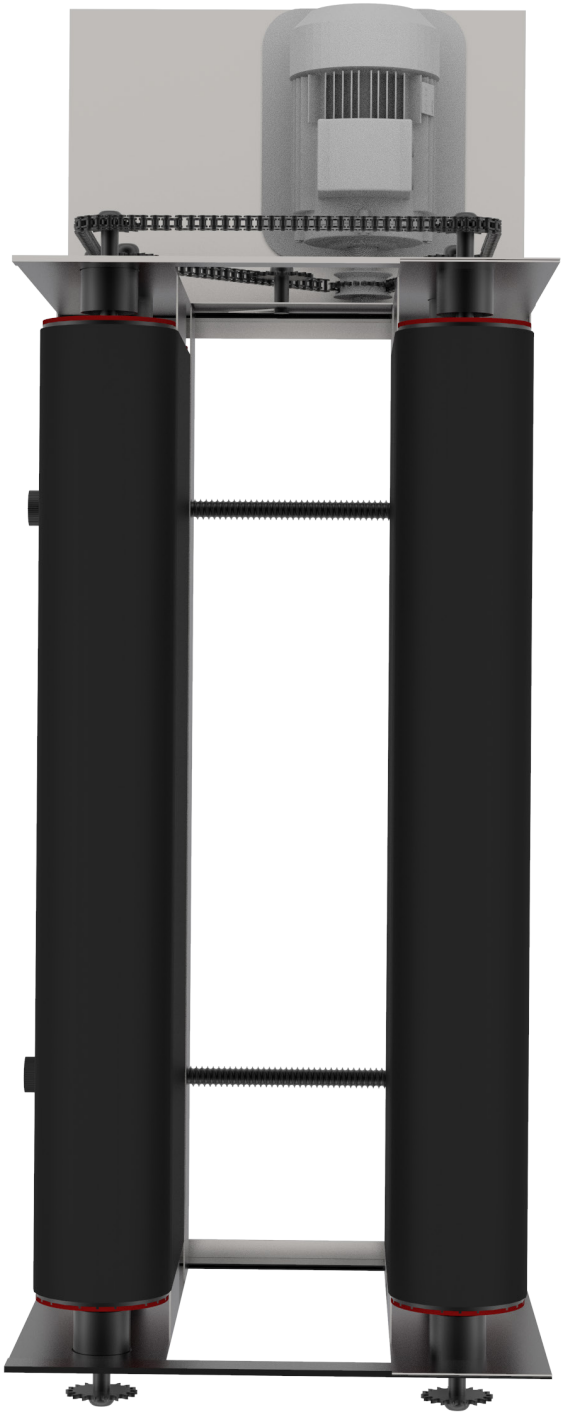
Open

Boarding machine

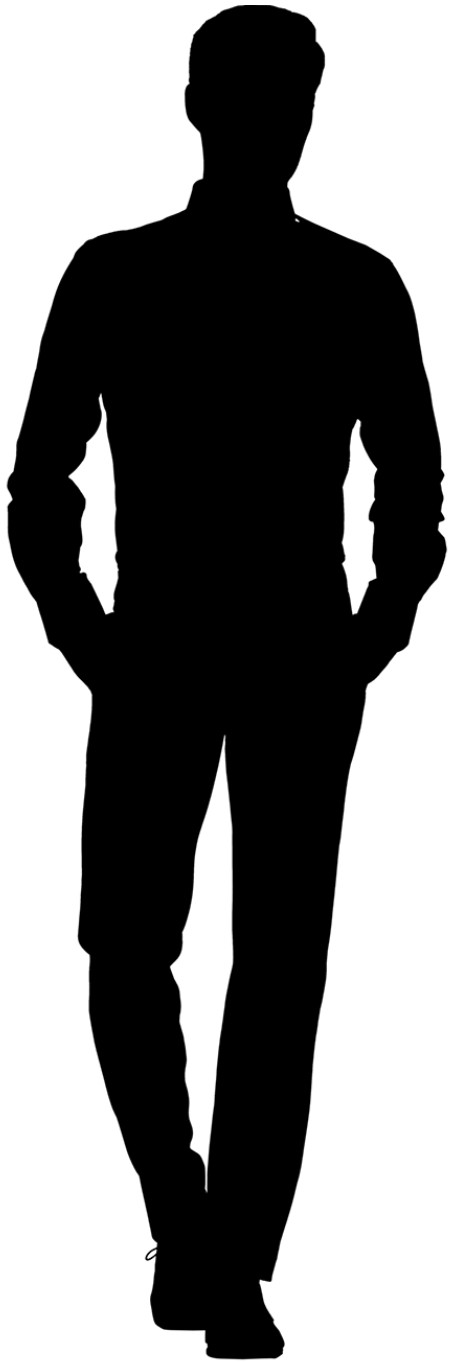
A concept for a standing machine with four 1100mm rollers, holding two conveyer belts and being run by an AC motor at about 75 rpm. The movement is propelled by a set of cycle sprockets, and chain links like that of a simple bicycle. The primary pair of rollers has a fixed place, and the second set of rollers is movable, sliding back and forth to allow for feeding sheets in and working for different GSM sheets. The translation is carried out over simple sliders and through the screwing in and out of two 20mm threaded rods.

