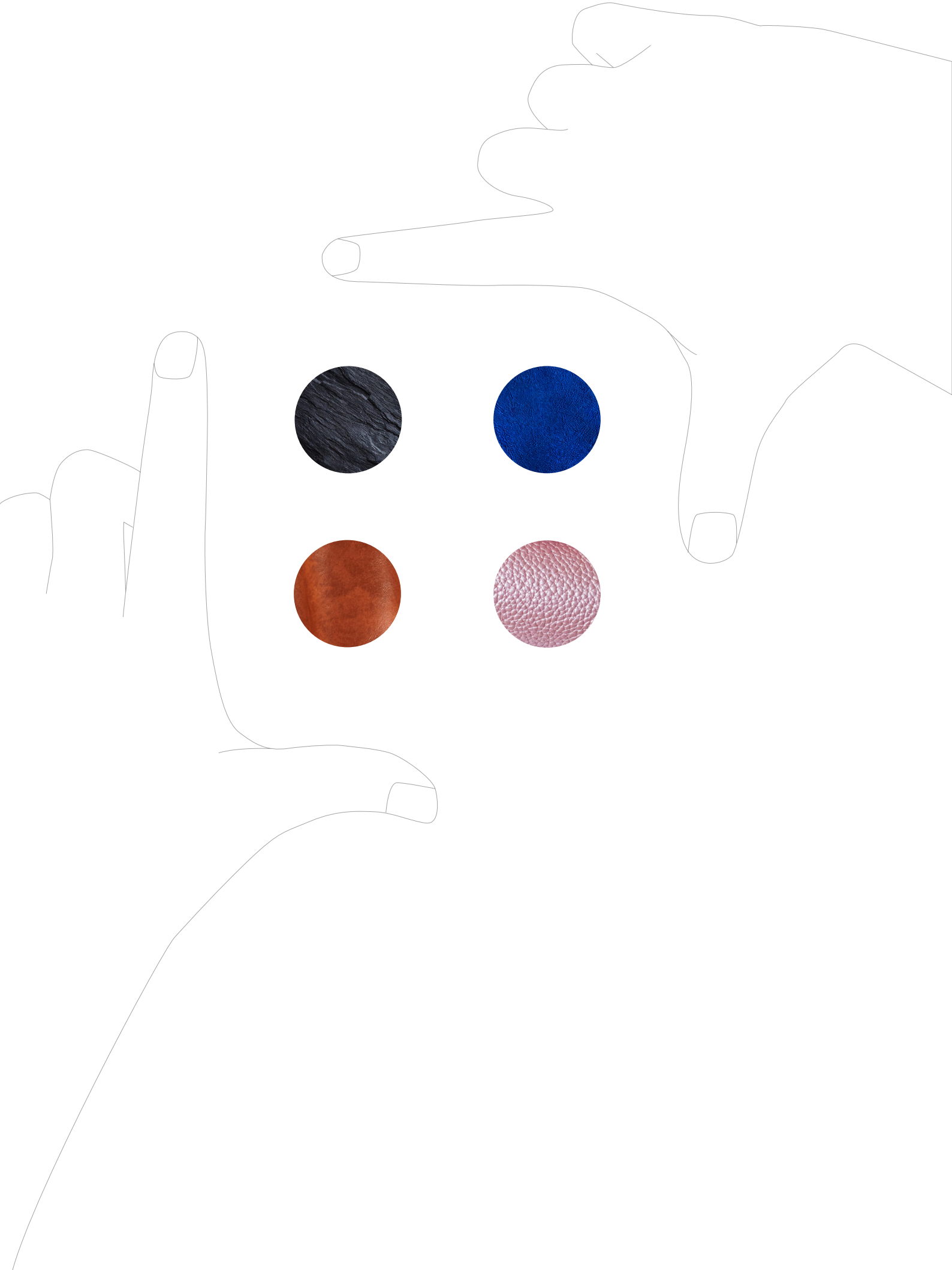
Framing leather

FOSTERING DIY-MATERIALS EXPLORATION IN BERLIN

Magdalena Milly
Supervisor: Dr. Valentina Rognoli
Matricola: 872256
Politecnico di Milano, School of Design
Product Service System Design
2018/2019



Abstract

The reversed role of a designer in a material creation process through DIY-Materials and the pressuring duty of cities as key actors towards a sustainable future open up design opportunities to create alternative materials. In this paper I elaborate on the places that can inform, inspire, connect and enable designers to start a tinkering process in cities apart from their homes.

Framing leather as a material, I introduce Material Maps, a tool to foster DIY-material exploration in cities. The map presents a starting point for future designers exploring the city in order to create an alternative material. Taking inspiration from the vegan hub Berlin this paper focuses on leather from vegetable sources.

During this study multi-level research methods, inspired by the methodologies of Materials Experience, DIY-Materials, the Fab City project and Service Design tools were used to define the material, understand its context and the underlying system, map case studies of alternative materials, immerse into the world of DIY-Materials in Berlin and map places.

Through this project we can learn about DIY-Materials exploration in cities on the basis of leather alternatives in Berlin. Taking the tool as a framework, it shows potentiality to be scaled to other materials and cities.

KEYWORDS: DIY-Materials, Leather Alternatives, Tinkering with Materials, Fab City, Self-produce, Maps

my leather story

Materials are the building blocks of our man-made world, a fascinating complex array of atoms assembled into objects, buildings, cities and countries. For a long time my relationship as a designer with materials was, well let‘s call it distant. I was fascinated by them and fond of touching different surfaces and I more or less knew how to apply them and transform them into objects.
The context of Materials Experience and DIY-Materials challenged this ‘worldview’. All of a sudden I was part of the creation process, it was dirty, hands-on and I was really proud of the result.
Dipping deeper into the field I realized it was not so unrelated to Service Design and could be easily merged into a final work for my master thesis.

At that time I moved to Berlin for an internship. Being immersed into a vegan hotspot and constantly feeling a little guilty of enjoying a steak every now and than, I started asking myself, why do vegans still wear leather products? Wasn‘t their some kind of paradox in philosophy going on? It seemed I had found my thesis topic: leather from vegetable sources.
Though there was one factor in the equation I had not thought about: the city. Berlin‘s housing market was on the edge and I was moving four times within 6 months. There was no room and little understanding from flat-mates to set up a lab in the kitchen and get started on a tinkering process to create a new vegetable leather material.

A MAP

Not having this space, the city became my challenge, before even starting a tinkering process. Inspired by the Fab City philosophy I started to map places that were beneficial, when working on leather.
The result is a framework for material exploration in the city - a starting point for future material designers interested in working on leather in Berlin.

„leather in my daily life"

Leather in my daily life

Is leather a wicked material?

Inspired by the paradox of vegans wearing genuine leather boots with pride, this essay seeks to summarize the current status of leather:

Leather has been a witness of human evolution since the very beginning, serving as vestments in the Stone Age in 100.000 B.C. and has adapted to change ever since, rising to a multi-billion industry today. (Giannetti et al, 2015) The material represents not only a matter of inheritance, but created a tradition of craft, that survived industrialization and although outgrowing many of its original purposes, with the introduction of new and better performing materials in the 20th century, it still can be found in an immense variety of products, from apparel, to furniture, leather goods and automotives (Král´, Schmel & Buljan, 2014).

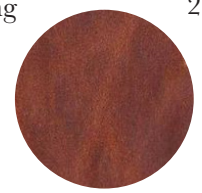
So, why describing leather as a wicked material? After studying the current context of leather, the socio-economic and environmental impact of the material, there was no single answer, but many facets and points of view. Was it better to let the animals' skin rot and waste the material or use a highly toxic procedure to turn it into a product that has a lifespan of only four years to than take an even longer time to decay?

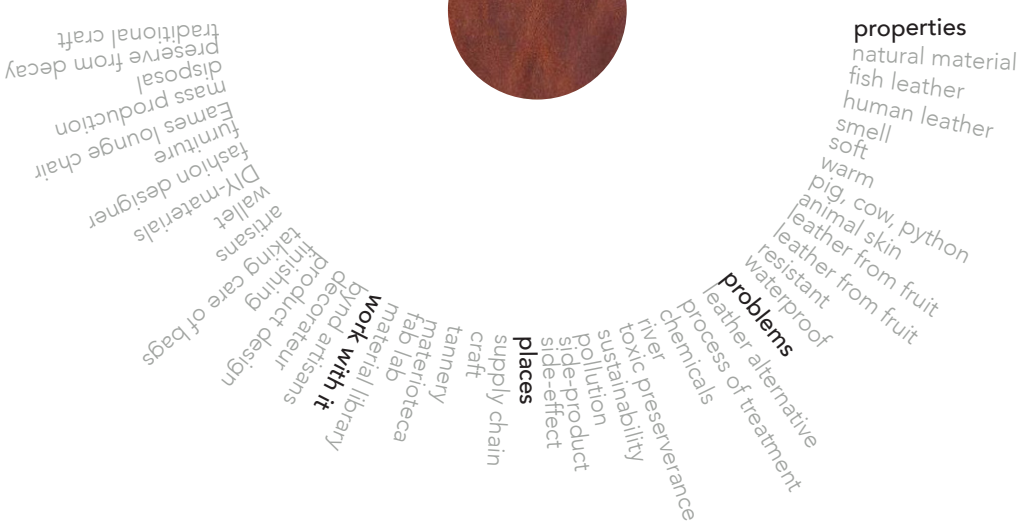
Let's look at an example: Paris is famous to be the city at the Seine, little people though remember that up until 100 years ago another river, la Bièvre ran through the city. Since 1376 it was commercially used for tannery, dye making and textile manufacturing and created a vivid industrial hub around its banks. By 1912 it was completely sealed and is now a sad part of the Parisian sewage system. (Crossman, 2013) Paradoxically due to the polluted water of La Bièvre the Royal tapestry manufactury Les Gobelin was able to create a very specific red color *'Mudder Red'*, which would become famous in art history to have inspired thoughts about the color wheel and complementary colors, theories crucial for our modern technology. (Finlay, 2014)

One could say this lies in the past, but still it has implications and effects that influence today's leather scene: Currently, the same chemicals are being used in leather processing, though in a more efficient way. In combination with a shift in consumption and production hubs due to globalization, basically the same problem is happening, just in another part of the world. We must acknowledge that this process is irreversible. In combination with steady population growth and therefore improved living standards for many more people, this eventually will lead to increased demands both in meat, with leather as a side product and luxury goods. (Král´, Schmel & Buljan, 2014, Rosling 2010, Kirchain et al, 2015)

Again I could ask another question: Fast Fashion is evil polluting our environment, but from another point of view jobs in the textile and apparel industry can decrease poverty, like a study of the World Bank about Madagaskar shows: A job within the textile and apparel production industry would increase an individual's purchasing power by 24% on average, a change that is sufficient to lift them out of poverty. (Nicita & Razzas, 2004) So, who chooses what is more important?

These were just two of many clashes of interests,





which have led to an ongoing news debate between activists and the leather industry in recent years. With both sides claiming their point of view, being right. In addition many studies about the impact of leather are conducted, ranging from chemical effluents, environmental footprint, product service systems or luxury good perception (Dixit et al, 2015; Laurenti et al, 2017, Bhamra et al, 2018; De Klerk, 2018).

All of these studies focus on a specific problem or a certain step within the product-material-lifecycle. They verify the fact that the awareness about these issues is omnipresent. In contrast, Biagio F. Giannetti and his team of researchers from Paulista University in Brazil and the Università degli Studi di Napoli expresses the need for *'breakthrough process alternatives beyond conventional technology optimization'* (Giannetti et al, 2015, p. 22) in the leather production. Due to the fact that currently 20 year old studies are still considered innovative in leather production processes. (Giannetti et al, 2015)

Many of the above mentioned studies highlight the import role of designers in shaping the consumers vision of leather.

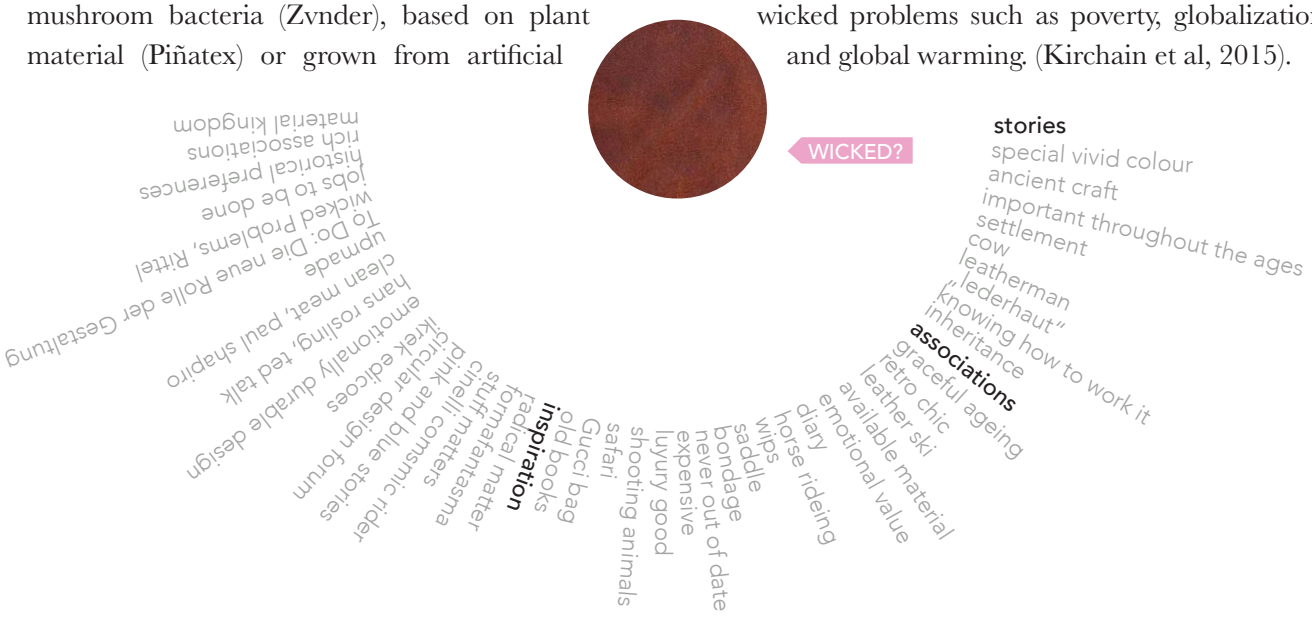
Within the field of design, sustainability is yet nothing new and surely *'no longer an optional facet'* (Bhamra, 2018). It is impossible to name all current angles of the ongoing research, some though suggest, what Giannetti would describe a *'breakthrough process alternative'* (Giannetti et al, 2015, p. 22): In the past decade the leather field has seen the emergence of various *'new types of leathers'* mainly from vegetable sources: made out of food waste (The Apple girl), grown with mushroom bacteria (Zvnder), based on plant material (Piñatex) or grown from artificial collagen in a lab (Zoa). In many cases the designer itself has been also the producer of the material, a phenomenon described as DIY-materials (Rognoli et al., 2015) enabled by the *'democratization of fabrication technology and the rising desire of individuals for personalizing their products'*. (Rognoli et al, 2015)

Thus again one could ask the question: Who chooses if it is more reasonable to design long lasting products (Chapman, 2015; Rognoli & Karana, 2014) combine materials and social sustainability (Kandachar, 2014, Franklin & Till, 2018) or biofabricate materials in a lab (Forgacs, 2018)?

I came to the conclusion that it was sheer impossible to describe the problem of leather in one sentence, even one article.

Eventually as long as humans will eat meat the dicussion around leather will be alive. As I realized there will never be a solution that is *'right'*, but according to the point of view just good or bad and due to the high publicity of the topic there is little room for failure, one just had to give it a try. Leather and its context was unique involving so many industries, people and being the symptom of other bigger issues like globalization. I set out to describe this problem in this thesis, it will be my point of view and later I will be judged, whether it was a good effort or a bad shot.

This description resonates Rittel's 10-step-characterization of Wicked Problems (Rittel & Webber, 1973) and from my point of view it applies to the material as it is interwoven and part of the creation of well known wicked problems such as poverty, globalization and global warming. (Kirchain et al, 2015).



Materials Experience

The theory of Material Experience was necessary to define leather as a material and understand its different facets.

'Materials Experience' (Karana et al, 2008) was firstly introduced by Karana et al. to describe the experience people have with and through materials. It acknowledges the role of materials in shaping not only our *'internal dialogues'* (Karana et al. 2015) with the artefact but also our *'ways of doing'* (Giaccardi & Karana, 2015). In their research on material experice Giaccardi and Karana argue that a materials experience is not created by objects nor people, but happens at the interrelation of materials, people and practices. This mutual interactions, referred to as materials expericence pattern, happens through inital '*encounters*' with a material, re-occuring '*performances*' and '*collaborations*', describing alterated perfomances. In addition to these three different contextual relationships, materials are experienced at four experimental levels: *sensorial, interpretative, affective and performative.* (Giaccardi & Karana, 2015) Sensorial encounters take place through touch, vision, smell, taste and sound, interpretative ones describe the initial meanings we attribute to materials through interpretation and judgement. The affective level concerns the emotions the materials triggers in us, formed by personal thoughts, attitudes and beliefs. Ultimately the performative level of material experience describes the performances we establish around a specific material. Giaccardi and Karana argue, that only if the performances and the aesthetics of a design are connected, it will be possible to explore and develop *'unanticipated'* practices with an object. (Giaccardi & Karana, 2015)

Referring to Pedgley's research, both end users and designers are important stakeholders in planned and actual materials experiences. (Pedgley, 2009) Thus when designing for materials experience it is not only important to be aware of the experiental levels of materials, but also to take various design aspects like form or finishing, user characteristics such as culture or age and the context of use into consideration. (Karana et al. 2015)

DIY-Materials

The theory of DIY-Materials is crucial to my research, giving a framework of how to classify and explore new material experiences.

Defining an emerging trend of aspiration for personalized products combined with the spreading availability of technology for self-production, the term *'Do-It-Yourself Materials'* (Rognoli et al, 2015) was used to describe this phenomenon:

'Do-It-Yourself Materials are created through individual or collective self-production experiences, often by techniques and processes of the designer's own invention, as a result of tinkering with materials.' (Rognoli et al. 2015, p. 693)

Ayala Garcia et al. show in their research on the emotional value of DIY-materials, that this experiental approach of research led to a '*complete change of perception, a fully positive appreciation*' (Ayala Garcia et al. 2016, p.641) of both the self production process and the outcomes by designers. (Ayala Garcia et al. 2016)

Within this spectrum of developing DIY-Materials two main directions can be differentiated: *'DIY new materials'*, that use atypical ingredients, usually organic or inorganic waste, for material creation. On the contrary

Terroir
Jonas Edvard

Harvest
Asif Khan

Hidden Beauty,
Studio Gutedort

Thousand Years
Tomáš Gabzdil Libertiny

'DIY new identities for conventional materials', aim at applying new production approaches, DIY and craftsmanship, to conventional materials and therefore give them new identities. (Rognoli et al, 2015)
In regards to these two directions, DIY-Materials are furthermore classified into 5 kingdoms according to the initial source of the material. (Ayala Garcia et al. 2017)

FIVE KINGDOMS OF DIY-MATERIALS

Kingdom Vegetabile: Materials based on plants and fungi are classified in this kingdom. Often designers collaborate with farmers and biologists using techniques to grow and farm the materials, which especially differentiates these materials from others.

Kingdom Animale: The primary source for these materials derive from animals or bacteria and can be either developed by using parts of animals or in collaboration with living organisms.

Kingdom Lapideum, refers to materials from mineral sources, such as stones, sand, ceramics, clay etc. Usually materials developed in this kingdom show a strong connections to craftsmanship, probably to its historical tradition.

Kingdom Recuperavit, considers all materials made of, what is considered waste by society. Generally they show the willingness of designers to tackle sustainability issues using side products of production processes and often contain plastic, metal or organic waste.

Kingdom Mutantis, contains all cases that have an original source in another kingdom, but undergo a *'significant change in the material's nature and behavior'* with the aid of any technology. (Ayala Garcia et al. 2017)

FabCity

The philosophy and context behind the FabCity project were inspiration and an important structure to understand where new materials experieces in the form of DIY-Materials could be created.
FabCity is an international iniative aiming to develop *'locally productive and globally connected self-sufficient cities'*. (Diez Ladera, 2014, p. 1)
According to United Nations predictions by 2050, 75% of the human population will inhabitate cities, which following the current lifestyle based on consumerism and linear economy causes destructive social, economic and ecological impact. The FabCity philosophy aims to change this *'PITO - Product in/Trash out'* into the *'DIDO - Data in Data out'* principle. Thus rescaling global manufacturing into a network of local fabrication ecosystems, where more production is occurring in the city, materials are recycled and inhabitants' needs are met with local iniatives. By creating a global network of cities, a single city's import and export would mainly consist of data in form of information, knowledge, design and code. (Diez Ladera, 2014)

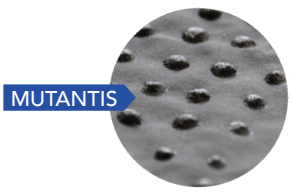
GOALS AND STRATEGIES OF FAB CITY

The ideals of FabLabs: culture, connectivity and creativity are the drivers of the iniative, that uses the following strategies to achieve their goals: advanced manufacturing systems, distributed energy production, crypto currencies for a new value chain, food production and urban permaculture, educating for the future, building the spiral economy and collaboration between government and the civil society. (Diez Ladera, 2014)

The people's Brick Company
Something & Son

Gyrecraft
Studio Swine

Decafé
Raul Lauri

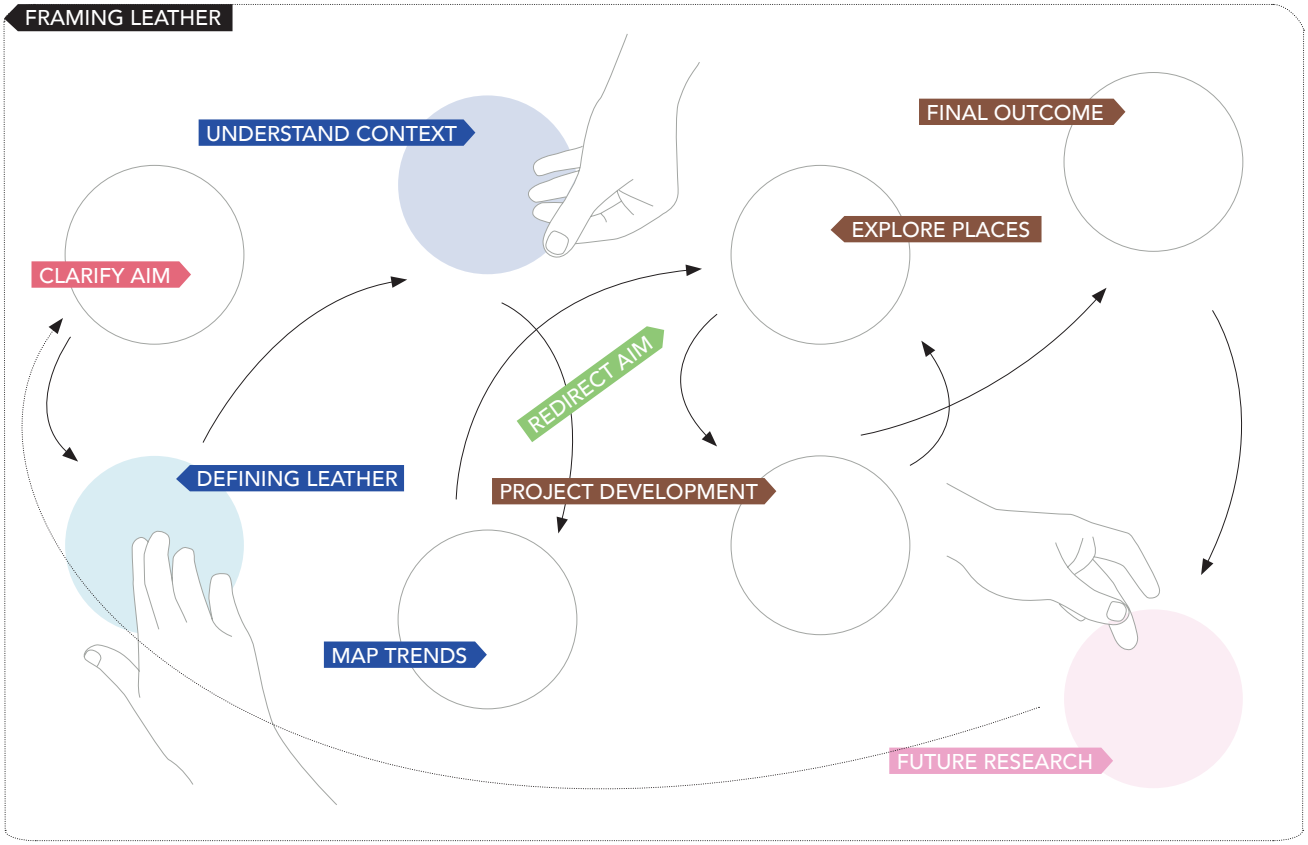


Magnetic Fabrics
Lilian Dedio

Adapted from: Franklin&Till, 2018, Rognoli et al. 2015

Project Development Logic

Initially this project started with the aim to create a material alternative for leather through a tinkering process. For this reason after the initial driving source was found, the first part of the project consists of the exploration of leather as a material using a materials experience approach. With the result of understanding the different leather types and material properties. In order to understand the problems omnipresent in the media discussion and understanding the trends in alternative leather development, I reviewed the current literature status and collected case studies. The output is an overview about the current market, issues and system as well as mapped cases. During researching this second part of the project, I was struggeling to start the tinkering process due to a lack of space in my home kitchen. This occuring problem set new boundaries to this project - the city. The focus of my work shifted towards fostering DIY-Materials exploration in Berlin. After setting a new frame called materials exploration in the city, the idea of a leather city map was born. As a result the exploration phase of useful places for a tinkering process in Berlin started: initial online and offline review of material databases and travel guides and local maps. This desk research lead to attending events in the local material scene and meeting like-mindeds as well as contacting alternative leather producers for expert opinions on this topic. Concurrently a process of mapping, collecting samples and observing the mood of leather in Berlin took place in order to design the look and feel of the map. After this open exploration, I curated the collected places by visiting them and rating them according to the willingness of support and openness towards sustainability. The final product is a material map. In four categories: (inform, inspire, connect and enable) it shows places, that are useful as a starting point for a tinkering process on leather in Berlin. Being aware that a printed map is an absolute today's solution, I ended this project with giving an outlook into the future research possibilities, such as digitalization, participation and partnerships.



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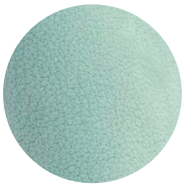
DEFINING LEATHER AS A MATERIAL



CHAPTER 1

Defining leather
Different leather types and their material properties
Leather, a starting point for tinkering

Defining leather

'The story of materials is really the story of civilization.' Mark Miadownik

In the case of leather, the material has been shaping the human world and who we are for a long time: evidence of use dates back until 100.000 B.C. with leather being the only flexible material available to satisfy the need for clothing.. (Giannetti et al, 2015; Keserwani, Jahan & Keserwani, 2015; Kula & Ternaux, 2009). Since then the uses of leather have changed alongside evolution and will continue to change according to the UNIDO report on the future of leather. (Král´, Schmél & Buljan, 2014)

Originally leather is understood as preserved skin and due to its production process shows in a huge variety of finishes. Accordingly to its qualities it is classified into different categories. (Lefteri, 2014, Kula & Ternaux, 2009) Likewise, the original source, initially the type of animal, determines its categorization. Next to various animal sources, the 20th century saw the commercial rise auf synthetic leathers due to technological advancement and shortage of the traditional source. The 21st century instead saw the emergence of leather from vegetable sources adding the factor of sustainability to the above mentioned. (Kula & Ternaux, 2009) Subsequently materials reffered to as leather can be classified according to its original source and the production process it undergoes. This results in a variety of different types and shade of leathers and urges a better understanding of the material profile, both the objective technical properties and the subjective sensorial properties for material selection. (Rognoli, 2010)

This chapter aims to explore, what Kula and Ternaux (2009) describe in their book The creative‘s guide to materials, as *'air of ambiguity'* that surrounds the material of leather, by defining the objective technical as well as the subjective sensorial material characteristics of three of its various types. Furthermore, taking a view, how leather can be characterized within a new context - as a starting point for a tinkering process and therefore the creation of yet another point of view on the multi-faceted material.

OBJECTIVE TECHNICAL PROFILE

The physical description of a material consist of largely numeric quantifiable data, categorized in mechanical, electrical, thermal, chemical and optical properties. (Ashby, 1999) The descriptions on the following pages serve to give a general idea of the technical abilities of leather from a designer's point of view, rather than exact calculi.

SUBJECTIVE SENSORIAL PROFILE

An understanding of sensorial characteristics is fundamental for user-centered materials selection to create, what Valentina Rognoli describes as, a *'relationship between the design and the designer, and the relationship between the user and the artefact'* (Rognoli, 2010 p. 289). (Pedgley, 2014; Rognoli, 2010)

Within this set of qualities it is crucial for a designer to understand the concept of *'tangibility and intangibility'* (Pedgley, 2014 p.346f), with tangible qualities referring to eg. strength, friction or transparency, contrasted by meanings, labels and emotions described as intangible features of materials. (Pedgley, 2014)
In addition a designer must acknowledge the *'discrepancy between subjectivity and objectivity'* (Rognoli, 2010 p.292), meaning that everyone perceives sensorial qualities differently. Therefore results of a personal perception and objective measurements show differences, which can be based on factors like cultural background, trends, associations and emotions. (Rognoli, 2010)
In order to give a framework of sensorial qualities the analysis of the following pages follows the four categories Giaccardi and Karana describe in their research on experiental levels of materials experience: *sensorial, interpretative, affective and performative.* (Giaccardi & Karana, 2015).

Leather from animal sources

Until the 20th century the only and original source for leather were animal skins. Most commonly used leathers at current state are collected from mammals, such as cattle, sheep, pig, goat and horses which are usually reared and slaughtered for their meat, milk or wool.

However, it is possible to find skins of more exotic animals turned into leather as well, like, fish, reptiles and birds. (Kula & Ternaux, 2009)

SKIN: COMPOSITION & CHARACTERISTICS

Independent from the animals' species, the compositition of the skin can be described as follows: The top layer, called epidermis, which is essentially made of keratin, followed by the dermis, which eventually will become leather including the *'grain side'* and the *'flesh side'*.
The sebaceous glands, the sweat glands and the hair sheet are implanted in the grain side of the dermis. The dermis is made of collagen, meanwhile the hair consist of keratin. Beneath the dermis lies the subcutaneous tissue or hypodermis, made of collagen. According to the purpose the skin fulfills on different parts of the body, variety in tightness and thickness appear. (Kula & Ternaux, 2009)

"kins and hides, like trees are not subject to the exacting demands of perfection, of reproducibility and dimensions of industry'. (Kula & Ternaux, 2009 p.34)

Thus every piece will be unique and several variables, like skin imperfections, breeding age, size of the leather piece and eventually differences and difficulties in the tanning process, should be taken into consideration, when thinking about material properties. Keeping in mind that, these factors will eventually determine the final material qualities. (Lefteri, 2014; Kula & Ternaux, 2009)

OBJECTIVE TECHNICAL PROFILE

The following characteristics depict leather from mammals, which is most common in use.

LEATHER & WATER

The material is considered water repellent and paradoxically to its origin is less damaged by water than sweat. For this reason direct contact with the skin is not desirable. Nevertheless one of the biggest qualities of leather is its ability to *'breathe'* and absorb moisture, which makes it comfortable in clothing and shoes. (Lefteri, 2014; Kula & Ternaux, 2009; Král´, Schmél & Buljan, 2014)

LEATHER & TEMPERATURE

The high amount of entrapped air makes leather a good thermal insulator, thus the material provides heat insulation in winter and keeps cold in summer. (Keserwani, Jahan & Keserwani, 2015)

LEATHER & FIRE

According to its nature and the undergone treatments, the level of flammability and fire resistance vary. Nonetheless leather is inherently fire-resistant. (Kula & Ternaux, 2009)

LEATHER & RESISTANT PROPERTIES

Specific kind of leathers can show a high tensile strength, resistance to bending, friction, traction, tearing and abrasion. These qualities are usually found in leathers for the furniture, sports or automotive industries. (Keserwani, Jahan & Keserwani, 2015; Kula & Ternaux, 2009)

LEATHER, ELASTICITY & PLASTICITY

The material possesses the ability to be either plastic or elastic. In order to achieve differences in shape, like moulding or higher flexibility, the material needs to be moistened. (Kula & Ternaux, 2009, Lefteri, 2014)

SENSORIAL SUBJECTIVE PROFILE

Leather from synthetic sources

Synthetic or artificial leathers can be divided into two categories: Compact Coated Fabrics simply imitate a leather-like appearance achieved by soaking or coating fabrics with a PVC or PU-film. Poromerics, instead, provide both the leather aesthetics and material features, achieved by a different process of applying a PU resin. (Shim, 2013; Kula & Ternaux, 2009)

Originally synthetic leathers were created due to the limited availability of leather from animal sources, in many cases though the new materials showed better performance and replaced the traditional material. White leather used in sport shoes is just one of the many examples. (Král´, Schmél & Buljan, 2014)

Leather from vegetable sources

Vegetable leather, instead refers to several leather types: Leathers, that have been produced with vegetable tannins, fabrics impregnated with natural latex and leathers deriving from vegetable sources. (Kula & Ternaux, 2009) Vegan leather is very openly defined as an *'artifical alternative'* (Kinge, Landaf & Wasif, 2013 p. 27) to traditional leather, that might have the same appearance and/or qualities. Regarding the technical properties of leathers from vegetable sources, I would like to highlight that most of these materials are at a semi-advanced state and not yet commercially available. But I would like to quote Andras Forgacs, CEO of Modern Meadow, a company on the forefront of bio-fabricated leather - *'new materials should not only imitate, but inspire new properties'*. (Forgacs, 2018)

Leather, a starting point for tinkering

Knowing about materials is a fundamental skill of designers. Material Tinkering, describes a method for designers to obtain this knowledge through experimental learning to develop the sensitivity necessary in order to design for meaningful material experiences. (Parisi, Ayala, Rognoli, 2017) According to Karana et al. two factors trigger novel material experiences: *'sustainability and technology'*. (Karana et al., 2015, p.23)

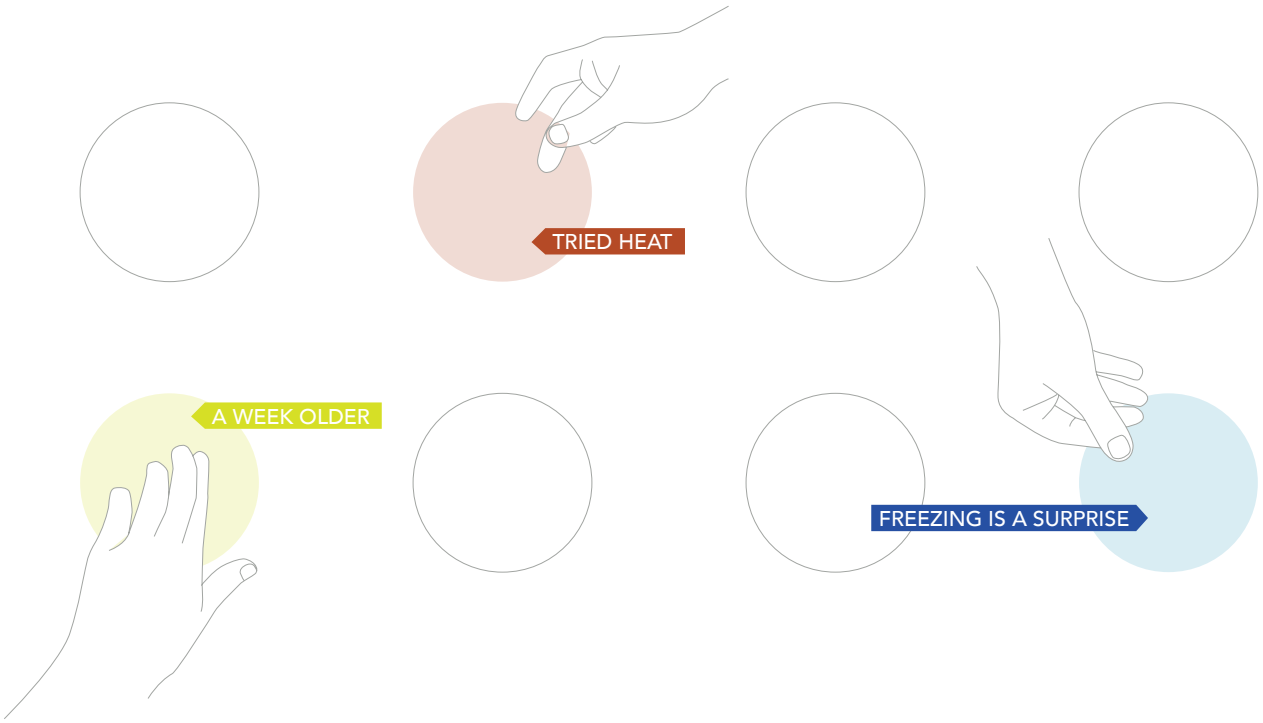
In the case of leather, clearly both factors Karana et al. describe apply: sustainability, shows in the emergence of leathers from vegetable sources mostly and advances in technology thtough the way leather is grown e.g. biofabrication.

The diffusion of knowledge and fabrication spaces through digitalization have led to the development of DIY-Materials, enabling a bigger range of people to work on materials. (Rognoli et al, 2015) The development reverses the role of designers and engineers in the creation of new material visions, with designers ideating them first and engineers making them feasible afterwards. (Parisi, Ayala-Garcia, Rognoli, 2017)

Material Tinkering proposes a framework for the designer's exploration combining hands-on experimentation and abstract conceptionalization. The practice supports to *'understand, evaluate and design the experiental, expressive and sensorial characteristics of material'*. (Parisi, Ayala-Garcia, Rognoli, 2017 p. 1167)

Starting to perform different interventions on leather, such as dyeing, exposure to weather, scratching,... and changes in process and recipe through ratio of ingredients, temperature or time, will result in establishing an emotional bond and intimacy with the material. Enabling the designer to not only understand his/her preferences but also to be empathic towards others' appreciations. (Parisi, Ayala, Rognoli, 2017)

Working on a material, so rich in culture, heritage and material properties and striving to develop a more sustainable alternative, developing an understanding of the above mentioned factors would be fundamental. Thus the tinkering approach seemed to be a feasible option for understanding and developing a material based on vegetable sources.



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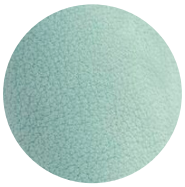
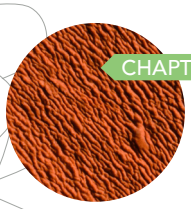
THE CONTEXT OF LEATHER



Leather market
Leather lifecycle, its problems and solutions
Leather system, its actors & drivers



CHAPTER 2

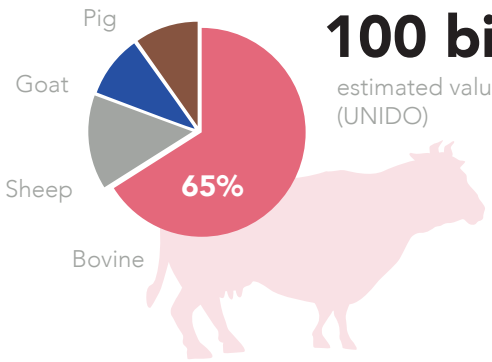
The context of leather

In the first chapter, I defined leather as a material, and understood that its final properties are depending on the original source and the production process it undergoes. In order to explore the process of making and understanding the wider context the following chapter analyses the status quo of the leather field.

To the before mentioned influencing factors towards more sustainable leathers: the impactful role of designers (Král´, Schmel & Buljan, 2014) and the necessity for breakthrough process alternatives (Giannetti, 2015), the research of Bhamra et al. adds the role of SMEs (Small and Medium Enterprises) in the transformation to more sustainable operation. (Bhamra et al, 2018) Given the complexity of the topic this chapter aimes to give a future material designer a quick overview on current procedures, actors in the system and market relevance.

I started by showing the economic value of the market. Followed by mapping the environmental, social and economic impacts (Liedtke et al, 2013) of the different types of leathers and furthermore listing the sectors involved in the process, identifyling drivers for sustainability. The five phases analyzed in the lifecycle: preproduction, production, distribution, use and disposal took inspiration from a product life cycle approach described by Carlo Vezzoli, but did not follow the actual method. (Vezzoli, 2014) Along this lifecycle it was my personal intention to not only list the problems arrising but also the interventions current research, which is already undertaken to solve them, in order to show a complete picture.
Within the leather system it is important to mention that each industry has its own legislative bodies, academia and sometimes even lobbies and is highly influenced by global economic flows and poltical situations.

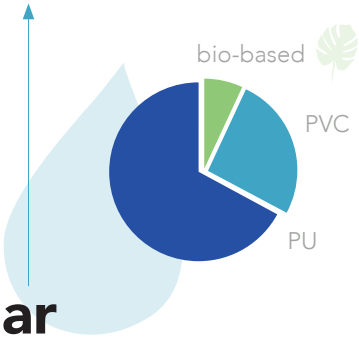
The leather market



100 billion $/year

estimated value of the global leather industry (UNIDO)

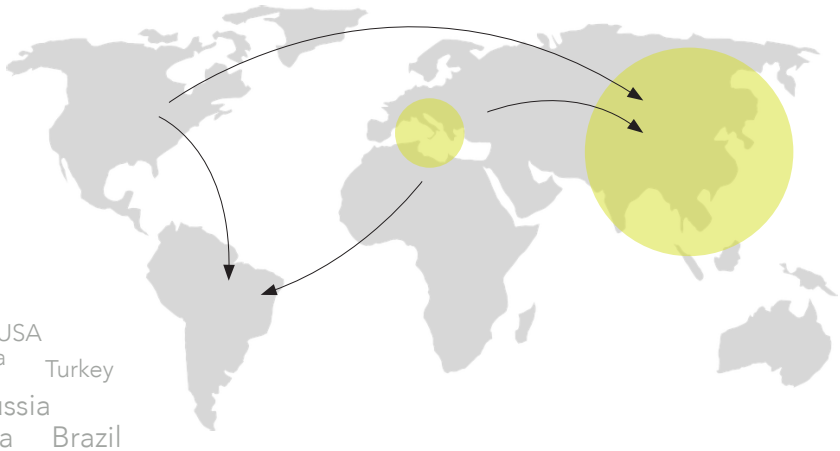
85 BILLION $/Y IN 2025



26 billion $/year

estimated value of the global synthetic leather industry (Grandview)

> LEATHER PRODUCTION SHIFTS FROM DEVELOPED TO DEVELOPING COUNTRIES



China, the world leader produces 3x times more than Italy, ranked 2nd.

USA
Argentina
Turkey
Mexico
Russia
South Korea
Brazil
India
Italy
China

few countries control market

60% OF RAW (BOVINE) MATERIAL PRODUCTION
70% OF LEATHER PRODUCTION
90% OF SHOE PRODUCTION

> USE IN FOOTWEAR DECLINES, RISES IN AUTOMOTIVES

55% Footwear

13% Automotive

use in years

Adapted from: UNIDO, 2010, Pringle, 2017, Grandview 2019

Leather from animal sources

The following analysis focuses on bovine leather, which constitutes of 65% of all leathers deriving from animal sources. (Keserwani et al, 2015) Overall a few notes on the data presented: Leather goods production does not follow a specific procedure, but rather depends highly on tanning, manufacturing preferences and methods applied. (Laurenti et al, 2017) The same applies for the research about leather's environmental impact. According to UNIDO there is *'no single method and no agreement'* (Brugnoli & Král', 2012) for this analysis in place. This results in different system boundaries for allocating emmission throughout the lifecycle. (Redwood, 2013) My intention was to show the wider cycle of the production of the material in order to understand the overall impact.