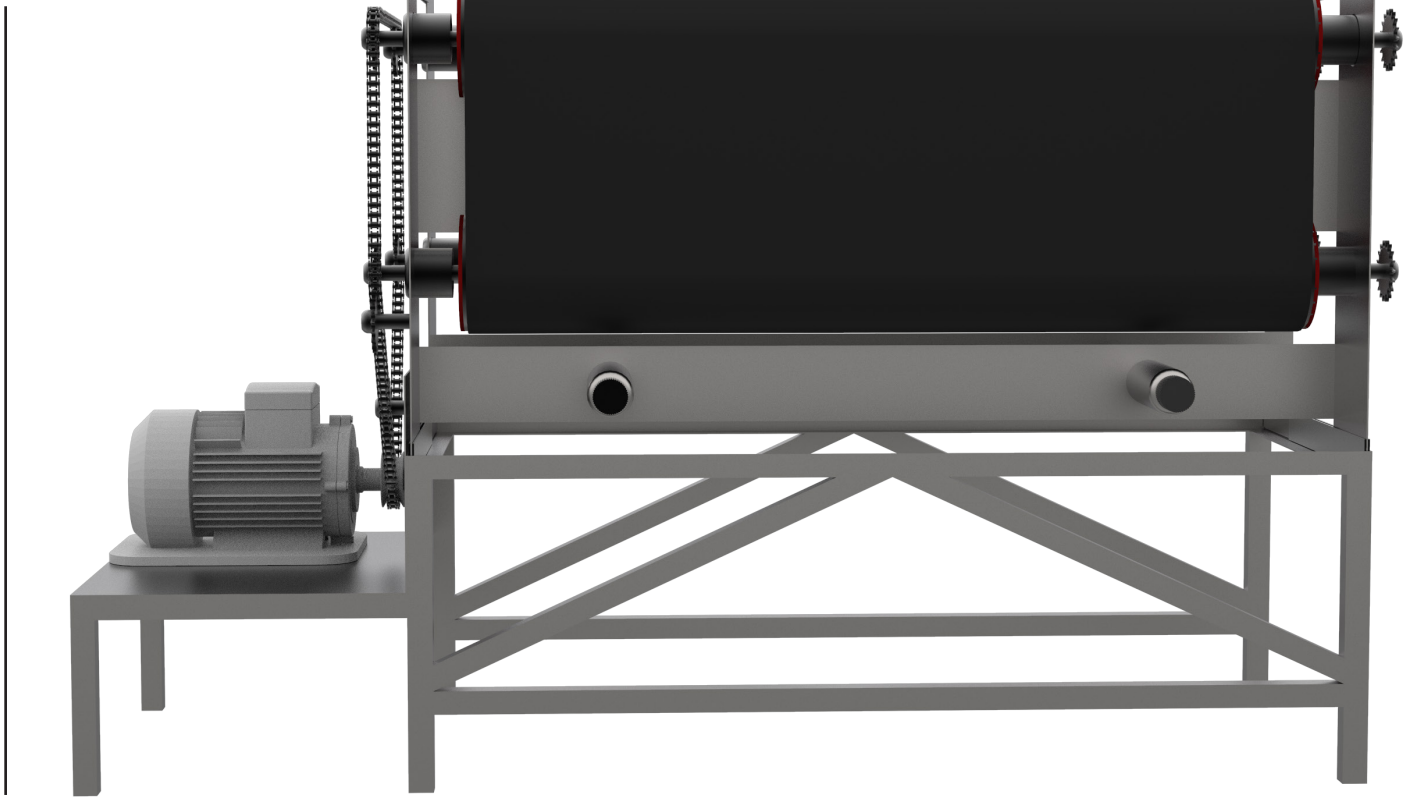
Concept 3D model

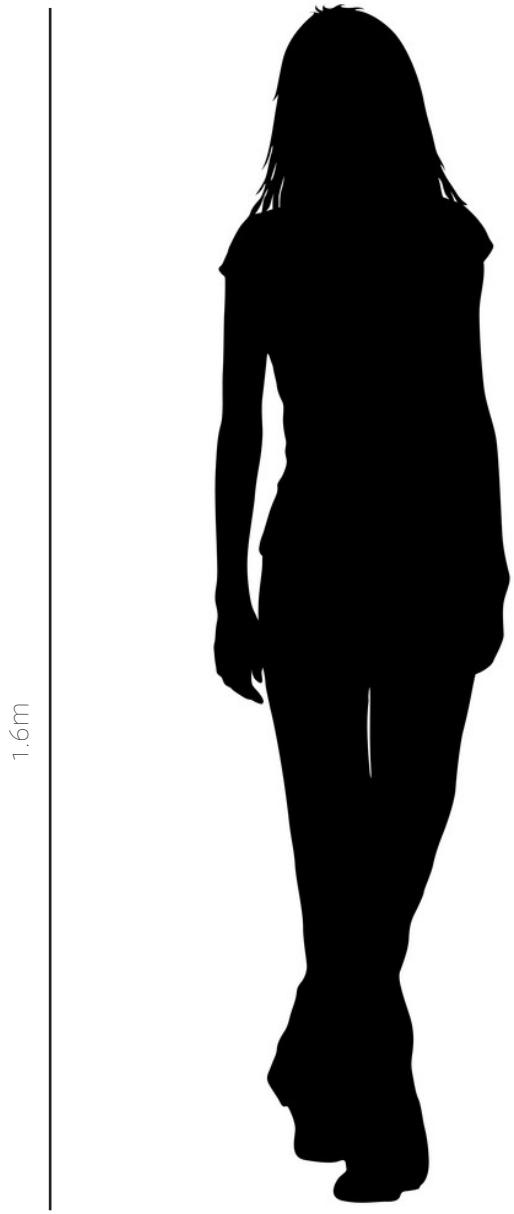




Concept 3D model


1.8m


1.05m



Cost sheet

5.11m rods	₹1,840 (₹200/Kg, 1.8KG/m)
1300mm x 1600mm sheet	₹28,000 (100x100x1mm = 1.5kg)
2060mm L sections	₹300 (₹160/Kg, 0.9KG/m)
4 bearings	₹400
4 rollers	₹18,000 (₹4,500 x 4)
Conveyer 2600mm x 1200mm	₹780 (₹150/m-500mm width)
Motor	₹5,000
Gearbox	₹3,000
Cost of manufacturing	₹70,000-₹80,000

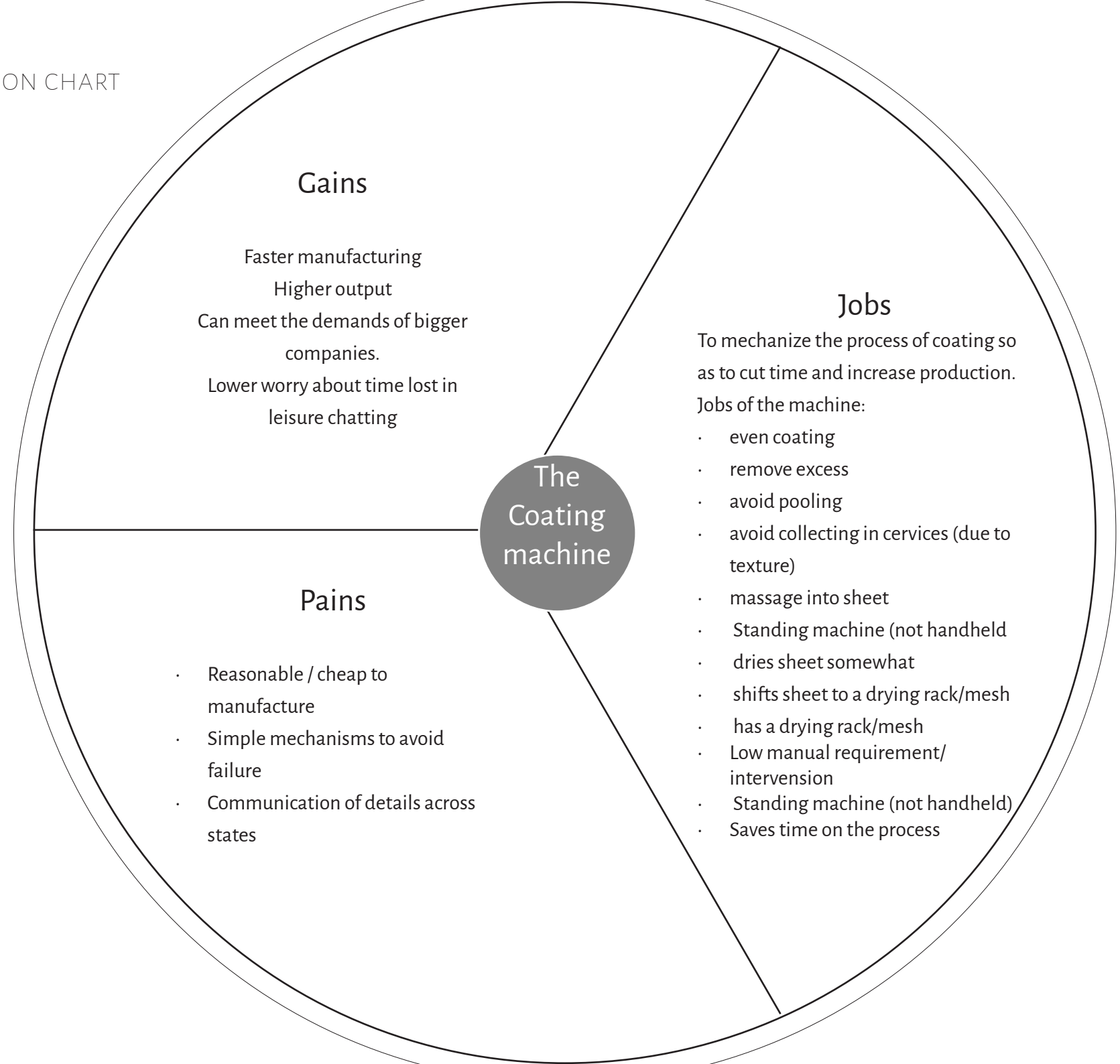
Future scope

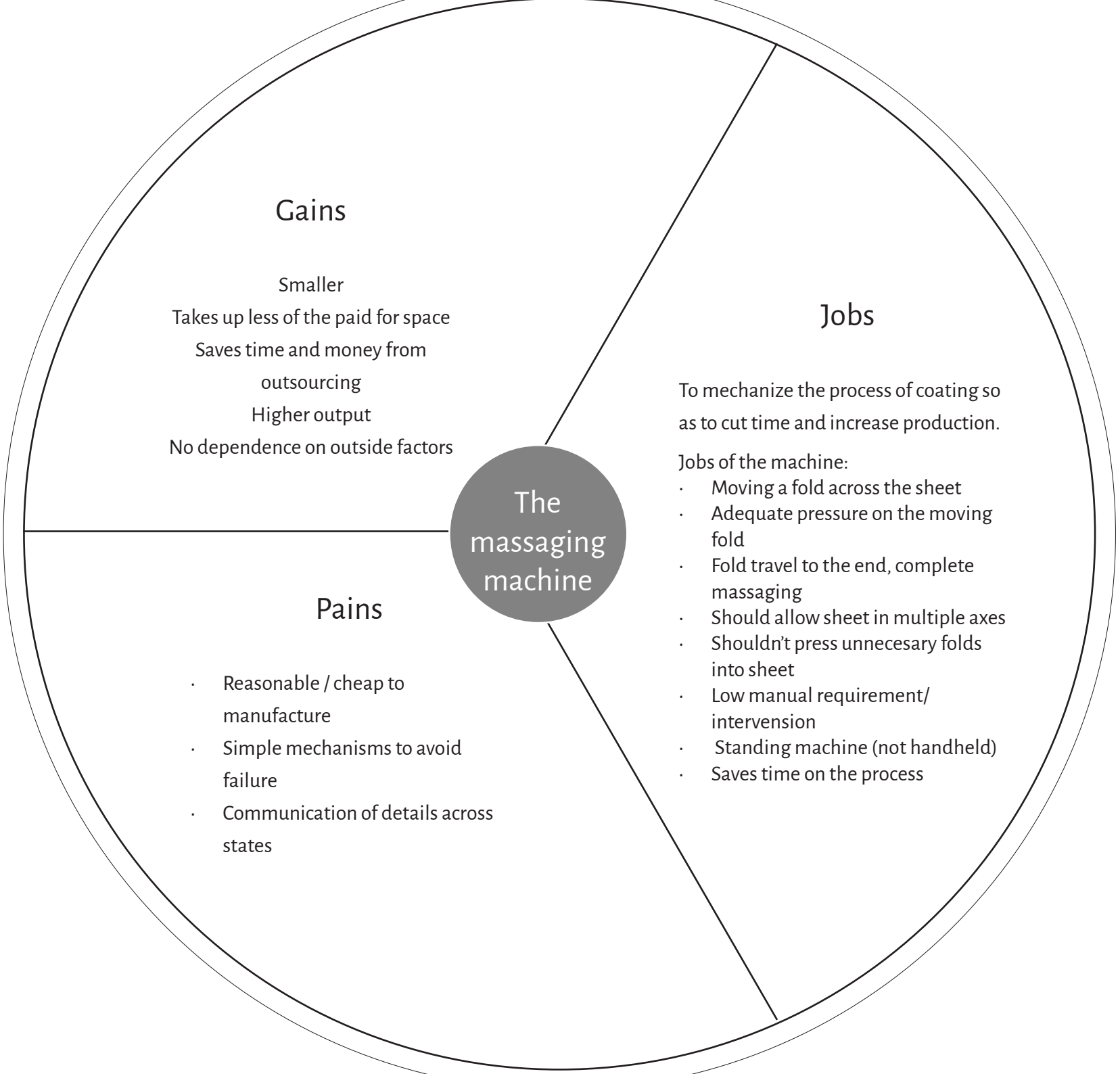
Once the machine is built and ready, the time taken for one swipe across the sheet can be calculated, and a simple mechanism can be added to switch the polarity at every end of fold, thus removing the need for human intervansion.

As of now, the concept and the details have been handed over. The machine is at the prototyping stage in Kerala, and once the detailing is finalized, we will start to get the actual machine manufactured.

Value proposition chart

For malai




Gains
Smaller
Takes up less of the paid for space
Saves time and money from outsourcing
Higher output
No dependence on outside factors
Jobs
To mechanize the process of coating so as to cut time and increase production.
Jobs of the machine:
· Moving a fold across the sheet
· Adequate pressure on the moving fold
· Fold travel to the end, complete massaging
· Should allow sheet in multiple axes
· Shouldn't press unnecesary folds into sheet
· Low manual requirement/ intervension
· Standing machine (not handheld)
· Saves time on the process
The massaging machine
Pains
· Reasonable / cheap to manufacture
· Simple mechanisms to avoid failure
· Communication of details across states

Business model canvas

For the machines

Key partners

- Material suppliers
- Machine manufacturer in Kerala
- Mentors - Tulip, Dharun, Jacob and others
- Client - Susmith and Zuzaana
- Workshop helpers and assistants
- Online partners to facilitate the process remotely - Zoom, Microsoft Teams, Google Docs
- College - facilitating travel and workspace
- Peers - feedback and combined research

Key Activities

- Communicate needs and wants with users