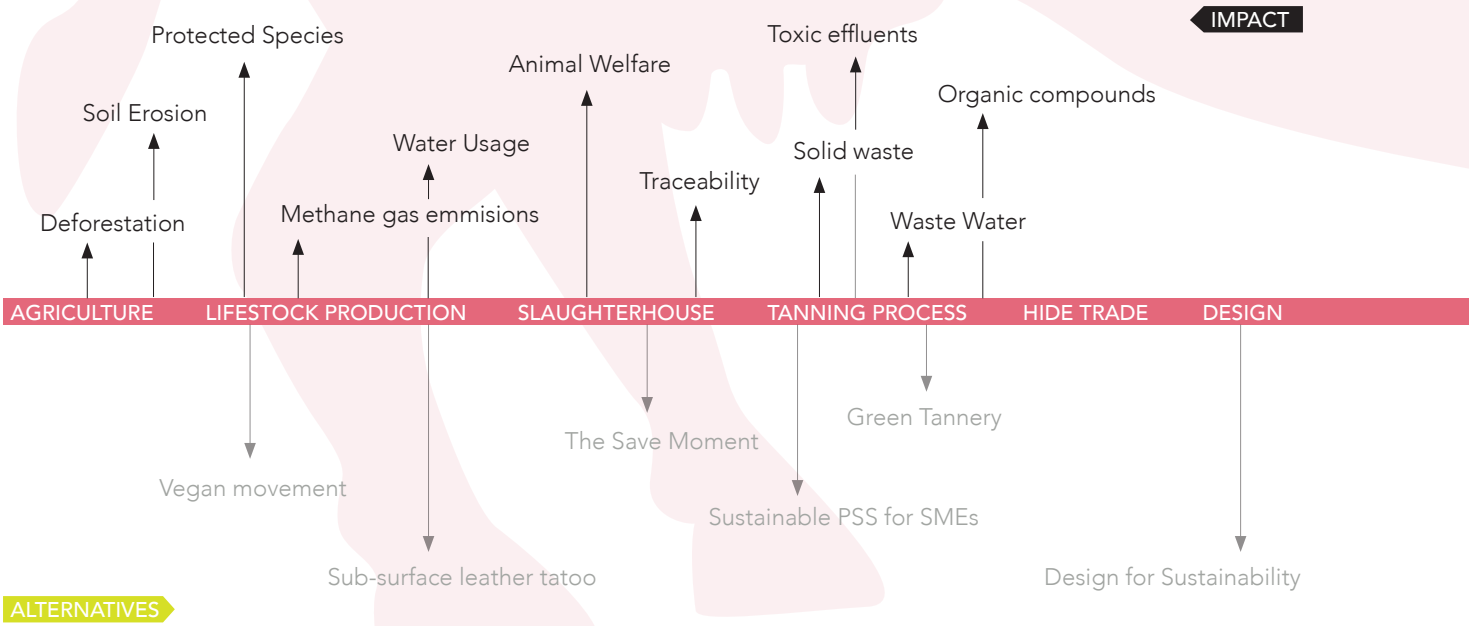
PRE-PRODUCTION

This phase mainly constitutes of agriculture & lifestock production, the animal slaughtering and the tanning process. The conversion of land to use for cattle rearing can release large quantity of Co^2 held in organic soil, threatens ecosystems and leads to soil erosion and deforestation. The continuing deconstruction of the Amazonas rainforest in favor of cattle ranches in Brazil, the fifth largest bovine leather producer, depicts these issues. (Kirchain et al, 2015)

The actual rearing phase of lifestock shows many implications: Animals need shelter and its provision includes farm equipment, energy input and land management. Animals need feed, showing not only in crop production and fertilizers, but especially in the methane gas released during the animal's digestive process. And animals need water to grow - 95% of the overall 16500 litres of water, used to produce one square meter of leather, are allocated to the lifestock production. (Kirchain et al, 2015; UNIDO, 2017)

The animal upbringing in mass production, raises serious concerns about animal health and welfare, which is continued in the slaughterhouse. Also in this phase the traceability of the hides is usually lost, disconnecting farmers, producers and eventually end consumers. (Origem , 2016)

In order to preserve hides over time, they need to undergo the tanning procedure, which consists of several treatments in the following categories: pre-tanning, tanning, post-tanning and finishing. (Laurenti et al. 2016) These processes produce a tremendous amount of volatile organic compounds, solid waste and industrial effluents. Out of a 1000kg of raw skin only 150kg eventually will



become raw leather, the other 850kg remain as waste. (Kanagaraj, 2014) According to Dixit et al. throughout the process at least 15 highly toxic and heath endangering substances are used, especially heavy metals. Through air pollution and diffusion of waste water in ground water, rivers and marine environments these substances arrive back to humans through food chain and groundwater. (Dixit et al. 2014, Kanagaraj, 2014, Giannetti et al 2015)

PRODUCTION

Leather can be found in thousands of products around the world, ranging from high-luxury-goods to practical items. As reported by UNIDO 55% are worked into footwear, producing 19 billion pairs of shoes yearly. Followed by the growing sector of the automotive industry, upholstery, leather goods and apparel. (UNIDO, 2017) Another 30% of the raw material constitute as waste in manufacturing, from which only very little is recovered and reworked. (Pringle, 2017)

DISTRIBUTION

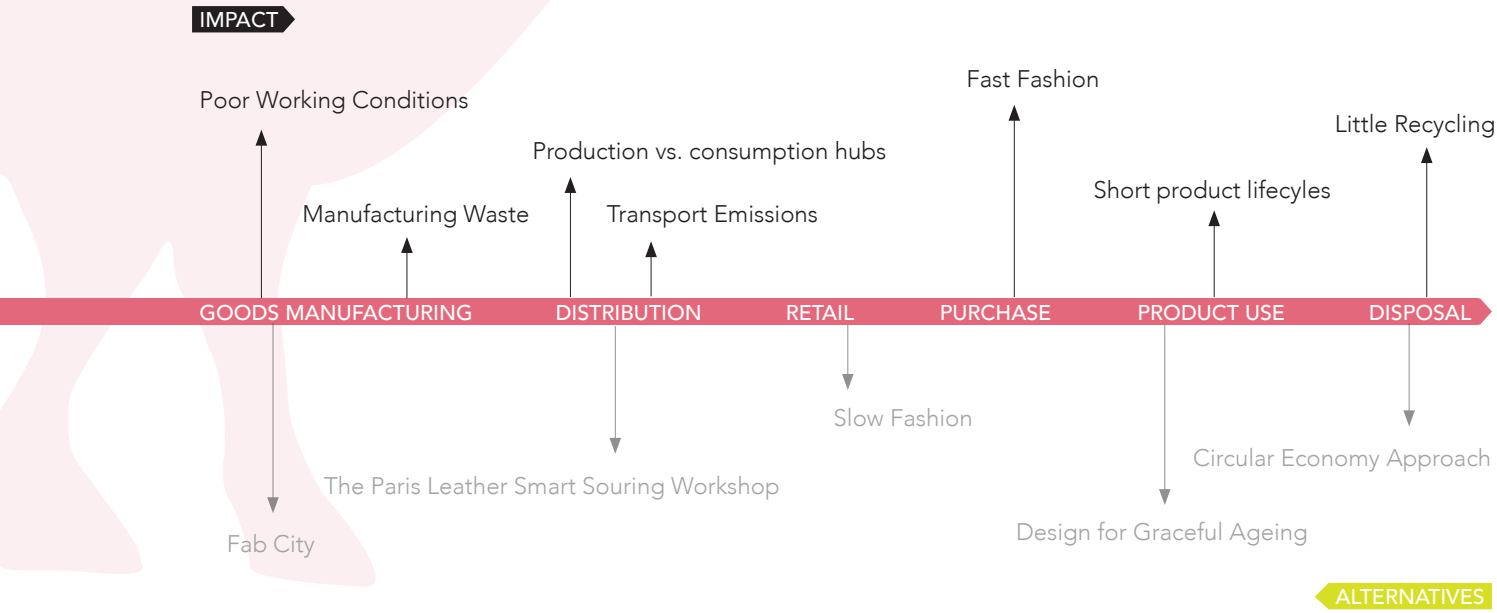
With regards to the example of the fashion industry, most goods are not produced, where they are consumed. As stated by Guagnami & Mishra 60 % of global production take place in South East Asia, while the main consumption hubs remain in Europe, North America and China/Japan. (Guagnami & Mishra, 2012) For this reason transport is an important element of the leather industry. (Kirchain et al. 2015)

USE

Digitalization has led to an impowerment of the consumer, disrupting the traditional path of purchase. (Perkins & Fenech, 2014, Carpenter, 2013) With Millenials consuming experiences not stuff. (Taylor, 2018) Awareness about the issues along the production process is given, but as de Klerk et al. describe in their research on controversial fashion in the leather industry, most users show strong concern regarding environmental issues in the leather industry but weaker aspiration, when theses actions directly impact themselves and are not highly motivated to engage in environmentally significant behaviour. (De Klerk et al, 2018)

DISPOSAL

The average use time of a leather product is 4 years, with the extremes of shoes used for approximately 1 year, upholstery 10 and apparel 4 years. (UNIDO, 2017) Sooner or later leather goods end up as waste and undergo various treatments to decay. (Pringle, 2017)



Leather from synthetic sources

The following analysis focuses on PU (Polyurethane) based leather, which constitutes the biggest amounts of leathers from synthetic sources. (Grandview, 2019)

PRE-PRODUCTION

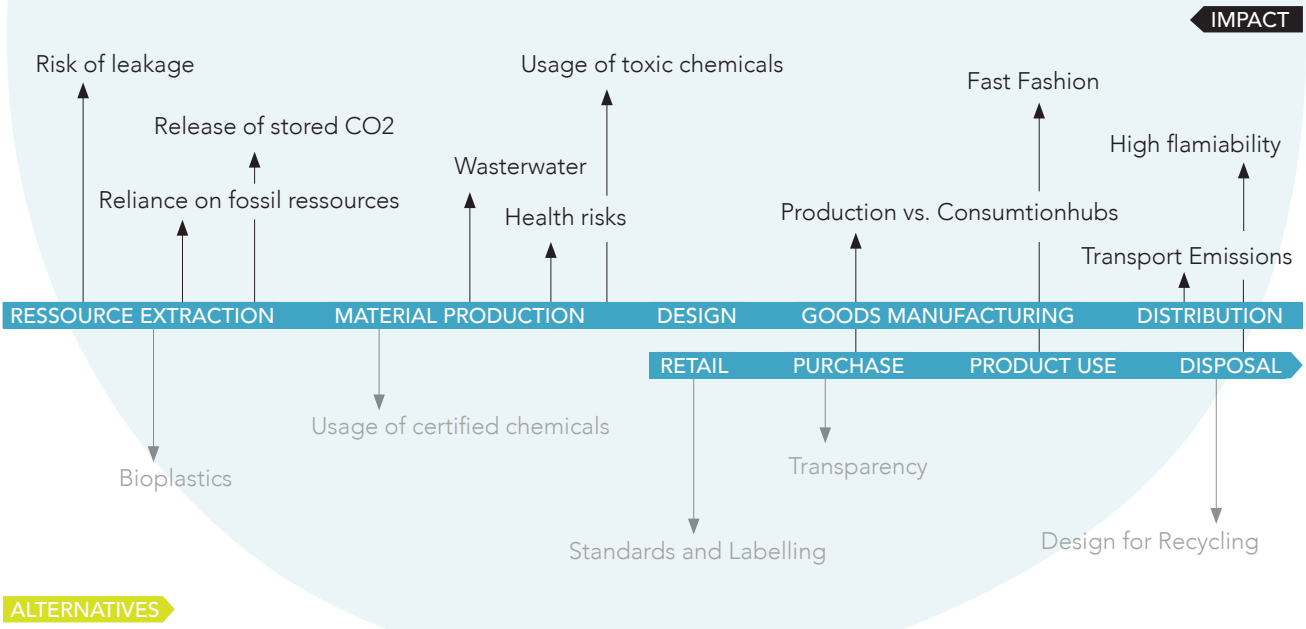
Polyurethane is a petroleum-based synthetic polymer, mainly made of polyols and diisocyanates, which are extracted from fossil oil. The extraction and further destillation of oil is an industry of controversy being essential for today's society but causing severe environmental and health risks, such as carbon emissions and lack of biodegradability of plastics. (Sha et al. 2008) The nature of these impacts, though, depend on the specific ingredients and the process of production of the final polymer. (Kraswoska, 2015) In the production of synthetic leather the application of the PU-film on the carrier takes place in two steps: Firstly the base layer is conditioned for the following coagulation of the thicker PU-base layer. This layer is applied through dipping and will be completely attached to the carrier through heat. After the drying and curing an embossed paper, that defines the final colour, gloss level and surface structure is laminated to the substrate and again cured to fix the film. After this process the synthetic leather is ready. (Winter, 2016) These processes are in need of heat, machines, human labor, dyes and molds. Chemicals used can cause health risks to workers and end-users through exposore to diisocyanates causing occupational asthma and cancer, pollute water streams and release toxic gases into the environment. (Lockey et al, 2016, Ecotextile, 2019)

PRODUCTION, DISTRIBUTION, USE

PU-based synthetic leather in comparison to genuine leather shows many advantages like cheaper production in bigger sheetsize and the possibility to add and adjust material properties easily. It has outranked genuine leather with being waterproof, possible to dry-clean and is much lighter than real leather and durable under sunlight, making it particularly ideal for automobiles and furniture. (Král´et al, 2014)

DISPOSAL

Polyurethane is highly flammable, posing risk during use and realeasing carbon monoxide, hydrogen cyanide and other toxic products throughout decomposition and combustion. (Mckenna & Hull, 2016)



Leather from vegetable sources

The following analysis focuses on Piñatex, a pineapple based leather, which is one of the few leathers from vegetable sources, that is already commercially available.

PRE-PRODUCTION

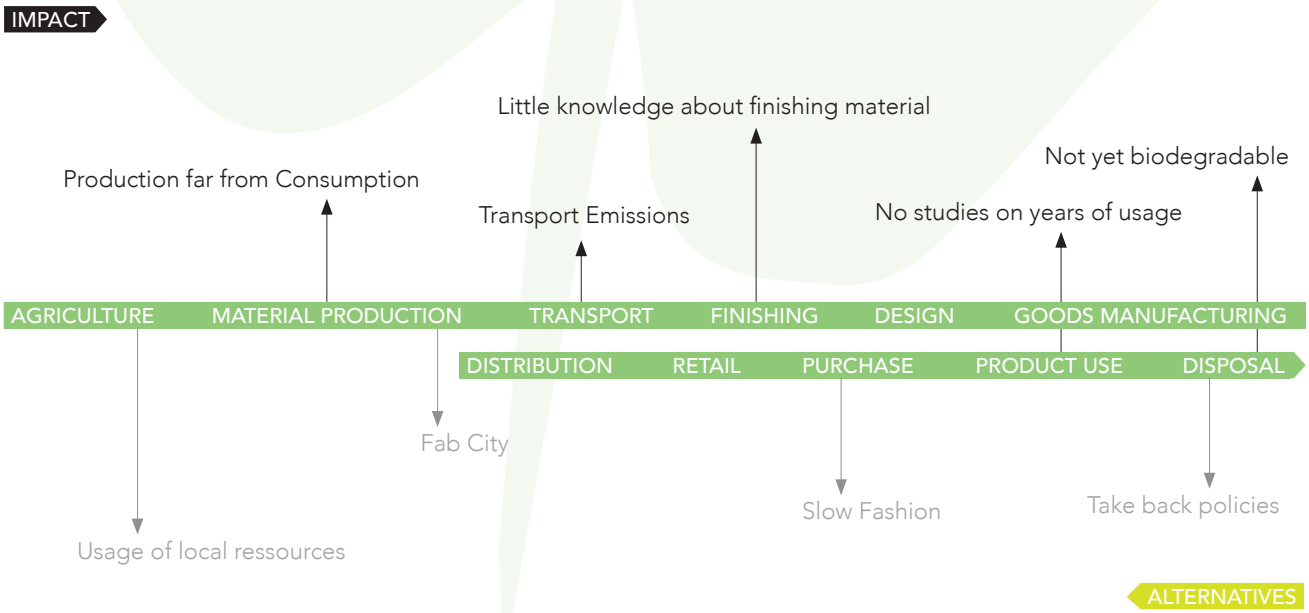
This phase mainly consists of agricultural growing of the ananas plant, the fruit's harvest, separation of the leaves and the conversion into the final material. The ananas is the third most important tropical plant in the world. In 2017 the global production of the fruit were 27,6 million metric tons. (Statista, 2019). In contrast to the usual process including both severe fertilization of plants and poor labour conditions (Lawrence, 2010), Ananas Anam strives to support Philippine's local farming iniatives and creates a Cradle to Cradle (C2C) inspired process. Using only C2C approved chemicals as well as adding value to the pineapple waste has created a new source of income for farming communities who otherwise rely on a seasonal harvest. With the #Imadeyourfibre campaign, farmers, designers and customers can be linked directly. The plant is organic matter and a fast regrowing ressource for Piñatex. It takes 16 plants or 480 pinapple leaves to produce one squaremeter of Piñatex. The long fibres are extracted through a decortation process, directly at the plantation in the Philippines. Once the leaves have been stripped off fibre the leftover biomass can be used as a nutrient-rich natural fertiliser or a biofuel, so nothing is wasted. The fibres then get degummed and undergo an industrial process to become a non-woven mesh, which forms the base of Piñatex. Later these rolls of unwoven mesh are transported to Spain for specialised finishing, which results in the leather-like appearance, creating a textile that is soft and flexible, yet very durable. (Ananas Anam, 2017)

PRODUCTION, DISTRIBUTION

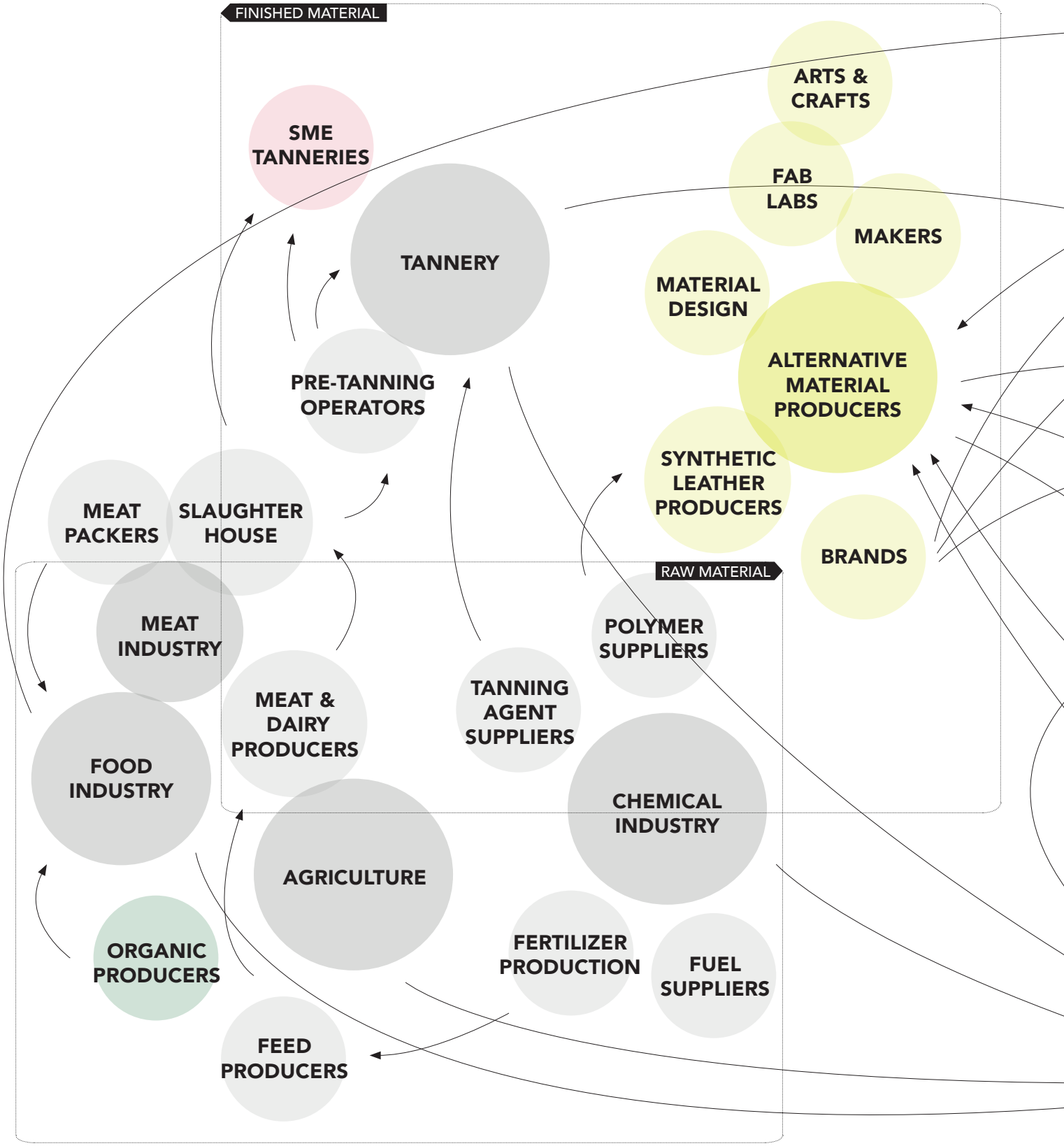
The finished textile is distributed to designers and worked into apparel, accessories and furniture using the standard procedures of production. (Ananas Anam, 2017)