- Design the machine
- Prototype for proof of concept
- Source mateirals
- Confirm design with users
- Find manufacturer
- Manage outsourced production of parts
- Arrange for the machine to be properly handed over

Key resources:

- Raw materials
- Softwares to ideate and finalize
- Internet - To study machines and concepts about them
- Mentors and their feedback
- Workspace and workshop

Cost structure

· Cost of prototyping	₹40,000
· Cost of concept and designing, iteration	₹60,000
· Cost of manufacturing	₹70,000 - ₹80,000 (per machine) (detailed cost breakup on page 121)

Value Proposition:

- To eliminate costs and time spent in outsourcing the processes of massaging the sheets and coating the sheets.
- To open the possibility of collaborating with bigger brands with the new ability to produce a higher output with the time and resources saved.
- Low manual requirement/ intervension
- Standing machine (not handheld) that is run on electricity and no manual power.
- Better results than existing machine for massaging

Customer Relations:

- Providing and discussing concept and design for a machine to improve yeild
- Delivering details and final concept
- Regular consultation to keep them updated of the progress and the process.
- Transparency of process and costs

Channels:

- Direct communication with the client

CUSTOMER SEGMENTS:

- B2B - for the company Made from Malai

Revenue Streams:

- Charges for concept and designing + iteration

Reflection

It has been a semester of surprises.
Most of us started this project with enthusiasm and tight schedules, and no one could have anticipated the pandemic; or the ways in which it changed our courses of action.