USE, DISPOSAL

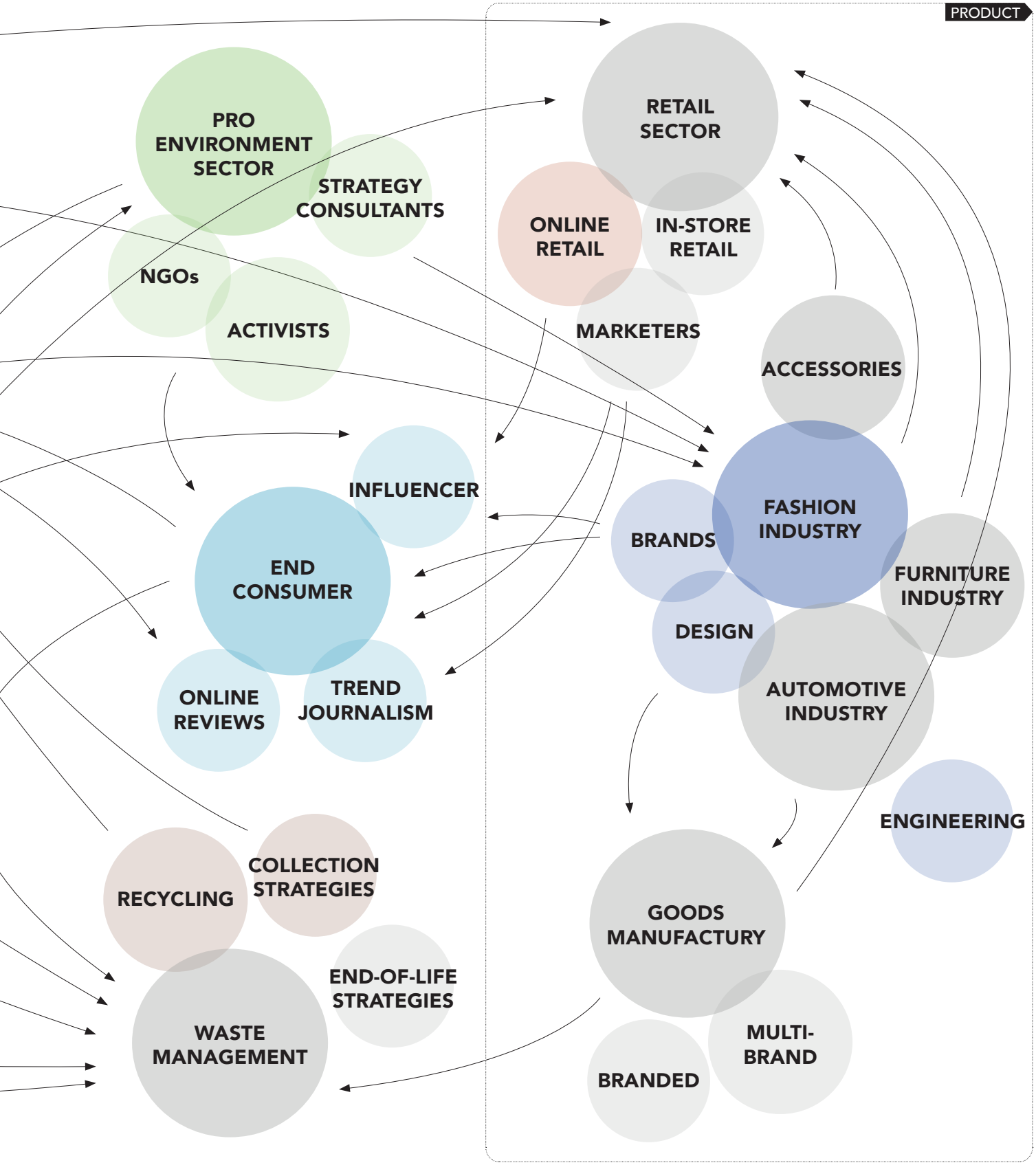
Piñatex is used in footwear, accessories, apparel and furniture products with a lifespan of usage between one and four years before descarding, when using traditional leather. (UNIDO, 2017) According to Ananas Anam, the finished material is not yet biodegradable, but sets this as a future goal. (Ananas Anam, 2017)



Leather system, its actors and drivers



Adapted from: Pringle, 2017, Memedovic, 2008, Kirchain et al. 2015


PRODUCT
PRO ENVIRONMENT SECTOR
STRATEGY CONSULTANTS
NGOs
ACTIVISTS
RETAIL SECTOR
ONLINE RETAIL
IN-STORE RETAIL
MARKETERS
ACCESSORIES
INFLUENCER
END CONSUMER
BRANDS
FASHION INDUSTRY
FURNITURE INDUSTRY
DESIGN
ONLINE REVIEWS
TREND JOURNALISM
AUTOMOTIVE INDUSTRY
ENGINEERING
RECYCLING
COLLECTION STRATEGIES
GOODS MANUFACTURY
END-OF-LIFE STRATEGIES
WASTE MANAGEMENT
MULTI-BRAND
BRANDED

Summary

In the first chapter I analyzed the various types of materials referred to as leathers, which can be categorized according to their source of origin and the undergone production process of the material. The following chapter included a summary on the current status of these types of leather, its economic value, the impacts during its lifecycle and the actors in the system.

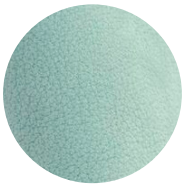
Concluding leather is a material of many facets, which is well appreciated in a huge array of products. It can be created using other industry's waste or artificially. Fact is consumers appreciate it's appearance and performance, but the environmental impact of leathers both from animal and synthetic sources seem unbearable. Furthermore the many actors and geographical discrepancy of the production process result in a complete disconnectivity of original material source and the end consumer.

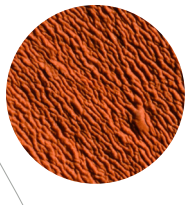
Actors identified to challenge this status quo by many scholars are the field of design, the end consumer, small and medium size enterprises and brand driven iniatives (often with the fashion industry seen as iniator of innovation). With developing technology end consumers have achieved more influence and changed their consumption patterns. Also the role of material design changes, with designers as iniators in the creation of new material experiences.

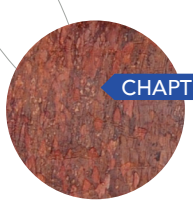
Not only considering the ethical conciousness as a designer for sustainability, but also the feasibility of this project, I set out to work on leathers from vegetable sources, with a production closer to the actual place of consumption of the material.

Framing leather

LEATHER FROM VEGETABLE SOURCES







CHAPTER 3

Manufacturing leather from vegetable sources
Growing leather from vegetable sources

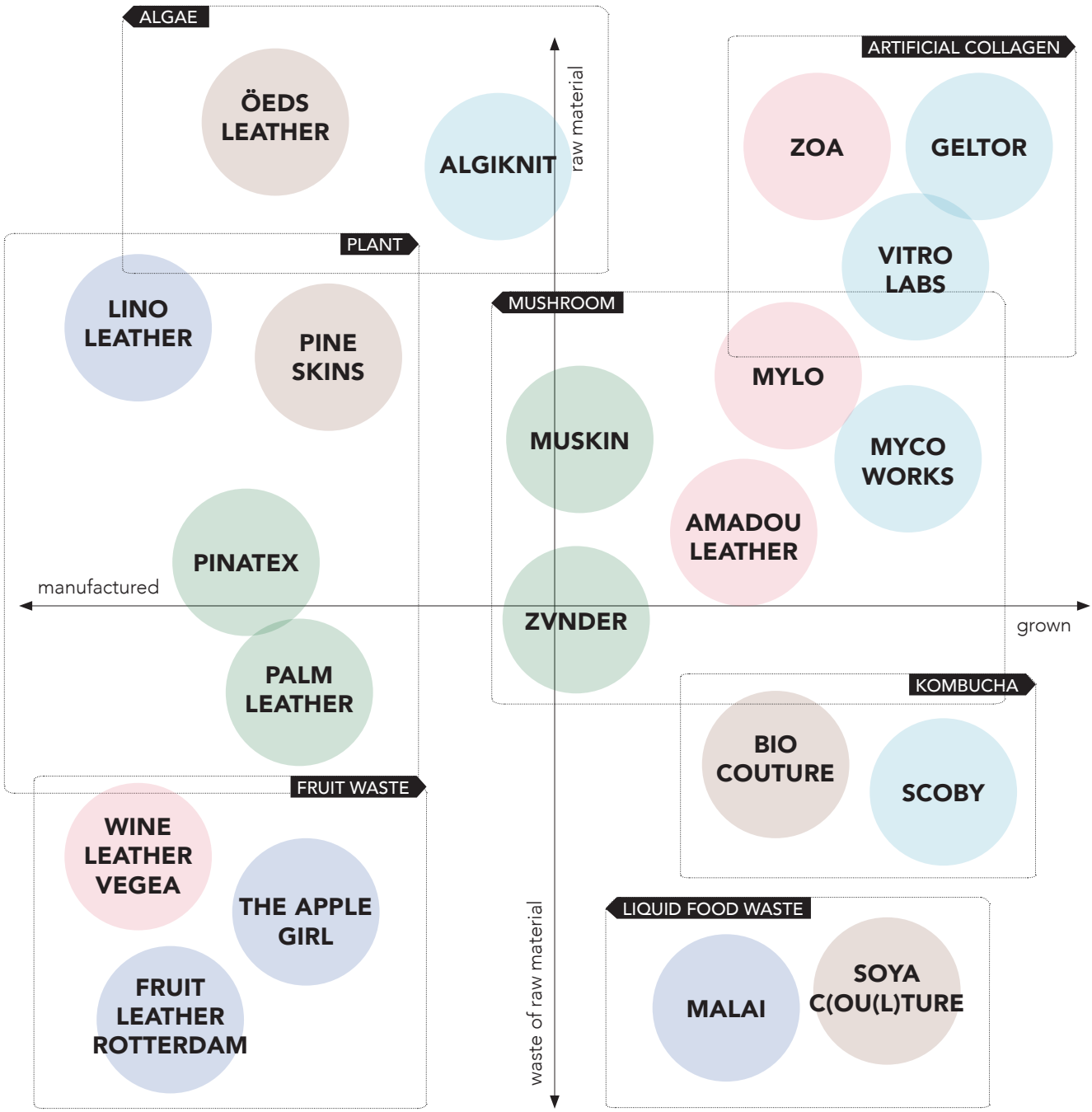
Leather from vegetable sources

New alternatives for leather are mushrooming in recent years, driven by two factors: pressuring sustainability issues and emerging technologies. (Karana et al, 2015) Scarcity and thus reaching out to seek alternative material sources as well as working at the intersection of design, biology and technology has opened up new ways of creating leather.

Exhibitions, events and awards within the design scene celebrate these new materials, such as the „Like leather" exhibition at the Dutch Design Week or MoMa's first exhibition about fashion in over 75 years - „Item: Is fashion modern?". Whilst many projects such as the Human leather project from Tina Gorjanc, Rumen leather from Mandy van Elzen or Hidden Beauty from Studio Gutedort create exceptional material experiences from underestimated animal sources, there is a whole field of designers that seeks to develop viable biodegradable substitutes on the one side and vegan ressource-efficient alternatives on the other side. (Franklin & Till, 2018)

On the following pages I have been using the DIY-Materials datasheets to summarize the collected data from personal statements (if possible) or email correspondence and an analysis of online ressources, such as articles, social media posts and videos about these new materials. At this point should be stated that some materials, for example the ones deriving through the aid of bacteria, might not be considered inside the Kingdom Vegetabile according to the DIY-Materials classification, but in order to give a more complete view I decided to include them in the analysis. Furthermore many materials could also be considered belonging to Kingdom Recuperavit as they derive from *'revived materials'* (Sauerwein et al, 2017), thus made from discarded raw material sources.
As in the previous chapters I have clustered the materials according to their orginal source as well as the way of production. Concluding the vertical axe ranges from the raw material, as found in nature or artificially created from waste of this raw material, thus referring to leftovers of a manufacturing process or an already used material. The horizontal axe, instead describes the way a material was produced: from being manufactured through the mixture or assembly of ingredients in a classical way to actually being grown in one piece.
Additionally some of the shown projects might not be considered DIY-Materials at the current point as the development is happening in closed company labs. Taking Zoa by Modern Meadow for example, but it should be stated that former BioCouture developer Suzanne Lee is the creative lead and has probably shifted the material use towards yeast. As well as the material of Fruitleather Rotterdam, which has developed from an unique haptical material experience towards a more traditional leather-like look and feel. It is for this reason that I felt it was also important to clarify the stage of material development, which I clustered in 5 steps. Most of the cases started as '*project based initiatives'* (stage 1), than exhibited, were awarded newcomer prices and received funding for their '*ongoing research*' (stage 2). In this phase usually further material qualities are explored, added or got rid off - the appearance of the materials developes into more sophisticated and advanced materials. Once the material qualities and processes are frozen the iniatiatives, by now small smart-ups, are *'trying to scale'* (stage 3) their production. Once the supply of material is guaranteed partnerships are formed by *'looking for application'* (stage 4). In this phase a high visibility on conferences, talks and exhibitions can be noted. Once the material is used in products it is *'commercially available'* (stage 5) to both end-users, brands and designers.

Analysing the alternatives for leather deriving from vegetable sources, these materials are created and influenced by various sources. Though, what all have in common is the driving source, as also stated by Ayaly-Garcia in his research. (Ayala-Garcia, 2016), to create a less impactful leather-like material. In general the cases obviously distinguish in the way of production, whether being manufactured or grown. The following pages elaborate on these two directions and the emerging trends will be further described.



PROJECT BASED INIATIVES ONGOING RESEARCH TRYING TO SCALE LOOKING FOR APPLICATION AVAILABLE

Manufacturing leather from vegetable sources

REWORKING FRUIT WASTE

Food has become a playground for designers‘ exploration in recent years, intersecting not only on the materials level but also culturally, experiential and prospective. (Rognoli, 2019) Additionally in the three cases of wine leather, apple leather and fruit leather all designers specifically mention to be driven in finding a solution for the leather problem without piling up additional ressource. Thus the make innovative use of by-products of agricultural industries, which would otherwise be discarded. (Franklin & Till, 2018) While Camilo Ayala-Garcia and Valentina Rognoli describe the aethetics of these materials to usually carry the aesthetical qualities of their previous state (Ayala-Garcia & Rognoli, 2017), I observed that the materials once more advanced are very hard to depict as a leather substitute.

AGRICULTURAL WASTE RESSOURCING

Piñatex and Palm leather are two examples of how designers are *‘sweating resources’* (Franklin & Till, 2018, p. 47), which we already have access too. By applying a circular approach to excisting acgricultural structures, these designers not only make innovative use of discarded plant waste, but also create additional income streams for farmers. No element of the harvest is now wasted in a *‘root-to-leaf’* mantra. (Franklin & Till, 2018) The materials deriving from vegetable sources usually show traces of imperfection and their main constitute. In contrast to leather from animal sources, these materials show their short-life. (Ayala-Garcia & Rognoli, 2017)

RETHINKING TRADITIONAL ALTERNATIVES

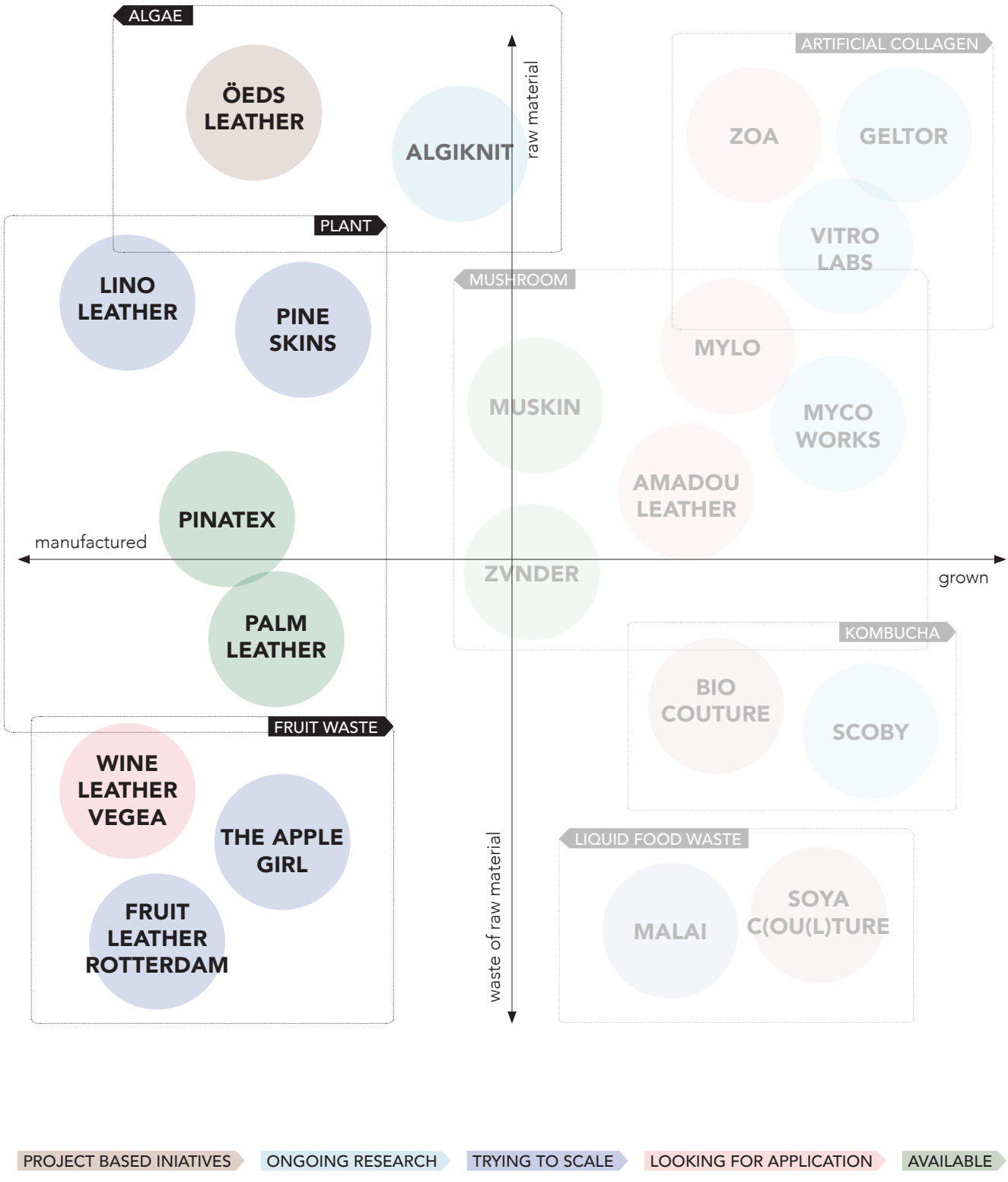
While designers are increasingly looking back in order to design forwards, they use innovative techniques and approaches to redefine traditon (Lotter, 2018) newly:

‘Tradition is the passing on off fire not the worship of the ashes’. Jean Jaurès

Daniel Charny, professor for design at Kingston University describes Making in an interview as *‘defeating the seperation between past and future’* (Franklin & Till, 2018), which means rethinking a material always builds on a heritage. In the case of lino leather and pine skins all these considerations apply. Both designers use traditional material in new compelling ways, resulting in especially haptically triggering leather alternatives.

ALGAE, THE NEW POWER PLANT

Projects like the Sea Me Collection (seaweed dyes) from Nienke Hoogvliet and Terroir (solid material) from Jonas Edvard, show the potential of a resource that was once abandoned - seaweed. Being praised as a new power plant in several areas including food or energy, it was rather a matter of time to be also explored in the field of leather alternatives. (Franklin & Till, 2018) The two examples could not differ more in the producetion process: from simple collection in the Öeds project to adaption of cells in a lab by Algiknit, the future will show whether seaweed constituted as a worthy substitute.



PROJECT BASED INIATIVES ONGOING RESEARCH TRYING TO SCALE LOOKING FOR APPLICATION AVAILABLE

Apple leather

THE APPLE GIRL

MATERIAL PROPERTIES

The material is breathable and available in different thicknesses, thus can be both rigid and highly flexible. It is robust to mold, can be sewn, lasercut and dyed and shows a soft and unique tactility. Deriving from apple waste the material is vegan and 100% biodegradable.

DESCRIPTION

Driven to tackle waste management and harmful ingredients of conventional leather production Hanna Michaud set out to create an alternative inspired by the biomimicry concept. Her approach is to upcycle pulp waste as a result of cider or juice production in a circular economy approach and create a biodegradable material. She believes the future of leather lies in biomaterials.

BASIC INGREDIENTS

Apple pulp
Natural resin
Water

CONTACT

The Apple girl
Hannah Michaud, Material Designer
https://theapplegirl.org

‘solving the leather problem with food waste’

KEY STEPS

Raw dried apple pulp as food waste.

Blending the pulp and mix it with water.

Cooking the mixture and adding resins.

Creating a smooth layer of pulp.

Letting the material dry to keep it flexible.

Apple leather can be sewn or laser cut.

Wine leather

VEGEA

MATERIAL PROPERTIES

The material shows the same mechanical, aesthetic and sensory qualities as skin. Its natural colour resembles the grapes it derives from but wineleather can also be colored. Furthermore it can be reworked like conventional leather materials.

DESCRIPTION

Searching for a vegetable based alternative against the polluting use of leather in the fashion industry the founders of Vegea discovered that the seeds and peels of grapes contain oils and fibres that are ideal for the production of an alternative leather. The circular economy approach is ideal, with Italy being the biggest wine producer worldwide and most producers discarding the grape marc.

BASIC INGREDIENTS

Grap marc
Biochemicals
Water

CONTACT

Vegea Textile Project
Gianpiero Tessitore
https://www.vegeacompany.com/en/project/vegeatextileproject/

‘producing eco-sustainable & vegetable leather from grape marc‘

KEY STEPS

Extracting the grape juice to make wine.

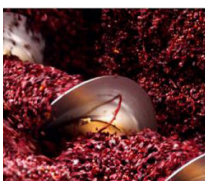
Seperating the grape marc.

Drying the grape marc.

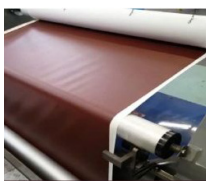
The pulp undergoes a chemical treatment.

Compounding of the pulp.

Creation of big sheet sizes.



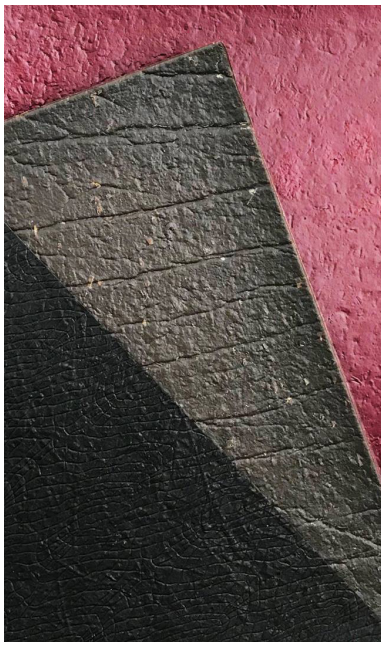


Fruitleather

KOEN MEERKERK, HUGO DE BOON

MATERIAL PROPERTIES

The material can show several different qualities and take a rather natural appearance with a rough and semi-opaque surface. Latest development show its appearance in different colours and with textures ranging from smooth to more structured.



DESCRIPTION

With a passion for creating value of things that have already been labelled useless, the vision of the designer duo behind Fruitleather Rotterdam is to spread awareness about the issue of food waste created by Rotterdam's fruit markets. Additionally following a circular economy approach the two want to show how waste in general can be used in a positive way.

BASIC INGREDIENTS

Apple pulp
Natural resin
Water

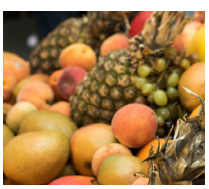
CONTACT

Fruitleather Rotterdam
Koen Meerkerk, Hugo de Boon
https://fruitleather.nl

'transforming leftover fruits into durable, leather-like material'

KEY STEPS

Deseeding the fruit.

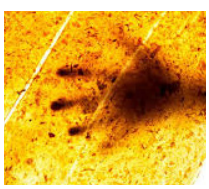


The fruit is mashed.

The fruit pulp is boiled to get rid of bacteria.

The fruit soup is smeared out over a surface to dry.

A finished sheet can take differemt qualities.



A sheet can be easily stitched and cut.

Piñatex

ANANAS ANAM

MATERIAL PROPERTIES

The non-woven mesh is covered with a specialized finishing that gives the material its leather-like appearance. The textile has a soft texture and is flexible, yet very durable. The cruelty-free material derives from a low impact process and can be further manufactured like leather.

DESCRIPTION

Driven to combat the effects of mass leather production and pollution by tanneries in Philippine, leather goods expert Carmen Hijosa set out to develop an alternative. The result is a material based on the pineapple leaf fibre, an agricultural waste product, which provides the opportunity to build a scalable commercial industry for developing farming communities with a minimal environmental impact.

BASIC INGREDIENTS

Pineapple leaf fibre
Water
Specialized finishing

CONTACT

Dr. Carmen Hijosa
info@ananas-anam.com
https://www.ananas-anam.com

‘innovative natural textile made from pineapple leaf fibre’

KEY STEPS

Harvesting the pineapple leaves.

Extracting the fibres through decorting.

Washing and drying the fibres.

Degumming process of the fibres.

A non-woven mesh derives.

The final material after finishing.

Palm leather

TJEERD VEENHOVEN

MATERIAL PROPERTIES

Palm leather shows great aesthetic qualities. After soaking in softener it is permanently soft and flexible. The upcycled leather alternative can be processed with conventional machines and all compounds are biodgradable and proofed for human use.

DESCRIPTION

Searching for a cheap plant-based alternative for leather the Dutch designer Tjeerd Veenhoven developed Palm leather. The mateial was created with the emphasis to restore appreciation for natural fibers and to upgrade a waste product from the food industry without polluting it. Since its development in 2011 the designer also created a economic benefit for the local farmers in India and the DR.

BASIC INGREDIENTS

Leaves from Arecae Betel Nut
Biological softener

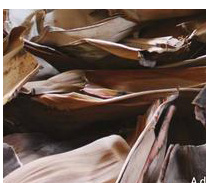
CONTACT

Studio Tjeerd Veenhoven
http://www.tjeerdveenhoven.com/portfolio_page/palm-leather/

‘a cheap plant-based alternative for leather’

KEY STEPS

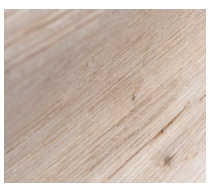
Drying the leaves of the Betel Nut.



Straightening the leaves out.

Soaking the leaves in bio softener for days.

Creating a flexible sheet material.



Manufacturing products with usual tools.

Pine Skins

STUDIO SARMITE

MATERIAL PROPERTIES

The material surprises with its softness contrasting the thick and harsh character associated with the pine. Treating the fresh bark with natural ingredients preserves its softness, afterwards it a layer of pigment or enriching finishing can be added.

DESCRIPTION

Tackling the waste of pine timber production, the tree's skin has become a leather-like material and *'becomes a living extension of the tree long after the tree has been cut into pieces'*. Studio Sarmite explores the use of this by-product of the pine industry, usually just valued for its cheap wood. The pine tree is specific because its bark is essential for the tree to live, thus it can only be harvested while cutting.

BASIC INGREDIENTS

Pine Skin
Natural Resin
Colour & Pigment

CONTACT

Studio Sarmite
https://studiosarmite.com

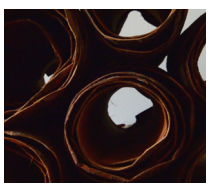
'giving tree barks a new purpose'

KEY STEPS

Harvesting the pine skin on site.

Preserving with natural resin.

Drying the skins.



Adding colour and pigment.

A sheet-like material derives.

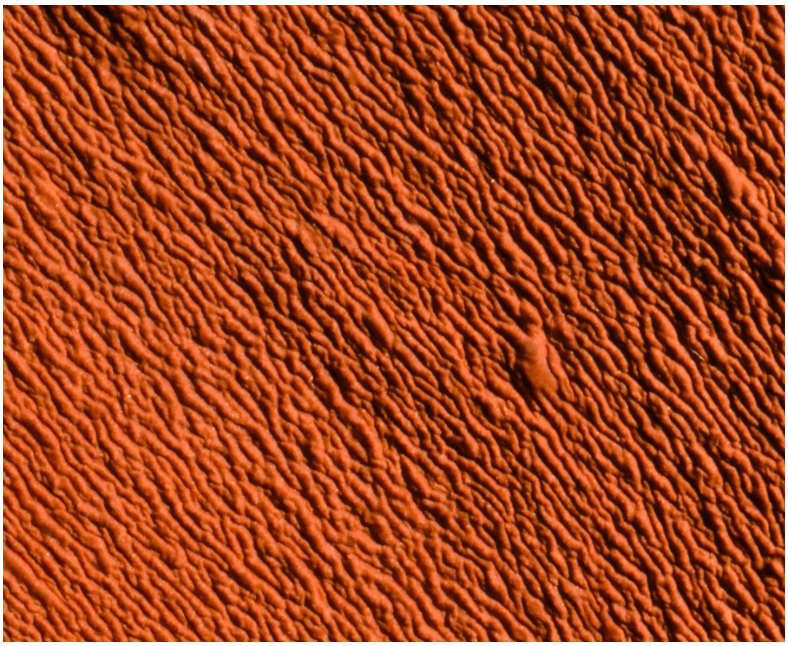
Experimenting with different shapes.

Lino leather

DON KWANINGS

MATERIAL PROPERTIES

The material is exploring Linoleum as a more sensorial material. It can show several different haptics by variating the ingredients, resulting in a textures ranging from soft to rough. By adding a fibre net in between, not only two sides can be used, but adds flexibility and self-support.



DESCRIPTION

Don Yaw Kwanings has started with a material research into the linoleum process with the result of a home made leather like material created with natural components. Currently the designer has teamed up with flooring company Forbo to develop a more versatile Linoleum. The designer aims to find new uses for natural materials and mentions that linoleum is usually an overlooked material.

BASIC INGREDIENTS

Linseed oil
Jute fibre
Wood fibres

CONTACT

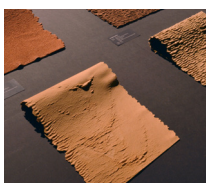
Don Yaw Kwaning
https://www.donkwaning.com/linoleather

'change the industry by introducing new ecological substitutes for existing materials'

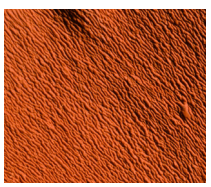
KEY STEPS

Mixing the basic ingredients.

Drying to achieve a sheet-like material.



Pressing a fibre sheet in between for stability.



Resulting in a two-sided material.

Öeds leather

ÖEDS STUDIO

MATERIAL PROPERTIES

The material derives from seaweed. It is long lasting, has a soft texture and no odour. It is damp proof but not water proof. The seaweed shows in its natural colour. So far the structure of the material remains very fragile, the use of kelp instead could change this.

DESCRIPTION

So far the project, initiated by Eude Panel out of the desire to collect natural materials has remained an artistic project at the stage of experimentation.

BASIC INGREDIENTS

Seaweed
Softening agent

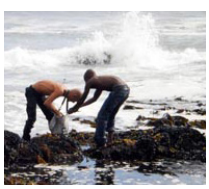
CONTACT

Öeds Studio,
http://oedsleather.gandi.ws/contact

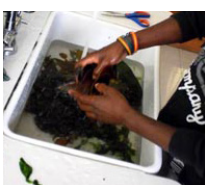
‘transforming seaweed into leather’

KEY STEPS

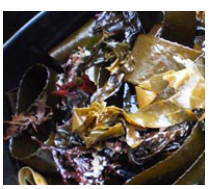
Collecting fresh seaweed during summer.



Cleaning, rinsing, cutting and wringing.



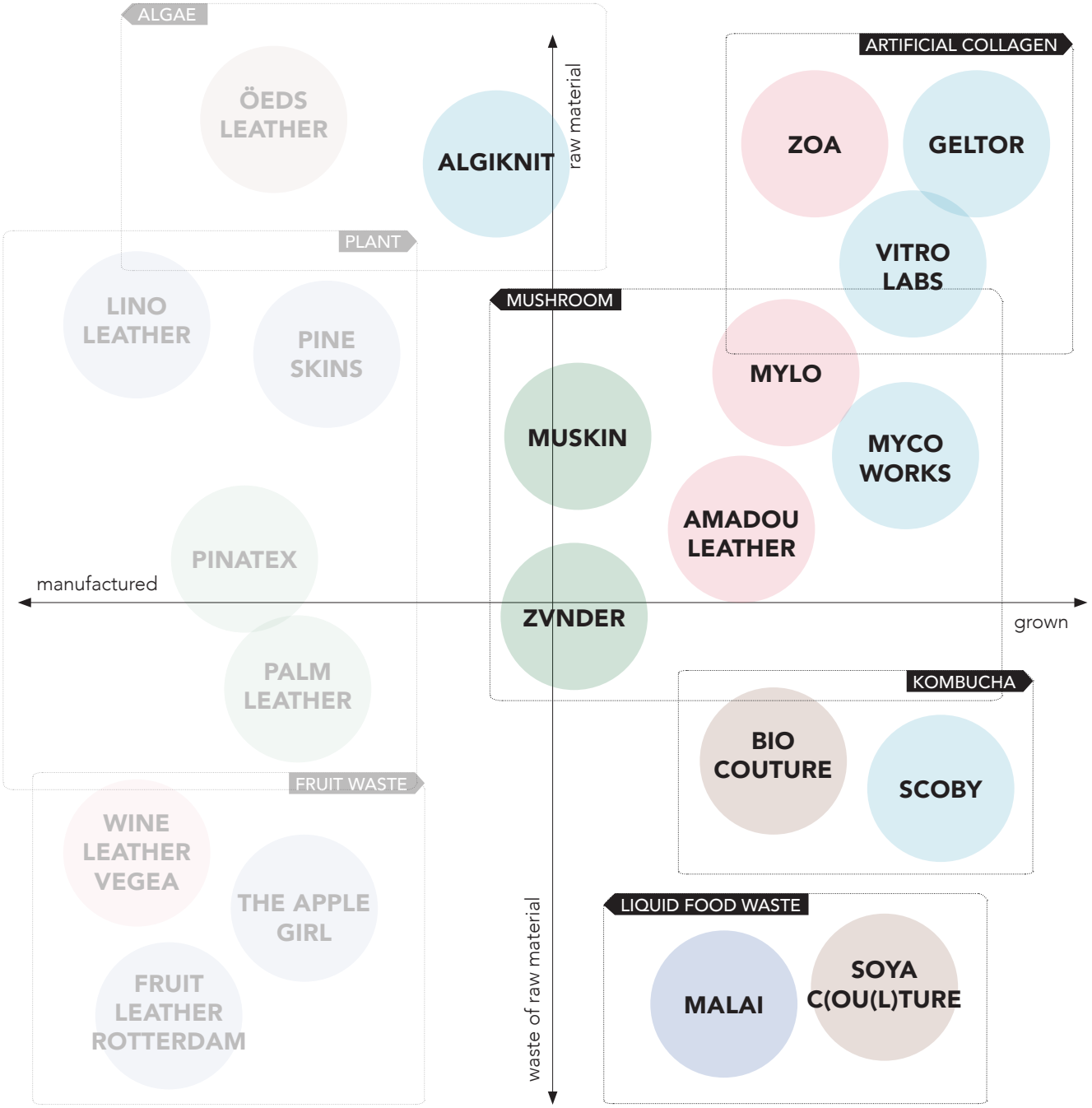
Replacing water with a softening agent.



Hanging it in a cool room to dry.

After 2-6 months a leather like material arrives.

Working it into products.



PROJECT BASED INIATIVES ONGOING RESEARCH TRYING TO SCALE LOOKING FOR APPLICATION AVAILABLE

Growing leather from vegetable sources

BIOFABRICATION

Biofabrication is truly a 21st century phenomenon happening at the intersection of design, biology, and technology triggered by the breaking of DNA code in the 20st century. According to Andras Forgacs, CEO of Modern Meadow, a frontier on realm of biofabrication, it is building with biology, that gives a designer an advanced toolkit to reinterpretate traditional materials like wood, silk, wool and leather and aimes to establish a biotech consumer industry. (Biofabricate, 2018, Forgacs, 2017)

All these cases whether based on artifically grown collagen, algae or yeast try to combine the advantages of synthetic and natural materials, thus enginnering biodegradable materials with what Suzanne Lee refers to as *'factories of the future'* (Lee, 2011) with the result of new properties like using the material as connectors for fabrics. (Forgacs, 2017) All these innovations though happen in closed labs and have very little to do with DIY-Materials. From my point of view though the speed of development and the inclusion of designers in the development teams as well as the power of feasibility of these materials, Geltor's material for example was just a try-out and developed in less than one year, make this direction very noteworthy in the field of leather from vegetable sources.

THE POWER OF FUNGUS

Fungi based materials, with their underlying root-like structure mycelium have emerged as new wonder materials. Research and projects around have been popping up around the easy-to-cultivate as well as manipulate and fast-growing material, used as substitutes for many traditional materials like wood, stone, polysterene and also leather.

In the case of leather the directions differ: On the one hand the material is harvested as found in nature, linked to a background of craft and tradition, like the Zvnder and Muskin projects show. On the other hand laboratories investigating mycelium based leather rather resemble farms. Controlling both the material abilities and the production, like the Mylo, Mycoworks and Amadou leather. With several years of research ongoing, these materials gain sophistication and try to scale their businesses, thus the gap between concept and reality seems to vanish. (Franklin & Till, 2018)

GROWING ON LIQUID FOOD WASTE

Another trend in the creation of novel materials as an alternative to leather from animal sources emerged with Suzanne Lee's BioCouture. She grew sheets of bacterial cellulose on the waste of green tea (Kombucha) a couple of years ago. Since then the way of Lee's material development has inspired many „imitators", which a simple Google search result on Kombucha leather shows. In recent years other designers are using this way of '*growing*' materials with the help of bacteria, but differentiating the liquid material source. Soya C(ou(l)ture uses liquid waste of the soy production and Made from Malai liquid coconut waste, instead.

While the project of BioCouture evolved into an annual summit called „Biofabricate" (Biofabricate, 2018) with the aim to connect visionaries in the field, the other two projects, that make use of local waste streams are trying to scale their business.

Jellyfish leather

GELTOR

MATERIAL PROPERTIES

The material has a distinctive white colour and lacks any odour. By touching the protein it reveals a silky texture. Geltors N-Collage can arrive in the form of powder or as a liquid solution. The sheet material is flexible but firm. All Geltor products are animal-free and non-GMO.

DESCRIPTION

Tech Company Geltor designs and grows textures with biology with the aim to create independency of natural ressources and form the ones needed on demand. Usually they tackle challenges in the fields of food, beverages and cosmetics, especially focused on the production of collagen and elasthin in human skin cells. In 2018 the company took up the authors challenge and grew its product into leather.

BASIC INGREDIENTS

Yeast cell based collagen

CONTACT

Geltor,
1933 Davis St, San Leandro, CA 94577
http://www.geltor.com

‘pushing the boundaries of lab-grown collagen’

KEY STEPS

Designing proteins, molecule by molecule.

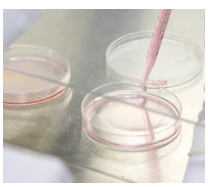
Duplicating the protein with the help of biology.

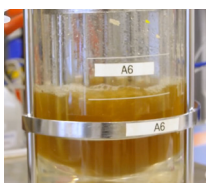
Brewing the mixture in controlled fermentation.

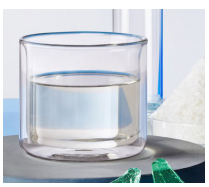
Formulating trunky solutions.

Growing solutions into sheet material.

Tanning, embossing and manufacturing.





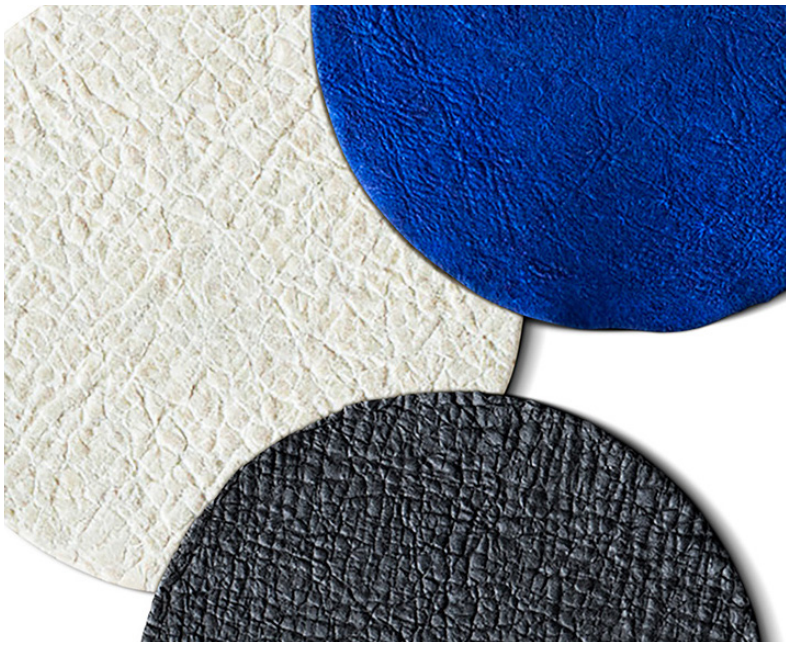


Zoa

MODERN MEADOW

MATERIAL PROPERTIES

Zoa is a biofabricated material with liquid collagen as basis. For this reason it can take various shapes: leather-like sheets, thick or paint-like forms. Due to the nature of its creation it can also be produced with different surface structures. It can be dyed and holds the same smell as leather.



DESCRIPTION

The journey started with using 3-D bioprinting for medical tissue, but soon started to apply the methodology of design, biology & engineering to consumer goods, first meat than leather. The output is a biofabricated leather, *'grown with the intention for making things of real value, that exist not just to serve humans, but to co-exist with everything'*. Designed, grown and assebled using DNA.

BASIC INGREDIENTS

Liquid protein based on yeast
DNA
Cells

CONTACT

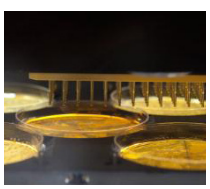
Modern Meadow,
hello@modernmeadow.com
http://zoa.is

'time has come for a less raw material that comes from nature'

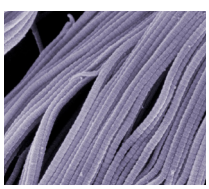
KEY STEPS

Cells are designed at DNA level.

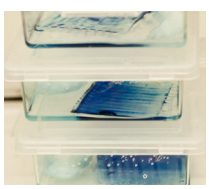
Fermentation duplicates the collagen cells.



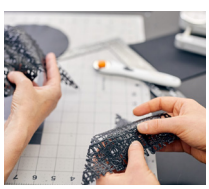
Depending on performance cells are arranged.



Growing the material in the lab.



Ecological tanning gives durability and smell.



Zoa can take many shapes.

Mycelium based leather

MYCOWORKS

MATERIAL PROPERTIES

The material is grown from mycelium and shows the same tactile and performative qualities as leather, being strong, and flexible and even water-resistant. Thanks to its technique of growing it breathes and can include desired features and textures. It is sustainable, versatile and animal-free.

DESCRIPTION

Mycoworks was created out of the awe for leather's qualities. They found their solution for the leather industry's hazards in nature's tools - in a carbon-negative process the company produces a custom engineered product out of a rapidly renewable natural resource. Over 20 years of research in design and engineering result in foundational work in the field of microtexture.

BASIC INGREDIENTS

Mycelium
Agricultural by-products

CONTACT

Mycoworks,
https://www.mycoworks.com/#product-section

'redefining leather with mycelium'

KEY STEPS

Mycelium is the starting point.

Growing the material.

Resulting in a sheet like material.

Dying the material.

Waiting for the impregnation.

Various finished derive.

Mylo

BOLT THREADS

MATERIAL PROPERTIES

Controlled growth of mycelium, the underground root structure of mushrooms results in a supple, warm, leather-like texture. It is strong, abrasion resistant and shows good moisture absorption. Due to its nature of production final properties like shape, thickness and form can vary.

DESCRIPTION

Mylo was born out of the sustainable drive to produce a material less invasive for the planet to meet increasing demand for leather. A partnership with Evocative, pioneers in the mycelium technology kicked off the process: The material can be produced in days versus years and is a sustainable alternative to animal leather, being non-toxic, biodegradable and producing less waste during production.

BASIC INGREDIENTS

Corn stalk
Nutrients
Mycelium

CONTACT

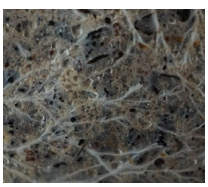
Bolt Threads Inc,
hello@boltthreads.com
https://boltthreads.com/technology/mylo/

‘using mycelium to make an entirely new, leather-like material.’

KEY STEPS

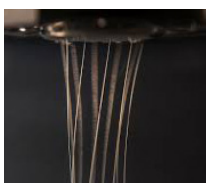
Starting with mycelium cells.

Growing the cells in a bed of corn stalk.



Controlling environment for self-assemblence.

Compressing network into 2-D shape.



Tanning and imprinting the desired pattern.

Manufacturing mylo products.

Amadou mushroom leather

AMADOU LEATHER

MATERIAL PROPERTIES

The material has a natural rich brown colour and a malleable surface with a ductile touch of suede. It is lightweight, flexible,breathable, insulates heat and absorbs moisture. It is naturally antimicrobial, thus stops the proliferation of bacteria, making it perfect to wear on skin.

DESCRIPTION

Amadou Mushroom leather is developed as a vegan leather solution for the fashion, furniture, automotive and transportation industries innovating the way we use ressources. The company seeks to to incorporate low-impact materials, circular economy principles and closed-looped systems. Using existing edible mushroom cultivation techniques they create compostable and sustainable products.

BASIC INGREDIENTS

Saw Dust
Amadou Mushroom

CONTACT

Amadou Leather,
https://www.amadouleather.com

‘developing a durable, scalable and biodegradable biomaterial substitute to leather‘

KEY STEPS

Amadou Tree mushroom.

Growing the material.

A sheet like material derives.