My learnings

It has been a thrill to work on something that is a part of the real world. Speaking with Malai, understanding what they need and designing for someone outside of two pages of user personas has been a new experience. I learned a lot about what the projects to come are going to be like, and how interactions of the sort are to be carried out. This project also brought with it field research on a scale that I have not done before, and I feel more confidence in my research abilities and tools than ever before.
My experiences with machines before this project were largely based on 3D printers and household appliances, and over the last couple of months I have had the privlage to understand industrial machines, study those at malai and otherwise as part of my research process, and it has been a very enriching experience.
Another learning has been of making do, and being flexible. With changing dates and formats of submissions, and lack of preferred facilities, time management and learning new ways to work was interesting.

The pandemic

We are a privileged lot, and that has become very apparent in the recent past. A few times I considered shifting the focus of my project to a response to the pandemic and the problems it has brought with it, but stuck with the initial brief. There were times where it was almost impossible to find the motivation to work on a project of this kind when there were people suffering and dying everywhere, but there were also times when it made me realize all the resources and guidance I have and that it would be a disgrace not to make the most of it.

It has been a semester of surprises, but an informative and enriching one, all the same.

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Machine study

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INSTITUTE OF ART DESIGN AND TECHNOLOGY

THESIS PROJECT PROPOSAL

Even Semester 2020

SRISHTI

Institute of Art, Design and Technology

Name: Smruti Mulchandani

Award: IADP - B.Des

Project: Impact Edge 2020

Guide: Dharun Rao, Jacob Matthew, Tulip Sinha

Title: Made for Malai

Abstract:

The luxurious feel and superior qualities of leather (like aging, durability and stretchability) make it a popular choice of material in goods like shoes, wallets, and bags, among other things. Every year, 19,000 million square feet of leather is produced across the globe[1], employing over 4.42 million people[2],.

Impact edge is a joint initiative between the Industree foundation and the students of Srishti, Institute of Art, Design and Technology, that seeks to educate, incubate and accelerate impact entrepreneurs in their endeavors to solve some of the world's most complex problems. This particular project under Impact Edge tries to understand an eco-friendly alternative to leather, made by Malai Biomaterials, that is made from bacterial cellulose of coconut water and other fibres, and to help them expand and make their material more accessible/ desirable to the consumer base of leather artifacts.

Background and Context

About Industree

"Established in 2000, Industree Foundation holistically tackles the root causes of poverty by creating an ownership based, organised creative manufacturing ecosystem for micro-entrepreneurs." Industree works towards a world where people are lifted from poverty into creative manufacturing, and developing sustainable livelihoods from it. "We believe that when producers have access to an enabling ecosystem they are able to pursue their futures with dignity, and that when women earn they are empowered at home and in their communities."

Market study

A study of the leather industry and market was conducted by going to stores that were selling primarily leather products, spread across different price points and mapping their product range, customer habits, prices and other details.
Stores with leather goods on the lower end of the price line have small showrooms with spotlights to showcase their products, and do their best do give whatever level of luxury they can stitch together with their relatively lower income, like seating in tiny spaces, promise of a prototype to test fitting, a catalogue of designs on their phones, among other things.

Their products range anywhere between ₹3000 to ₹5000, give or take a few hundred.

The most expensive stores had products ranging from ₹25,000 to ₹75,000, bigger, well lit showrooms with strategically placed goods and friendly, well dressed sales-people with lots of knowledge about the products and the brand.

These companies had slaughter houses to have the finest quality of animal hide, but give to animal welfare charities as well.

One common point across this market research was that the customers are slowly asking for cruelty free alternatives to leather, and while the low end stores are doing this to please the customers, the high end brands refuse to comply. This said, the sales people at these high end brands believe strongly that it is the status symbol that comes with the brand that matters to the customers, and if the same brand were to sell vegan alternatives, it may sell as long as the quality and brand name still exist.

Alternatives and Malai biomaterials

There exist vegan alternatives to leather that involve materials like Polyurethane and Poly vinyl chloride, toxins that are now believed to leach out of the goods and into the environment of the user. This makes the material non biodegradable, non compostable and seemingly toxic to use. This raised the requirement and demand for a non plastic based alternative, and small startups and individuals across the globe are now experimenting and using plant based/cellulose based alternatives to mimic leather.

One such startup based in Kerala, India is called Malai Biomaterials (coconut cream biomaterials), and has been founded by Zuzana Gombošová and Sushmit CS. They have developed a fairly promising material that is similar to handmade paper but structurally stronger because the adhesive has the same molecular structure as the suspended fibres, and the material is held together by virtue of material cohesion, instead of adhesion, which is stronger. It is made from combining cellulose based fibres with pure cellulose produced by Acetobacter bacteria, in their process of consuming and digesting glucose molecules. One of the three constituting fibres shrinks during the process of production, this giving it the distinct, wrinkly, skin like look.

Study of the ecosystem and existing, well established systems

Malai biomaterials is a two year old startup, and a comparative study was done to develop an understanding of the ways in which Malai may be able to progress and establish themselves well. They have a small work force of 6 people, one

admin and 2 designers/founders and a dog named babu at the moment.

All of these people (besides the dog) are well versed with the process of production, and besides Mrs Sindhu (admin), anyone in the unit at any time is either working on whatever stage the sheets of that batch are in, or taking a break.

The work ethic of the employees is not as motivated as the founders would like it to be, and there are steps being taken in this direction (higher pay, but based on hours worked, and sheets produced).

The material sourcing is a result of whatever source made itself available, as opposed to a thorough research and analysis of what the best place to source material might be, and as a result, the raw material costs more than it should and sometimes is not up to the quality mark that it can be for the same or lower price.

This can be attributed to the fact that a small founding team of two people have made all the decisions of development, marketing, establishment of the unit and other things, besides doing their other jobs, and simply have not yet had the time for a thorough scan.

The process of production, however, is very well established, the steps are few and well understood by all workers, the outsourced jobs have alternate backup workers, and the in house workers know how to do them too, in case of emergencies.

Bigger factories and units we visited (coir, rubber, oil) worked like well oiled machines, where everything that could be mechanized was, and the workers were assigned specific tasks and knew exactly what to do and look over.

All processes were running simultaneously, and material was being moved efficiently enough that no person or machine was idle at any given point in time.

All of the units (rubber, coir, coconut oil) had backup generators, and lost little to no time in case of electricity blackouts.

There was a hierarchy of tasks, and supervising managers specifically making sure everything was running smoothly, but without a thorough understanding of each process.

The tasks were grouped and divided into departments, with well planned space allocation, and workers worked in the shifts that were assigned to them, to avoid overworking the employees.

Areas of interest

As it stands right now, the production of the material is done in 10 broad steps, each with its own sub steps and details

Sourcing the material

Prepping it for pulping (cutting and cooking)

Pulping

Dying

Mixing

Pressing

Drying

Folding

Coating

Massaging

A lot of this work is done manually, or semi manually in cases where the work is partially mechanized. But as a startup, there are still processes that are time consuming and done manually, and a bit haphazardly. Processes like cutting of the fibres, drying of the sheets, folding, coating, massaging are either partially mechanized or had attempts in the past to be mechanized, but did not work as well as planned. Two of these processes are now outsourced, and this adds a significant amount (5%) to the cost of each sheet. There seems to be scope for altering the machines for these processes or developing machines or instruments that could make these tasks more quick, efficient, and reduce area for human error.

The 5-6% of the cost of each sheet comes from outsourced processes, that can be done in house if there was enough time.

Processes like coating of the sheet and trimming of the sheets takes 20-25 minutes total.

Coating of the sheet takes 12-15 minutes,

and a sheet takes 45-60 minutes to dry on one side. At a time, a batch to be coated is around 30-40 sheets (area of the warehouse allows this many sheets to be spread out at one time). Once one side dries, the second side is coated, and once that dries, the sheet is oiled. Once the oil is dry, it is trimmed.

So per batch of 30, there is an approximate 9 hour wait time, and if all these processes could be made more efficient, the total time of these processes would, in an ideal situation, come down to 3 hours per batch, from 12 hours per batch.