Manufacturing goods.

Zvnder

NINA FABERT

MATERIAL PROPERTIES

The sponge-based vegan textile material has a velvety soft touch and a marbeled unique surface. The material resembles leather just optically - the high amount of compressed air makes it a natural insulator and very light-weight. Naturally it is absorbent and anti-septic.

DESCRIPTION

Reviving lost knowledge and craft of the Zundersponge facturies in Rumania and combining it with new medical research on dermatologic healing effects, Nina Fabert has created a leather-like textile. Through industrialisation the knowledge about Zunder manufacturing has been nearly lost, but has now found its way into a small Berlin-based studio bringing a vegan, cruel-free leather alternative.

BASIC INGREDIENTS

Zunder tree sponge
Natural resin

CONTACT

Nina Fabert,
http://zvnder.com

‘crafting tradition into a new leather-like material’

KEY STEPS

The mushroom grows on trees.

Breaking it down into small pieces.

Pressing the pieces into a layer.

Optimizing the surface qualities.

Working the material into products.

MuSkin

GRADO ZERO INNOVATION

MATERIAL PROPERTIES

The material derives from the caps of the largest fungal fruit recorded, thus the sheet size is limited. It shows a soft, suede-like touch and can range from a soft to slightly harder texture. MuSkin breathes and is very comfortable to wear on skin and is *'hygienic'*, proliferating bacteria.

DESCRIPTION

The Italian corporation, Grado Zero Innovations developed a type of mushroom-based faux leather called MuSkin which is produced from the caps of mushrooms of the species of fungus called Phellinus ellipsoideus, a specimen of which happens to be the largest fungal fruit body ever recorded. Every product is unique and in order to showcase this the material is commercially available.

BASIC INGREDIENTS

Phellinus ellipsoideus

CONTACT

Grado Zero Innovations,
https://www.gzinnovation.eu/material/21/muskin-the-mushroom-peel
https://lifematerials.eu/en/

'MuSkin - the mushroom peel'

KEY STEPS

Raw material: Phellinus ellipsoideus

Harvesting the bacteria.

Growing a sheet like material.

Creating products.

Biocouture

SUZANNE LEE

MATERIAL PROPERTIES

This green tea based material is not only biodegradable but compostable. According to the mixture the seonsorial qualities can resemble either paper or leather. In liquid shape it can be moulded or cut and sewn once dried. By using iron oxidation or fruit staining colour can be applied.

DESCRIPTION

Lee likes to think of microbes as the factories of the future, not only growing the materials but being a living material establishing a relationship with the user. Biocouture started out as a research project, became a book and transformed into a movement with the goal to bring *'bioneers'* together in a global community ideating new manufacturing systems, based on biodesigned living organisms.

BASIC INGREDIENTS

Green tea
Sugar
Microbes (yeast & bacteria)

CONTACT

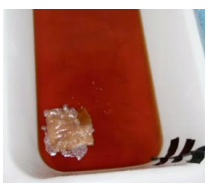
Suzanne Lee, Biocouture
https://www.ted.com/talks/suzanne_lee_grow_your_own_clothes?language=en#t-349346
https://www.launch.org/innovators/suzanne-lee/

'grow your own clothes from microbes'

KEY STEPS

Heating green tea and adding sugar.

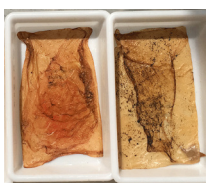
Cooling of to 30° and add microbes.



A sheet of bacterial cellulose grows.

Letting the moisture evaporate and dry.

A leather or paper like sheet derives.



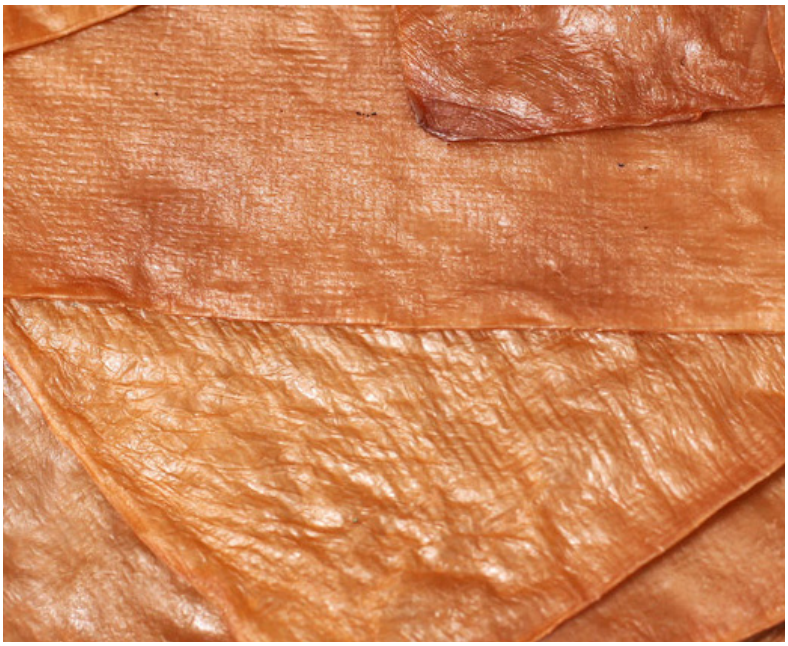
Sewing or moulding the material.

Scoby

IOWA STATE UNIVERSITY

MATERIAL PROPERTIES

The material provides similar haptical qualities to leather. Its colour is determined by the green tea basis. Scoby is not waterproof, treatment with natural oils or bee wax make it showerproof, but in contact with moisture it becomes sticky and soft. Cold instead makes the material brittle.



DESCRIPTION

Young sees fashion as a expression of personality and culture, but highlights to think about the waste that is produced year by year, creating *'tremendous underground spaces'* on Earth. For this reason she and her team work on a truly biodegradable and sustainable fabric or material that can go to the soil as a nutrient rather than a toxin. Young's goal is to introduce it to the apparel industry.

BASIC INGREDIENTS

Kombucha tea
Sugar
Vinegar

CONTACT

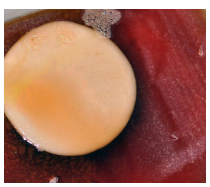
Iowa State University
Young-A Lee, Apparel, Events & Hospitality Management
ylee@iastate.edu, 515-294-7826
https://www.news.iastate.edu/news/2016/04/26/sustainableclothing

'growing a truly sustainable fiber on green tea waste'

KEY STEPS

Cellulosic fiber deriving from kombucha.

Growing the material takes around 3 weeks.



Harvesting the material.

Treating the material with wax or oil.

A shower-proof sheet material derives.

Kombucha leather can be sewn or glued.

Soya C(o)u(l)ture

XXLABS

MATERIAL PROPERTIES

The material is grown on the basis of soy culture and according to the composition can result in haptical qualities of paper or leather. If coconut water is used the material can even be edible. Later the material can be sewn or lasercut.

DESCRIPTION

Soy C(o)u(l)ture is the result of curiosity in terms of making in art, science and technology. The female collective XXLabs from Indonesia values open source knowledge and free technology. They use soy waste from tofu production that is polluting the rivers to combat poverty in their country. Making the process open source, the collective engages local females in the production of the material.

BASIC INGREDIENTS

Liquid soy waste from tofu production
Sugar
Vinegar
Fertilizer

CONTACT

XXLabs,

http://xxlab.honfablab.org

‘from soy waste to fashion’

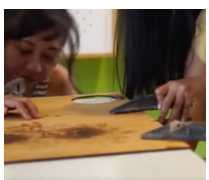
KEY STEPS

Boiling liquid soy, adding other ingredients.

Adding bacteria.

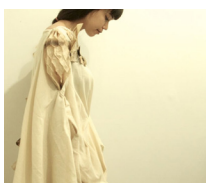
10 days until the bacterial cellulose is growing.

Pressing the sheet and letting it dry.



Pressing the sheet and letting it dry.

Once dried the sheet can be sewn.



Malai

ZUZANA GOMBOSOVA, SUSMITH C S

MATERIAL PROPERTIES

The material can be customized in different thicknesses and colours, thanks to mordant-free natural dyes. It has a feel comparable to leather, is waterresistant and biodegradable. The flexible biocomposite is made from bacterial cellulose. It can be matte, semi-glossy or glossy.

DESCRIPTION

The designers Zusana Gombosova and Susmith C S, had already started experimenting with growing materials on a small scale together, sharing values like: a passion for craft and making as well as a concern for sustainability and the environment. The Malai project tackles the waste issue of the coconut industry in India and aims to provide an alternative material for the fashion industry.

BASIC INGREDIENTS

Coconut water
Fibre
Bacterial culture

CONTACT

Made from Malai,
http://made-from-malai.com/prototypes-2018/

‘growing an alternative for the fashion industry’

KEY STEPS

Collection of waste water from coconut flesh.

Fermenting produces a sheet of cellulose jelly.

Harvesting and refining the jelly.

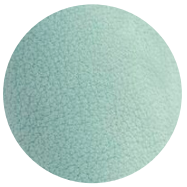
Air-drying and softening the finished material.

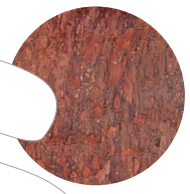
Dying into different colours.

Manufacturing goods.

Framing leather

THE CITY, NEW BOUNDARIES FOR VEGETABLE LEATHER DEVELOPMENT





Cities as sources for material development
Berlin, a starting point for leather from vegetable sources
Problem Framing

CHAPTER 4

Cities as sources for material development

After mapping the trends in the development of alternatives for leather from vegetable sources, it became clear that all designers and *'expert amateurs'* (Kuznetsov & Paulos, 2010), thus people without any scientific and structured knowledge of materials, engaging within these trends share the willingness to tackle the issues of leather in one or another way. The work of Camilo Ayala-Garcia on the conditions of DIY-material development clusters these motivations in the following sources: driving source, inspirational source, technology source and craft source. (Ayala-Garcia, 2016)
Additionally the concept of *'Material activism'* (Rognoli & Ayala-Garcia, 2018), spurs designers to break free of the exclusion of industrial material development and act pro-actively. The concept is closely connected with democratization, sharing, hacking, self-production and Do-It-Yourself. (Rognoli & Ayala-Garcia, 2018) DIY-Materials thus, can be considered one of the many facets of a movement called *'Third Wave Do-It-Yourself'* as described by Stephan Fox. Who describes the necessary infrastructure for enablement as follows: internet access, digital tools and manufacturing equipment. While, he argues, that mobile manufacturing can bring great value in regions that do not meet these requirements, it is more than common and widely accessible in urban areas. (Fox, 2014)

According to United Nations more than half of the world's population is already living in cities and this proportion is expected to raise to 68% in 2050. (UN, 2018) Taking this into consideration as well as the infrastructural needs and the fact of cities as main material consumers, I asked myself the question: What are the conditions and influences for material activism in cities, if as stated in the concept, one could simply start a tinkering process in one's kitchen? (Rognoli & Ayala-Garcia, 2018)

'City is a word used to describe almost anything.', this is how Deyan Sudjic, director of the Design Museum starts his book: The language of cities. Having said that, he argues cities are distinctive identities, none is the same, which is not only shaped by climate, topography, architecture and orgins, but mainly by its people. With a city being a dynamic creation, ever changing and developing, thus in order to make sense of a city, one has to understand its people and embrace the quality of the unpredictable as a key virtue. (Sudjic, 2016)

With cities, being *'the talk of the world'* and currently investigated in many ways, on the following pages I have gathered case studies, influences and opportunities for DIY-Materials creation in cities.

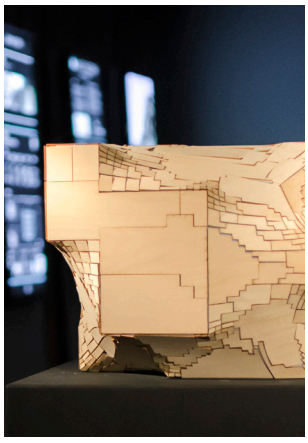
FUTURE URBAN MINING

'We have all the materials we need, they are already here.'[2]
Anders Lendager

1. Material Illusions, Sophie Rowley

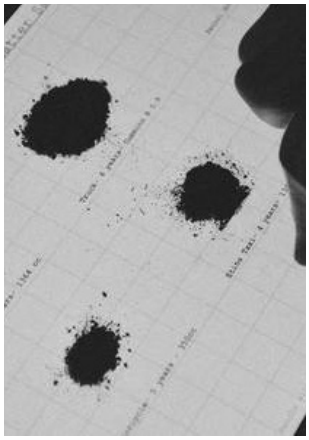
The architect formulates in one sentence the core of the Fab City philosophy. A model for self-sufficient cities that recycle materials, raw and trash, produce locally with the diffusion of FabLabs and trade in Data and being globally connected. (Diez Ladera, 2014) Thus, what happens if we see cities not only as living space, but as deposits of ressources - what we consider waste turns into a valuable ressource. (Metzger, 2018)
While one might connect these thoughts with a less aesthetically pleasing results, the following cases prove the opposite:

In her project Material Illusions designer Sophie Rowley mines *'non virgin materials, which already have had a life'* and are hyper common in our daily waste streams: denim, paper, styroform or glass. By breaksing them down and replicating natural processes she is able to create material aesthetics that are the *'antithesis of typical upcycling and recycling'* (Franklin & Till, 2018) and resemble wood, marble or corals.



2. Mine the scrap, Certain Measures

Mine the scrap, an installation by certain measures, combines construction waste with machine vision and big data. Within 45 seconds a programme scans the pieces, catalogues and assembles them to a new unique form. Tobias Nolte, one of the founders says in an interview with brandeins, their driver is not recycling but redistribution with the goal of rearranging pieces in a probably better way. In their concept Urban Fracking the studio explores empty spaces in the city, that might be useful to be built up, using the same technology. (Metzger, 2018)



3. Kaalink, Graviky Labs

Kaalink collects particulate pollution emitted by car engines before it enters the atmosphere. Afterwards the team of Graviky Labs detoxifys the particles, which results into high-quality liquid ink. A collaboration with Tiger Beer in 2016 has produced 150 litres of Air-Ink equating roughly 2500 hours of car emissions. (Graviky Labs, 2015)

HYPERLOCALITY, IDENTITY & TRADITION

What happens if we act hyperlocal, which is what a self-sufficient city implies. According to design researcher Florian Pfeffer it is the only way not to capitulate to the complexity of our world. (Pfeffer, 2014) Rather we can use it in a way of heritage, craft and local ressources as a continuum of knowlege, bridging the past and the present. (Franklin & Till, 2018)

While the reinterpretation of materials is nothing new, neither is the idea of small. Though as Ezio Manzini states in his S.L.O.C. (small, open, local, connected) principle for a new society, local and small in the era of the internet becomes a global implication and the former small, is far from being insignificant, but gains value through reproducibility. (Manzini, 2013)

4. Five Ways. Kate Fletcher

In her 5 Ways project Kate Fletcher for example designs for a specific street Brick Lane in London, UK. The output is a hand-knitted bag, made from leather scraps found in local workshops. It is designed to carry fruit and vegetable home from the market stalls, thus shop local, it communicates your community idetity, pointing out that one lives there and uses waste of a local source employing local people. (Fletcher, 2007)

In her project Discovering Nature, Masayo Ave follows a completely different approach: framing rituals through the organic design process. She uses Singapore‘s rich nature as a source for pattern inspirations and development with the output of rugs that speak the language of the tropical city, abstract narratives on organic dyed yarns. That shows that even within limited boundaries of the city, this does not necessarily mean a sole aesthetic of man-made materiality. (Chua, 2016)

5. Discovering Nature, Masayo Ave

THE SOCIAL SIDE OF MATERIALS

In her essay *'Don't do it yourself'* design researcher Lisa-Anne Auerbach pledges a new social form of Do-It-Yourself practices that is uncommercial, based on sharing, crazy about communities and liberating. (Auerbach, 2008)

Concurrently a growing number of designers uses materials as medium for social innovation, bringing people in neighbourhoods together. In these places people can exchange, share knowledge and ideas and pool their skills. Franklin and Till argue, that in our increasingly technical world using our hands for more than pressing buttons, triggers a sense of *'agency, fulfilment and empowerment.'*(Franklin & Till, 2018, p. 111) Manzini describes, these *'Creative communities'* as people, who cooperatively invent, enhance and manage innovative solutions for new ways of living. In fact, he describes them as *'social experiments of possible futures'*. (Manzini, 2015)

6. Granby Four Streets, Assemble

The Granby Four Streets iniative is based on making and design founded in local heritage. Together with the local residents the Assemble collective have regenerated Toxteth neighbourhood in Liverpool. In order to refurbish local houses and create affordable living, they have set up a workshop, a social enterprise, that employs and trains local people to make items for the home in experimental processes. Examples are mantelpieces from construction waste or ceramic door handles smoke fired in barbecues. (Franklin & Till, 2018)

Cucula is the name of the refugee company for crafts and design in Berlin. Addressing the issues of integration the workshop offers a place to enhance making skills, empower young people to build a future and access to education, legal advice and social support. The workshop produces the 19 designs from Enzo Mari's 1974 manual Autoprogettazione project, which the designer has granted them the right to sell furniture based on his designs. (Franklin & Till, 2018)

7. Lampedusa Chairs, CUCULA

ABOUT DREAMS & FEASIBILITY

Third Wave Do-It-Yourself claims to be revolutionary for prosumption, for innovation and for entrepreneurship. (Fox, 2014)
According to Neil Gershenfeld digital fabrication will bring the disruptive change for manufacturing, the same way the internet brought for communications. (Gershenfeld, 2012)
Microproduction Everywhere could generate *'new processes of productive sense-making'* through access to and distributed control over the production scale and means. (Bianchini & Maffei, 2013)
Three interconnected ideas, but are they feasible and operational? The following two example exemplify beacons in the above mentioned future.

8. Opendesk

Opendesk offers downloadable furniture design to be made everywhere in the world. It supports the Open Making process, which is strictly simple. Designer can submit work from everywhere in the world and choose a licence. Customers can download the design and go to their nearby make shops and produce them themselves locally or work with one of the trusted maker partners from Opendesk. The disruption it implies is rather social - the experience of engaging in the way something is made, close to home and customized precisely to purpose. (Franklin & Till, 2018) Regarding materials, one of the offered materials is Solidwool, a new solid material from wool and part of the first DIY-Materials classification. (Rognoli et al., 2015)

The Post-Couture Collective claims to be the first brand to combine the maker movement and the third Industrial Revolution. Similarly to Opendesk it is a open-source project, that lets customers design their own clothes to be manufactured locally. The use of laser-cutters and 3D printers as well as the slot technique result in less waste as the garments do not have to be sewn. Usually the clothes are designed out of a breathable and malleable 3D-knitted material, but the founder Martijn Van Strien also stresses the use of appropriate local materials, hoping for a lot of added emotional value. (Franklin & Till, 2018)

9. Post-Couture Collective

Berlin, a starting point for leather from vegetable sources

FUTURE URBAN MINING

The German capital has undergone drastic political and architectural changes since the opening of the wall and the reunion of Germany 20 years ago. While this has resulted in many new sites that are now heart to Berlin‘s center like the Jewish memorial or the Spreekanal, it has also left the city with a high amount of open spaces and green areas. Some like the „Schrebergärten“ known today as Urban gardens carry a long tradition and are reliving a revival. In other areas the helplessness of the authority creates space for areas like the Holzmarkt, where creatives can live their dreams. (Beier et al, 2018)
Construction sites, inner city nature, from car polluted air, it seems Berlin has all the ingredients for material activism.

One could now argue, that from bricks one cannot arrive at leather based on vegetable sources. That is true, but I would argue this depends on the point of view.
Talking to Zuzana Gombosova, part of the From Malai team, which produces a leather alternative from Coconut, opened my eyes. She mentioned *‘Malai could be produced practically everywhere, where you can find an South Indian Restaurant, because they produce Coconut waste.’* (Zuzana Gombosova)

HYPERLOCALITY, IDENTITY, TRADITION & THE SOCIAL SIDE OF MATERIALS

Berlin is home to about 3,75 million people from 193 nations and is steadily growing. Around 40.000 new residents arrive every year in the city. While people joke about the fact, that it is even hard to meet someone, that originates from the German capital, Beier et al. from Spiegel Online state that actually everone claims the public space as theirs and makes it clear *‘This city is mine’* (Beier et al, 2018) JFK‘s popular quote *‘I am a Berliner‘* gets a whole new meaning in the reunited Berlin of the 21st century. As the city becomes more crowded the tone harshens up, crime in socially disadvantaged districts such as Neukölln rises as well as the gulf between the rich and the poor, friction between the old and new dwellers and gentrification. (Beier et al, 2018)
The effects are very visible on Berlin‘s housing market, which resembles rather a roulette than anything else and is victim to speculations on the cost of renters according to Sören Görtz from die Zeit. (Görtz, 2018)
Having this in mind as well as the city‘s extraordinary structure with seven former cities at the basis, projects like Granby Four Streets would be more than needed.

ABOUT DREAMS & FEASIBILITY

Berlin is clearly facing serious challenges in the upcoming years and the city government is currently working on a 2030 plan, which shall be starting by 2020. (Beier et al, 2018) Thus it seems to be the right time to introduce a concept like the FabCity philosophy on a bigger scale.

Regarding active citizenship involvement two examples show that Berliners are not afraid to neither speak up, nor to embrace change. In 2018 citizen protests stopped tech-giant Google to set up in their neighbourhood Kreuzberg stating *‘Google is not a good neighbour’*. The old Tempelhof airport area, which was opened to the public about 10 years ago, has turned into Berlin‘s green lungs embracing everyone to be free to use the space in their own way. And it was not a planned iniative, it just happened. By 2014 a votum made it official that nothing had to be changed. (Beier et al, 2018)
Thus many iniatives exist, linking and providing them with the right tools might be the true challenge.

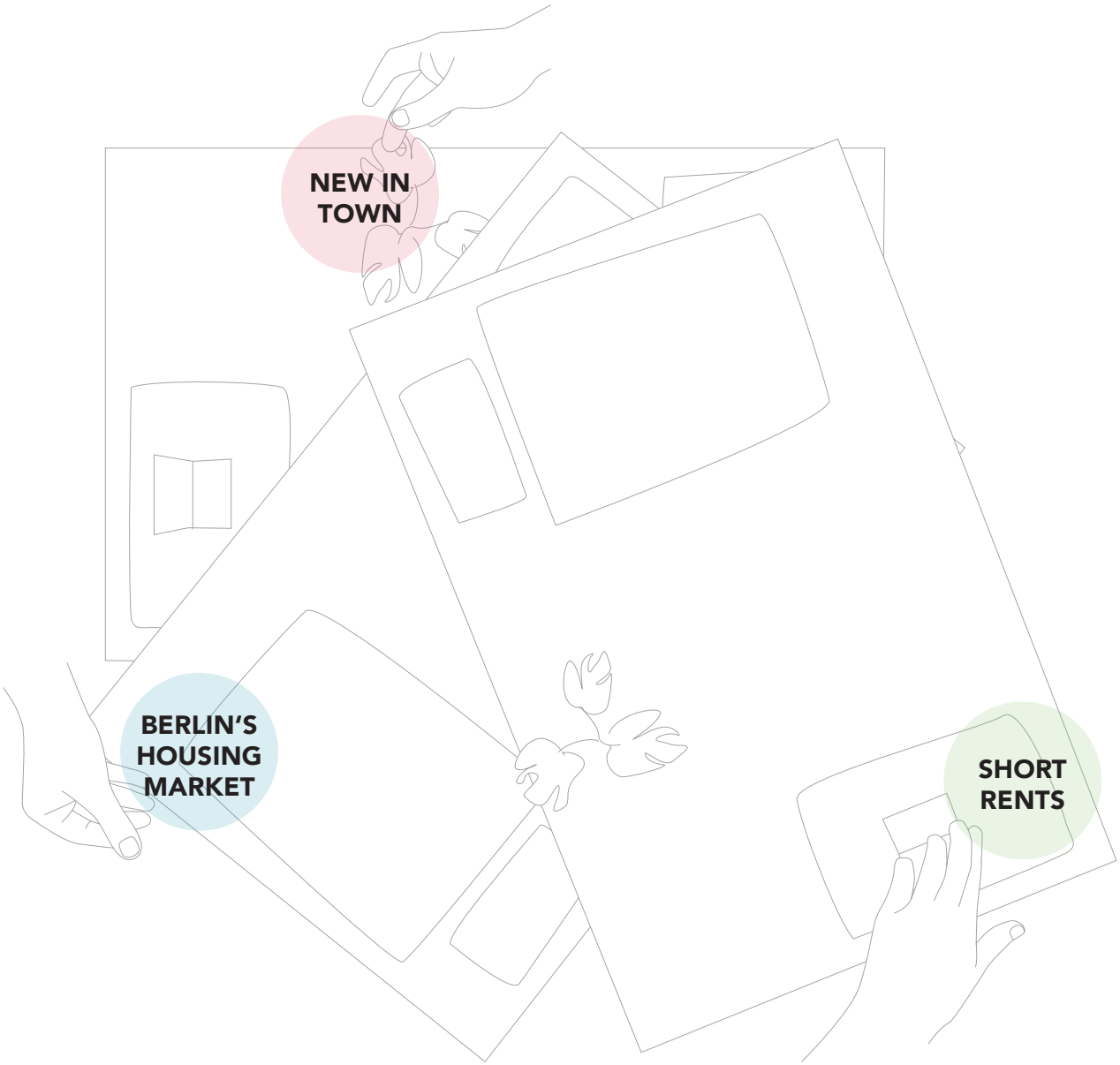
Eventually the take on leather from vegetable ressources. Berlin is said to be one of the vegan capitals of the world (Naomi Larrson, 2019) with around 90.000 vegans living in the city. The trend has started out as a niche and is establishing in what successful Dandy Diner owner call *‘Trend Veganism’* and is now not only conquering food but also clothes and shoes. (FAZ, 2018)
With a rising market and a huge nurturing start-up culture in the city, working on an alternative from vegetable sources seems promising.

Problem Framing

'A designer can feel right now the will to go home, enter into the kitchen and start any materials experimentation experience that may find interesting in any website. After some iterations with the material may also will go and buy any open-sourced instrument that can help improve what have created.' (Rognoli & Ayala-Garcia, 2018)

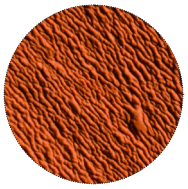
But what happens if for any reason you cannot experiment in your home? In my case I arrived in Berlin, got hit by its very complicated housing market and faced with room mates that were not happy with me growing mushrooms in our kitchen or kombucha in the bathtub. For this reason I asked myself the question:

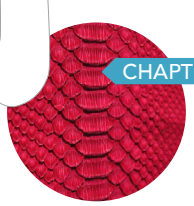
HOW DO MATERIALS ACTIVISTS FIND PLACES TO TINKER ON DIY-LEATHER EXPERIMENTATION IN A CITY?



Framing leather

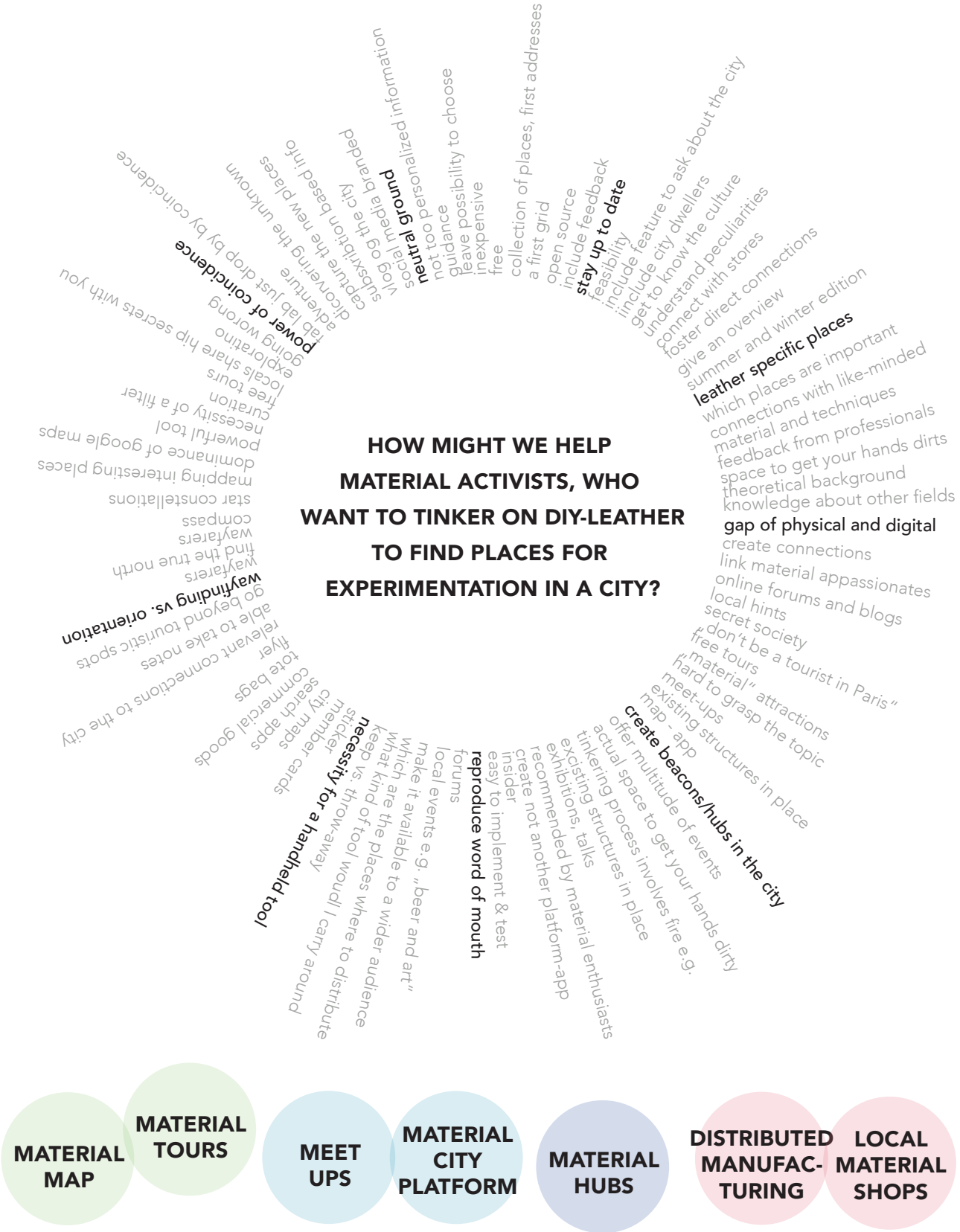
LEATHER CITY MAP, FOSTERING DIY-MATERIAL EXPLORATION IN BERLIN





Idea of a leather city map
Maps, tools for orientation
Exploring Berlin's leather places
Logic of the map
Use Case of the map
Context of the map

CHAPTER 5



MATERIAL MAP

MATERIAL TOURS

MEET UPS

MATERIAL CITY PLATFORM

MATERIAL HUBS

DISTRIBUTED MANUFAC-TURING

LOCAL MATERIAL SHOPS

FEASIBILITY

‚today'
easy solution, quickly implementable, done by individuals

‚tomorrow'
feasible solution, in need of further research & funding, done by groups of individuals

‚near future'
difficult to implement, in need of established local project partners & funding, done by organization

‚far future'
tricky to implement, in need of established global project partners & funding, done by several organizations

Idea of a leather city map

In order to describe the idea I used the **JOBS TO BE DONE** method, based on the work of Hannes Jentsch and Martin Jordan.

CONTEXT (WHERE, WHAT, WHEN...)

Where? an urban area, a city, in this case Berlin

What? giving information about places, where a material activist can start tinkering with leather, through the medium of a map

When? independently chosen by the user

DESIRED OUTCOME (WHAT DO I WANT?)

neutral but curated information about relevant places for DIY exploration of leather; seeing the map as a tool, that can be used more often

UNWANTED OUTCOME (WHAT TO AVOID?)

commercial map with only visibility of sponsors, representing a throw-away item after use

FUNCTIONAL JOB

tool for orientation, finding places to experiment

EMOTIONAL JOB

compass, beacon and starting point for tinkering process and project development

SOCIAL JOB

finding connections to like-mindeds, places to explore

CURRENTLY EMPLOYED SOLUTION

unconnected individual array of places, meet-ups, online platforms, travel guides, maps of single events

Maps, tools for orientation

'As a state-of-the-art scientific tool, helping us to make decisions, maps can be found everywhere in our daily lives, representing the world in its smallest details, in any form and at any scale.'
Jasmine Desclaux-Salachas

Thus maps are tools to navigate through our complex world, linking us as travel companions to the space we stroll, which can be out of desire or necessity. They measure, trace and show the world for us in order to better understand our sourroundings at a local and global scale, giving detailed information and the possibility to tell stories about the society in which we live. (Desclaux-Salachas, 2016)

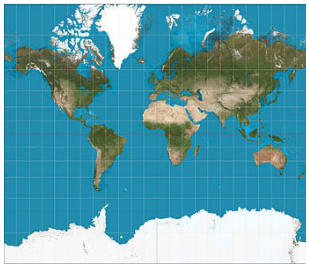
MAKING THE ROUND FLAT

Map making is a way to *'express what must be said'* (Desclaux-Salachas, 2016 p. 4) and transforming it into a visionary and universal language. As the earth is a sphere and globes are limited in transmitting information, translations to a flat surface are needed. These are called projections. (Pater, 2016)
But they are not limited in forms and functions as the history of map making shows. The wooden map of Greenland's shorelines used by the Ammasalink Inuit were designed to be felt instead of read, while navigating through the arctic darkness in a kayak. (Harmsen, 2018) It is just one out of many examples of the variety of maps used by indigenous people. Modern cartography instead has begun with a similar reason, navigating the oceans safely, but has transformed into a tool to depict power from colonialism on. (Pater, 2016)

10. Greenland's wooden maps

SHOWING POWER

The mercator map is probably the most common map used in western society. Based on the drawings of Gerardus Mercator from 1569 it shows a world in wrong proportions, overvaluing the so-called white-man's territories. But still it is the basis for modern maps like Google maps or Apple maps. This example shows that through simplifying this reality, cartographers are given a sense of power, giving meaning and importance to



11. Mercator Projection

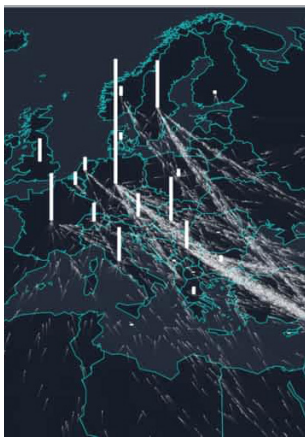
12. Where are the Syrian refugees? Gapminder

14. Café Cartographiques

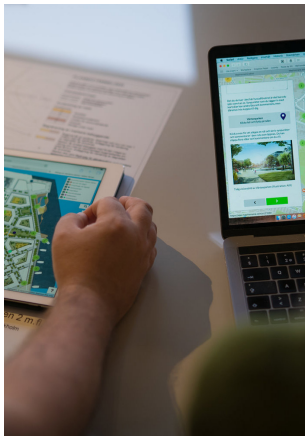
some and insignificance to other areas. (Pater, 2016)
With the arrival of the information society and a more and more complex world, good data translation has the power to translate complex processes to a wider audience. For example showing different point of views of a debate. The two pictures show maps that depict the Syrian refugee crisis. The same data, two maps, two completely different stories. (Pater, 2016) Thus maps are neither outdated nor quickly drawn but can be *'complex, opinionated, political or personal'* not only mapping the physical environment, but also human activity. (Desclaux-Salachas, 2016)

MAP MAKING IN THE 21ST CENTURY

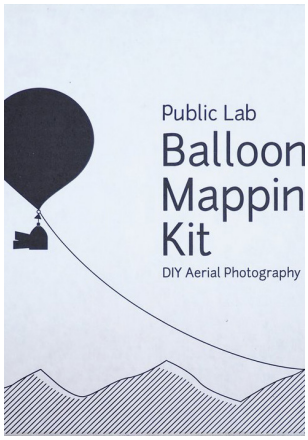
Today's digital tools create the illusion that a map can be produced within a few clicks. This is merely the case, rather mapping is a complicated process. In order to arrive at a set of information, graphically prepared to allow spontaneous interpretation by readers it takes *'tons of work and effort'* (Desclaux-Salachas, 2016, p. 4) Today this is not only a cartographer's work, it links several disciplines together through the use of observation, data, technological innovation, collage and illustration. (Desclaux-Salachas, 2016)
Recent years see another phenomena on the rise, called *'civilian mapping'*, which aligns map making away from a subjective art and historical medium towards civilians expression for the common interest. Café Cartographiques is a Paris-based service that welcomes the public to take part in the universe of map making, by hosting workshops. (Desclaux-Salachas, 2016)
Another direction are digital participatory platforms designed as research tools to gather citizen's opinions about life in cities. Maptionnaire was used to ask Helsinki's inhabitants, what they think about a parc and Block by Block enables unheard voices to be heard in urban planning in problem areas. (Garassini, 2019)
The series of balloon and kite-mapping kits, instead, are the DIY-answer to satellite and drone mapping. A bird perspective on ourselves and earth, offers a human perspective on science. (Public Lab, 2019)
These trends show that despite its historic problemacy maps can become powerful tools that can federate citizenship, curiosities, sensibilities, and creativities like DIY-material exploration. (Desclaux-Salachas, 2016)



13. The flow towards Europe, Lucify



15. Maptionnaire

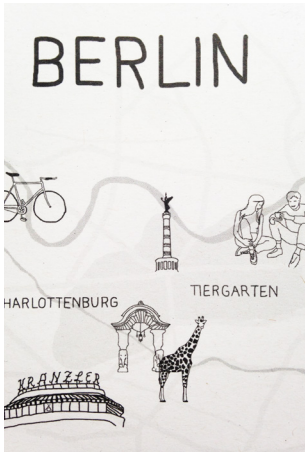


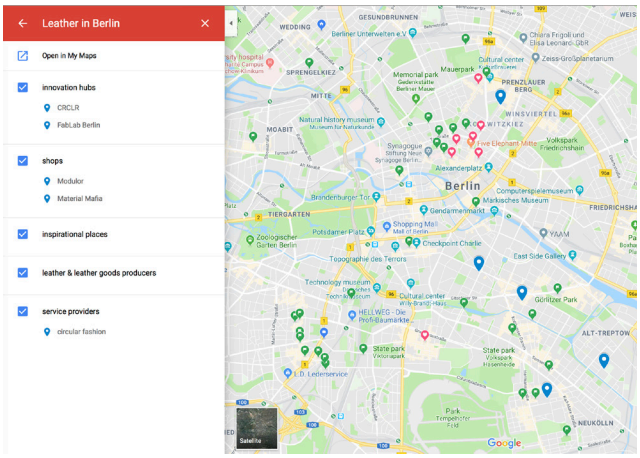
16. DIY- Aerial mapping, Public Lab

Exploring Berlin's leather places

INITIAL SEARCH PHASE

A simple google search using the keywords: leather in berlin, leatherplaces in berlin, leathergoods in berlin, leather manufacturers in berlin was the starting point of mapping excisting places. The result was a personal google map, where I marked all places that had leather in their name or company description.





ANALYSING BERLIN MAPS & GUIDES

In the second step I started collecting maps of the city in order to analyse them for their functionality on the one hand and use them as inspiration on the other hand. Especially interesting and useful, where maps that were handed out at temporary events, such as the Berlin Coffee Festival.

primary desk research

OBJECTIVE: starting point for exploration

MEETING OTHER DIY MATERIAL ENTHUSIASTS

To fully immerse myself in the scene and meet other DIY-Material enthusiasts I attended two specific events: The 2-day held Circular Design Forum with talks, discussions and exhibitions and the opening of the Textile Prototyping Lab at Fablab Berlin. It was a good chance to exchange and talk to like-mindeds.

WORKSHOP FOR AN ALTERNATIVE LEATHER

During the Open Source Circular Economy Days in Berlin I attended a one day Workshop with the topic of *'How can The Apple Girl a faux leather start-up, be competitive and fully circular'*. Throughout the workshop we brainstormed ideas and clustered circular production ways and communication strategies.

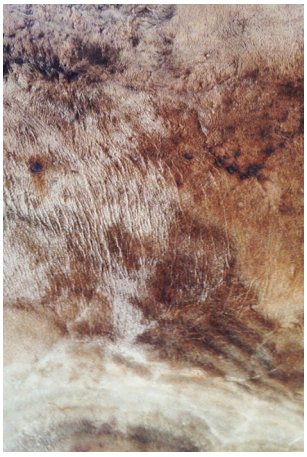
autoetnography

OBJECTIVE: get *'insider hints'* from local DIY-culture

Exploring Berlin's leather places

REACHING OUT TO ALTERNATIVE PRODUCERS

With the goal to collect material samples of leathers from vegetable sources, I reached out to 20 alternative leather producers. In an email I was explaining my research and asking whether their material could be produced in an urban context as well. I received five material samples and had broader insight from three.



'Producers ask all the wrong questions about standards, when the right question would be what the material can do, which leather cannot' Sarmite Polakova, PineSkins

'Malai could be produced practically everywhere, where you can find an South Indian Restaurant, because they produce Coconut waste.' Zusana Gombosova, Malai

'I am in contact with Dough producers to scale the production, but it is hardly impossible to test and to meet the scope of machines.' Hanna Michaud, The Apple Girl

INSIGHT FROM ALTERNATIVE PRODUCERS

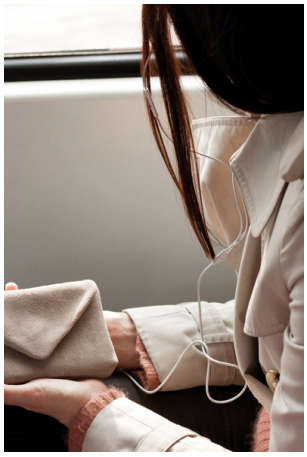
Through the initial sample search I got in touch with Zusana Gombosova, iniator of Made from Malai, Hanna Michaud, CEO of The Apple Girl and Sarmite Polakova, designer behind PineSkins. Talking to these experts was important to understand the broader context of production and relevant places.

expert views & secondary desk research

OBJECTIVE: expert insights on production places

GRASPING BERLIN'S LEATHER MOOD

With the goal to understand the *'vibe'* for leather in Berlin, I started observing in the public: which people wear and buy it, where advertising or relevant exhibitions or talks are promoted and which places one can randomly find without actually having done research before. I collected these impressions over two months.



VISITING BERLIN'S LEATHER PLACES

In addition to understanding the 'look and feel' of leather in Berlin, I visited the places researched and collected in the previous phases. While talking to the people in touch with leather, I collected the name, address, location, photos if possible and notes for openness to share information, sustainability and expertise.

observation & contextual informal interviews

OBJECTIVE: validation and selection of places gathered during online research and suggestions


WEDDING
MOABIT
Schloss-
garten
Tiergarten
CHARLOTTENBURG
SCHÖNEBERG
4
10
36
38
14
5
25
26
16
11
17
27
8
41
#inform
#inspire
#connect
#enable
waterways
parcs
rails
main roads
secondary streets


Humboldthain
Mauerpark
PRENZLAUER BERG
Volkspark
Friedrichshain
MITTE
FRIEDRICHSHAIN
KREUZBERG
NEUKÖLLN
Tempelhofer Feld
3
7
22
24
35
37
9
6
34
21
13
18
40
28
20
19
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1
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33
44

Logic of the map

#INFORM

Immerse yourself in the world of leather and learn about its history, craft, techniques & types.

This category was inspired by the need to tinker and to understand leather as a material upfront. In order to do so, my research showed that one needed material samples to understand the functionalities and qualities of leather, to simply explore haptically the variety of different types of leather, like velour or whole grain. Additionally next to a traditonal crafting process, material ressorcing was key for recovered materials. Understanding the material's roots often results in a driving source for new material development.