Coating	Time (minutes)	Total time (minutes)	Drying time (minutes)	Wait time (minutes)
Konjac gel	8	8 * 30 = 240	60 minutes (max)	180 minutes
Konjac gel 2	8	8 * 30 = 240	60 minutes (max)	180 minutes
Oil	4	4 * 30 = 120	30 minutes (max)	90 minutes
Trimming	4	4 * 30 = 120	30 minutes (max)	90 minutes (before packing)
Total		720 minutes	180 minutes	540 minutes
		12 hours	3 hours	9 hours

The material that malai produces has a niche but promising market, that mostly consists of small companies across the globe looking for a vegan, eco friendly and non toxic substitute for leather (like noos eco, lemniskata), and making small one time products. The request of samples is now at an all time high, but the company has no hold over these, and seem to not have the time to be a part of these small product experiments, or to even try to monetize that market.

On speaking with the co-founder of malai, the founders are confident with the material as it is, and believe it requires no alteration besides better abrasive resistance, but also believe that the products can be designed in such a way that the abrasion can be minimized.

There is scope for the manufacture of products with this material in India itself, for an added revenue stream, to expand the market and the awareness of the material, and to tackle the damage done through wear and tear, with the available work-force around the unit and the added advantage of being manufactured close to home.

Research Aims:

This research aims to analyze

- The leather industry as it stands, its advantages and drawbacks, and alternatives available, so that we may understand the ecosystem (and its consumer base) and what it needs to sustain itself in a more environmentally conscious and cruelty free manner, and work towards it.
- Malai, as a material, how it is produced, what it took to get to the existing formula, what component adds what property, and what properties could be incorporated.
- Malai, as a business, how it runs, how much they produce, how much it costs then and subsequently how much they make, what hurdles they face in increasing the output.
- Malai's customers, who they are, what they like, what they don't like and what they do with the material.
- Study the ecosystem and communities around the unit, to explore possibilities of community upliftment through collaboration with Malai.

Research questions:

- Why isn't vegan leather as popular as animal

leather?

- How can malai (the material) be made better?
- How can the system/production process at malai be made better?
- How can the costs be cut while maintaining or improving the quality of the material?

Design Brief:

In what way might we develop instruments or alter existing machines that could make the tasks of cutting of the fibres, drying of the sheets, folding, coating, and/or massaging more quick, efficient, and reduce area for human error, while potentially eliminating the need to outsource any of these processes, which at the moment adds to 5% of the cost.

Timeline:

Phase 1 : 6th January to 9th February
Primary and Secondary research
Field visits
Drafting a proposal

Phase 2 : 22nd February to 22nd March
Ideation
Iteration
Prototyping and mockups
User testing

Phase 3 : 4th April to 30th April
User testing
Final prototype
Documentation

Learning outcomes:

Through this project, I hope to develop a better understanding of startups and how they can improve and expand, through our research and analysis of the startup we are working with, and study of existing, established firms.

As this is the first time I will be working firsthand with industrial machines, there will definitely be a lot of learning of how mechanical design works, and what things need to be kept in mind while making or tweaking industrial instruments, as opposed to small house machines and accessories.

Another thing I am now learning about is the material itself, and through material explorations I have begun to understand fibres and binding strata more. Learning the experimentation that the founders had done during the development of malai, and all the trial and error I've done and will continue to do to replicate and hopefully better the material will add to my understanding of fibre based material.

Student Document Publication
(for private circulation only)

Final Thesis Project
(Undergraduate Professional Programme)
Srishti Institute of Art, Design and Technology
Bangalore - 560064 Karnataka

Written, edited and designed by
Smruti Mulchandani
Printed at
xyz, Bangalore

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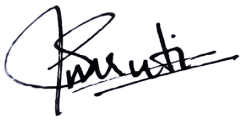
Signature: 

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THESIS PROJECT **2020**

IMPACT EDGE

Made for malai

STUDENT: **SMRUTI MULCHANDANI**

PROJECT: Impact Edge

SPONSOR: Made from Malai

PROGRAM: Undergraduate Professional Programme

AWARD: Industrial Arts and Design Practices

Examiner 1 (name and signature):

Examiner 2 (name and signature):

Examiner 3 (name and signature):

Date:

Academic Dean:

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Final Examination Panel COMMENTS:

SMRUTI MULCHANDANI

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