Modulor
Prinzenstraße 85, 10969 Berlin

Material Mafia
Harzer Str. 39, 12059 Berlin

Kunst-Stoffe
Berliner Straße 17, 13189 Berlin

Leevenstein Ledermanufaktur
Lüderitzstrasse 13, 13351 Berlin

Dr. Josephine Barbe @ TU Berlin
Marchstraße 23, 10587 Berlin

Gusti Leder
Kastanienallee 13, 10435 Berlin

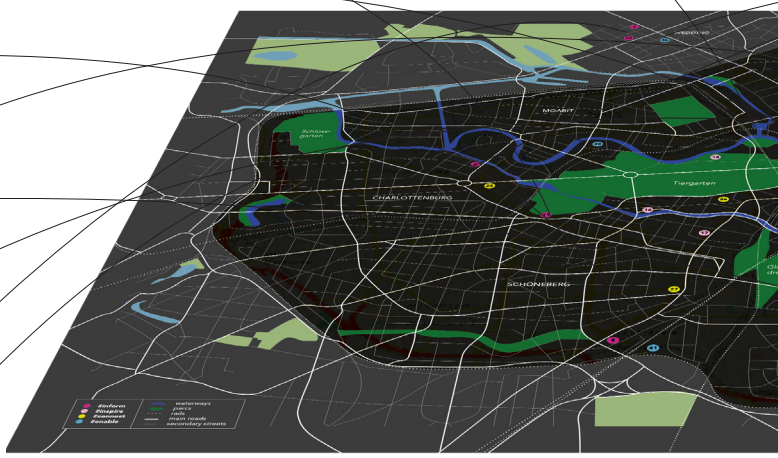
Leder + mehr
Erich-Weinert-Straße 3, 10439 Berlin

L.D Lederservice
Hauptstraße 117, 10827 Berlin

Lapáporter
Brunnenstrasse 65, 13355 Berlin

Leder Hobby
Seestraße 103, 13353 Berlin

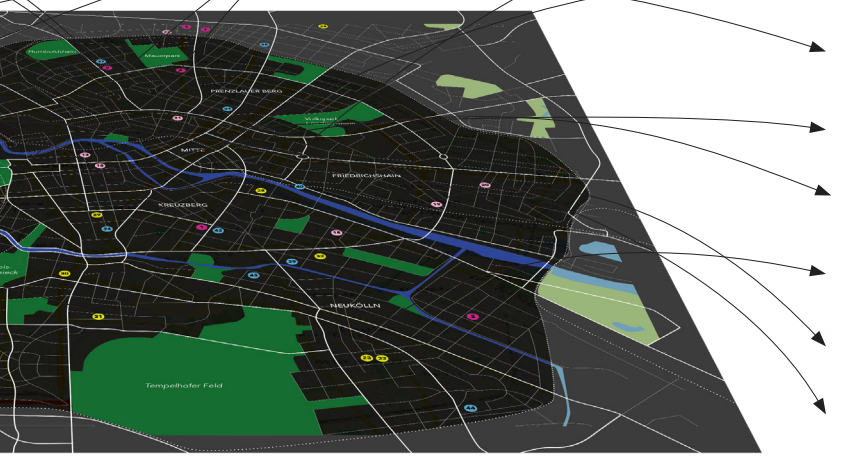
Ikono Möbelmanufaktur
Budapester Str. 38-50, 10787 Berlin



#INSPIRE

Looking for the sparking idea, get inspired with magazines, products, events, exhibitions & talks.

While seeking for inspiration might seem very obvious, it shall not be underestimated. If you arrive in a new city and are not immediately integrated into a scholarly context like a university, it is important to find these places, which often well kept secrets in the community and not to be found in usual guidebooks. I collected and listed libraries and bookstores, that keep a good range of critical and up to date design literature, but also shops that sell vegan fashion and local exhibition places connected to culture, food, materiality and design.



12 **do you read me?!**
Auguststraße 28, 10117 Berlin

13 **Dußmann**
Friedrichstraße 90, 10117 Berlin

14 **Haus der Kulturen der Welt**
John-Foster-Dulles-Allee 10, 10557 Berlin

15 **Markthalle Neun**
Eisenbahnstraße 42/43, 10997 Berlin

16 **Bauhaus Archive & Campus**
Klingelhöferstraße 14, 10785 Berlin

17 **Trippen P100**
Potsdamer Straße 100, 10785 Berlin

18 **Avesu**
Warschauer Str. 33, 10243 Berlin

19 **Drive. Volkswagen Group Forum**
Friedrichstraße 84, 10117 Berlin

20 **Ucon Acrobatics**
Gabriel-Max-Straße 16, 10245 Berlin

21 **Ecoalf**
Alte Schönhauser Str. 5-5a, 10119 Berlin

22 **Dear Goods**
Schivelbeiner Str. 35, 10439 Berlin

Logic of the map

#CONNECT

Visit these hubs, schools, events & services for a second opinion or to boost your project.

Often it is simply the exchange with others that triggers a new idea. Especially in the field of leather alternatives, a designer can learn a lot from biologists, urbanists or any other profession. I listed here places that work around the topics of Circular Economy, Make City and Vegan and Sustainable Fashion. If one is looking for further education or a boost to pitch his idea and seek connections to the industry. Services like beta-haus‘ start-up pitches or consultancies like Sourcebook might not be free of cost, but a good investment if a project is already further progressed.

CRCRL House Berlin 23
Rollbergstraße 26, 12053 Berlin

Kunsthochschule Weißensee 24
Bühringstraße 20, 13086 Berlin

Chora concious city @ TU Berlin 25
Straße des 17. Juni 135, 10623 Berlin

International Design Center 26
Am Park 4, 10785 Berlin

betahouse 27
Rudi-Dutschke-Straße 23, 10969 Berlin

Neonyt @ Kraftwerk Berlin 28
Köpenicker Strasse 70, 10179 Berlin

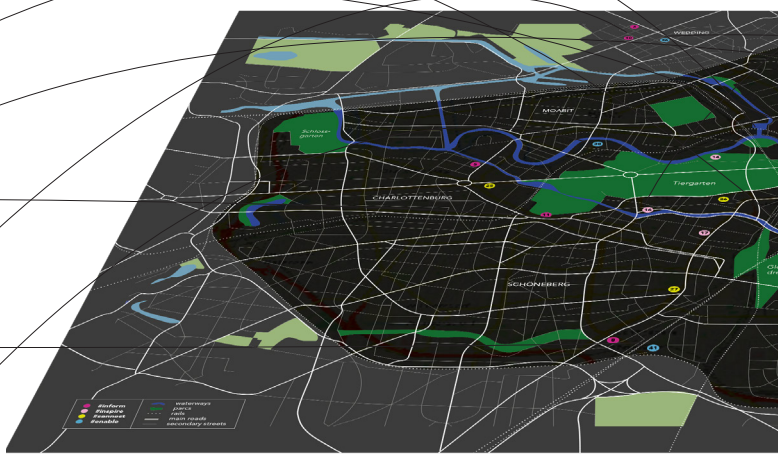
Udk Schnippeldisco @ Junk Food Project 29
Grunewaldstraße 2, 10823 Berlin

Premium Exhibitions 30
Luckenwalder Str. 4-6, 10963 Berlin

Haute Innovation 31
Fidicinstraße 13, 10965 Berlin

Sourcebook 32
Reichenberger Str. 155, 10999 Berlin

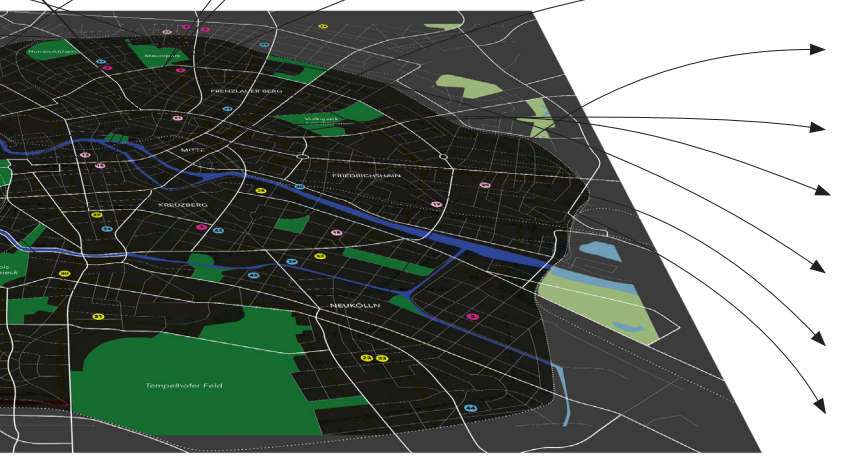
circular.fashion @ CRCRL House Berlin 33
Rollbergstraße 26, 12053 Berlin



#ENABLE

Simply want to get your hands dirty? These labs & workshops welcome you.

This collection of places is the result of lacking the possibility to tinker in one's home. The category includes *'traditional'* makerspaces and fablabs, which can usually be used on a subscription basis, but also spaces more linked to social and biological themes. While Cucula and the Crisis Response Makerspace especially address social issues and would host projects linked to these themes other places host workshops and offer space to experiment around the topics of growing, urban gardening and natural processes, ideal for growing leather alternatives.



34 **Textile Prototyping Lab @ FabLab Berlin**
Prenzlauer Allee 242, 10405 Berlin

35 **Maker Space @ Maker Store**
Prenzlauer Allee 173, 10409 Berlin

36 **Makerspace-Zone Schillerbibliothek**
Müllerstraße 149, 13353 Berlin

37 **Happy Lab Berlin**
Demminer Str. 3, 13355 Berlin

38 **The bakery Coworking & Makerspace**
Claudiusstraße 6, 10557 Berlin

39 **Cucula**
Paul-Lincke-Ufer 41, 10999 Berlin

40 **Crisis Response Makerspace**
Holzmarktstraße 19, 10243 Berlin

41 **EUREF Campus Berlin**
EUREF-Campus 13, 10829 Berlin

42 **Prinzessinnengärten**
Prinzenstraße 35-38, 10969 Berlin

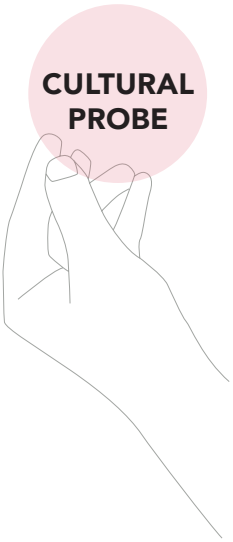
43 **Edible Alchemy @ Daheim Manufaktur**
Dieffenbachstrasse 68, 10967 Berlin

44 **Trial & Error Kulturlabor**
Braunschweigerstr 80, 12055 Berlin

Use case of the map

PERSONAL TOOL (INFORM)

The material map at its current state is intended as a personal tool for DIY-material enthusiasts. It should foster the exploration around leather as a starting point for a tinkering process. From my point of view in its printed version it functions as a travel companion and resembles a cultural probe for one's own project exploration, adding places, notes and personal leather stories.



INTERACTIVE TOOL

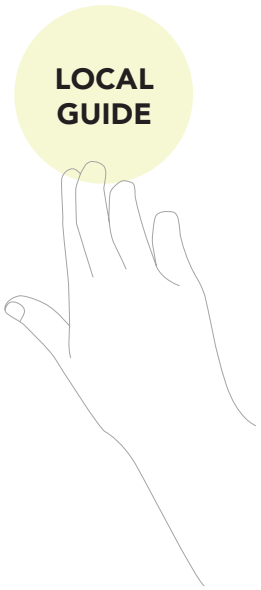
One section on the map offers a way to share the holder's story with the curators via Whatsapp, as well as to receive an update on the progress via a newsletter in the same medium.

Context of the map

This section answers the question, where the map can actually be found?

IN STORE (INSPIRE)

In this case I would adapt a system that already works well for the city maps I collected in Berlin, especially those focusing on promoting different quarters, local places or specific topic areas. These maps are usually placed in the locations which are on the map and free to take for anyone. This creates a win-win situation for the map, that gets visibility in physical places and a cross-commercial situation for the mentioned places.



WALKS (CONNECT)

Another point of getting in touch are guided *'leather walks'* hosted ideally by possible partners from the Enable-section, for example the CRCRL House hosts Green Fashion Walks, so why not also Material Walks. The walks would be guided by a 'connector' and could be done by walking or bike according to the host or chosen by the group. The walks can be thematically or according to location and would be a nice way to get to know other enthusiasts.

LIMITATIONS & DIGITALIZATION (ENABLE)

The Materials Map, Edition leather in its current status as a printed personal tool in fact has its limitations. As mentioned before it is an absolute today's solution, a quick win. Consequently critics could say it has limitations in reach, visibility, interactiveness and actuality and this is definitely true. Nevertheless the concept creates a framework for material exploration in cities that could be adapted and further developed on personal, local and global scale.

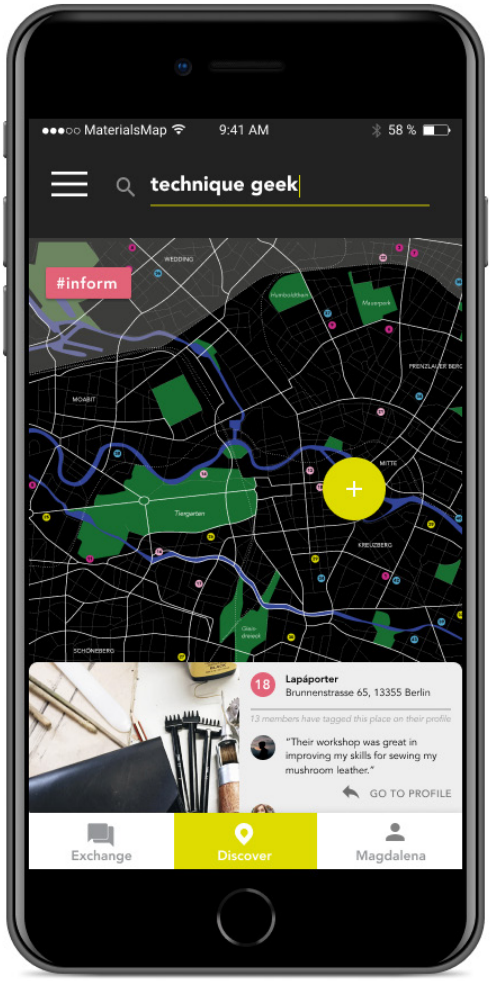
In fact the map is designed to be a first prototype, printed on the *'trusted'* (Miadownik, 2013) medium of paper, which is inexpensive to prototype the solution and a starting point for a future digital development. In order to make a difference and not simply be just another city map or digital map - the Materials Map is in need of further research, project partners and funding.

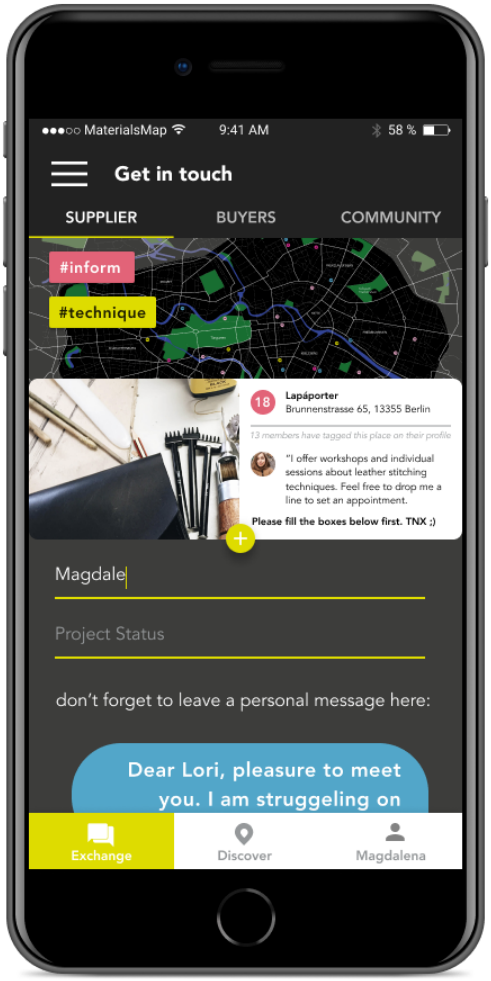
FRAMEWORK

As the concept is inspired by the FacCity philosphy it would be ideal to become part of this ecosystem. Further development in this case should also follow the FabCity Manifesto and its ten values: ecological, inclusive, glocalism, participatory, economic growth & employment, locally productive, people-centred, holistic, open source philosophy and experimental.

In regards to this vision the following pages outline a scenario of further research directions and development of the map.

Future Research Directions



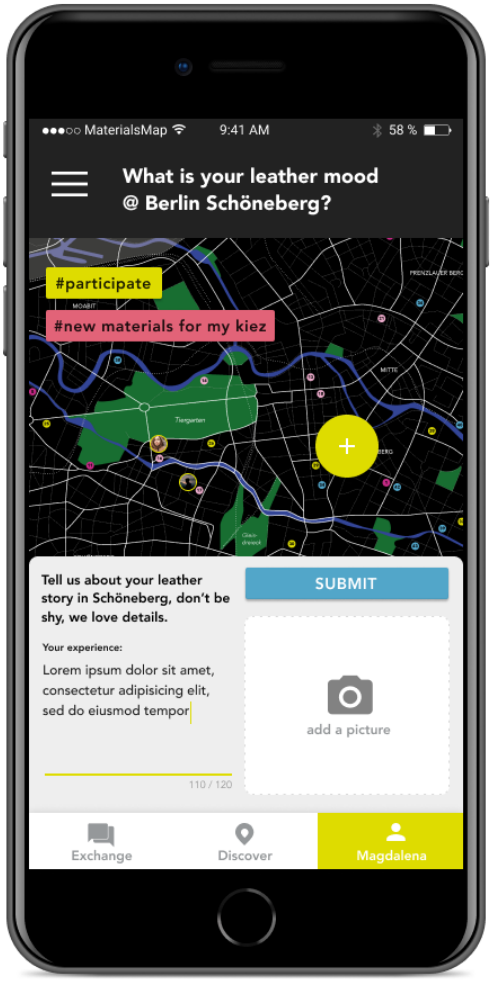


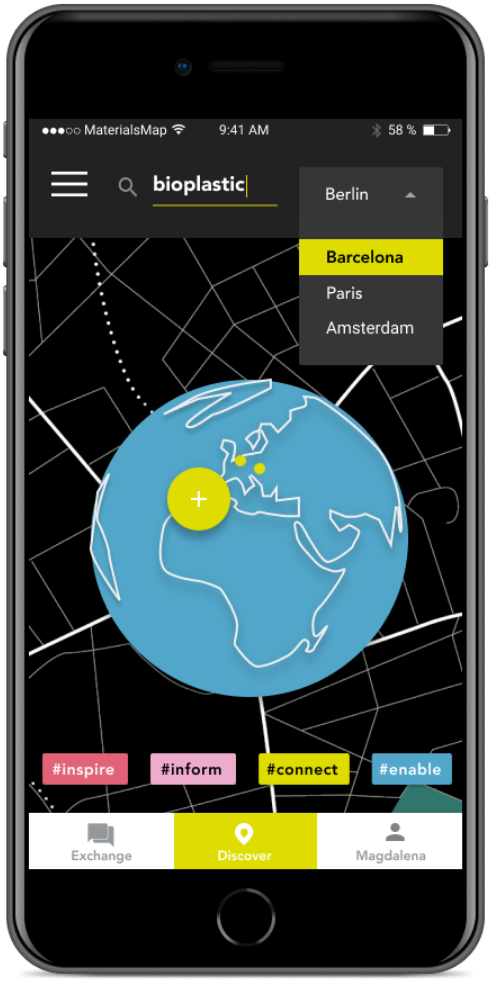
MATERIAL MAPS AS A PERSONAL TOOL

First step in order to move on would be a user test of the concept and further research. In this case I would suggest to partner with the local art university KHS Weißensee that offers a BA in Textile and Surface Design. A simple online survey with students of this programm would distingish material enthusiasts that are interested in the topic of leather and have just arrived in the city. An experience prototyping session in the city and following qualitative interviews would build the basis for information architechture and function development for a digital version, that would also enable designers to interact with the tool.

MATERIAL MAPS AS A CONNECTING TOOL

As a second iteration on research further stakeholders should be included that are relevant in the development of materials: local producers, service providers, shop owners, brands and goods manufacturers. The Material Maps tool would help to connect materials activists with like-mindeds to get feedback on their projects and to find local collaborations with producers, brands or goods manufacturers to make their projects feasible.
An initial partnership with the local FabLab could help raise interest and get connections with these professionals to iterate the maps as a connecting tool on a local level.





MATERIAL MAPS AS A PARTICIPATIVE TOOL

Calling a design process user-centered the material development needs feedback from users. As my research has shown local urban material development can be a tool for social inclusion and neighbourhood development. As these are two very relevant topics in the city materials maps could collaborate with technical Know-How providers Maptionnaire or CitizenLab on the one hand and the CityCouncil of Berlin on the other hand. The outcome would be a tool for designers to collect feedback about materials in cities directly from users. For example to find material sources or incentives for social material development.

MATERIAL MAPS AS A GLOCALISTIC TOOL

The next level would be the integration of the tool in the FacCity project, which would guarantee international testing, review and reputation. Thus in addition to adding different materials such as plastic, fibers or wood among others, the map offers a framework for material exploration, connection and participation that can be adapted in other local urban contexts. According to the FabCity philosophy these cities can be connected and learn from each other in the development of new materials within the DIDO principle. Different needs in different cities would push the development of the map.

Conclusion

At the beginning of this project I asked the question, if leather was a wicked material? Now after working on the topic, one point of Rittel's characterization of wicked problems stands out *'Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solution'* (Rittel & Webber, 1973). For my leather story that was definitely true, while I set out to develop a physical material alternative for leather, I ended up working on a tool to solve a problem I was not even aware of before: Finding a place to start a tinkering process.

In that sense it was a compelling and engaging project, that gave me the possibility to dip into a materials world of research, theories and thoughts far and eventually not so far from Product Service System Design. Thanks to this project, I was able to see a connection in the two research fields of Material Driven Design, DIY-Materials & Materials Experience on the one hand and Service Design on the other hand and to build my own knowledge system. Eventually both fields are very pragmatic, hands-on and co-creative.
Approaching this project with the mindset of a Service Designer has helped me to deepen my understanding of the domain as a cross-disciplinary language.

CROSS-DISCIPLINARY

Throughout this process, I have also grown personally as a designer, opening up new fields of interest and solving a problem I had a personal connection with: materials as a personal activist movement, as a medium to pro-actively tackle global issues on a local scope and as a platform for social innovation.

„framing leather in Berlin“

Bildtext

Framing leather in Berlin

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Acknowledgements

I would like to thank Professor Rognoli for her expert advices, encouragement and flexibility throughout this project, many thanks to Camilo Ayala-Garcia for kindly sharing his unpublished research with me and to Stefano Parisi for last-minute feedback.

Thanks to my family, for their support and guidance, which I can count on in any situation I face.

I'm grateful to all of those with whom I have had the pleasure to work and discuss during this project. I would especially like to thank Pier Paolo Curti for many motivational speeches, to my saviours in Berlin Zeynap Özge Aydin & Cemal Caglar Bektas and to Luzia Kettl for being a great support, even from far far away.

GRAZIE