

THE NEW WAVE OF SUSTAINABLE SURF INDUSTRY

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Abstract

The aim of the thesis is to find alternative materials and processes that could be applied to the surf industry to make the production more sustainable. The thesis is written for the client Primvs Surfboards/ Homeblown Factory.

The research process involves inclusive observation, interviews and qualitative research in the field. As an end-result, I analyse the possible materials and processes that are best suited for to the field. I also present three different alternative concepts for an ecological surfboard.

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Tiivistelmä

Opinnäytetyön tavoite oli löytää vaihtoehtoisia materiaaleja ja prosesseja, joita voitaisiin soveltaa surffausteollisuuteen, jotta tuotanto olisi kestävämpää. Opinnäytetyö on kirjoitettu asiakkaalle Primvs Surfboards / Homeblown Factory.

Tutkimusprosessi sisältää osallistavaa havainnointia, haastatteluita ja alan kvalitatiivista tutkimusta.

Lopputuloksena analysoin alalle parhaiten soveltuvia mahdollisia materiaaleja ja prosesseja sekä esittelen ehdotukset mahdollisista konsepteista.

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1. Introduction

1.1 The Brief

The idea behind my thesis project came by participatory observation, while working in Lisbon as an intern. I became familiar with the surf culture and process. I spent time in the Homeblown factory and became aware of the downsides of the industry.

“The dirtiest thing about surfing is under our feet — a conventional surfboard is 100 percent toxic” Frank Scura.

As a designer, I saw an opportunity to change this and find ways to make the industry greener. My mission was to minimise the environmental impact by innovating and implementing the most sustainable manufacturing practices possible. I tried also to find a way to change materials to more ecological one.

In this thesis I’m focusing on the process of the Homeblown factory but my thoughts and conclusions are applicable to all of the market.

My idea is to find alternative materials that would be affordable for the companies and easily adapted into the manufacturing process. The materials have to have the same performance, they have to be strong and flexible and easily to be produced in series. I am narrowing my thesis to typical (nowadays made from polyurethane) short and longboards. However, I do not focus on boards like kite boards which need different kind of performance of the materials.

My study will be based on literature, reports, articles, statistics and interviews. I will study also how other industries has been dealing with this kind of materials and problems.

In the first chapter I’m opening background for my thesis and introducing the surf industry. After that, I open the manufacturing process more closely and do preliminary research about the materials in the second chapter.

Third chapter is for researching the materials and finding alternative methods for manufacturing. Last three chapters are for further analysis, solutions and conclusions. I also present three alternative concepts.

Before even starting my thesis, I have talked with many people working in the industry and I have doubts if the process can be developed to be 100% ecological. However I am trying my best and finding different approaches to it. The relevant terms to the research and the interviews can be found in the attachments.

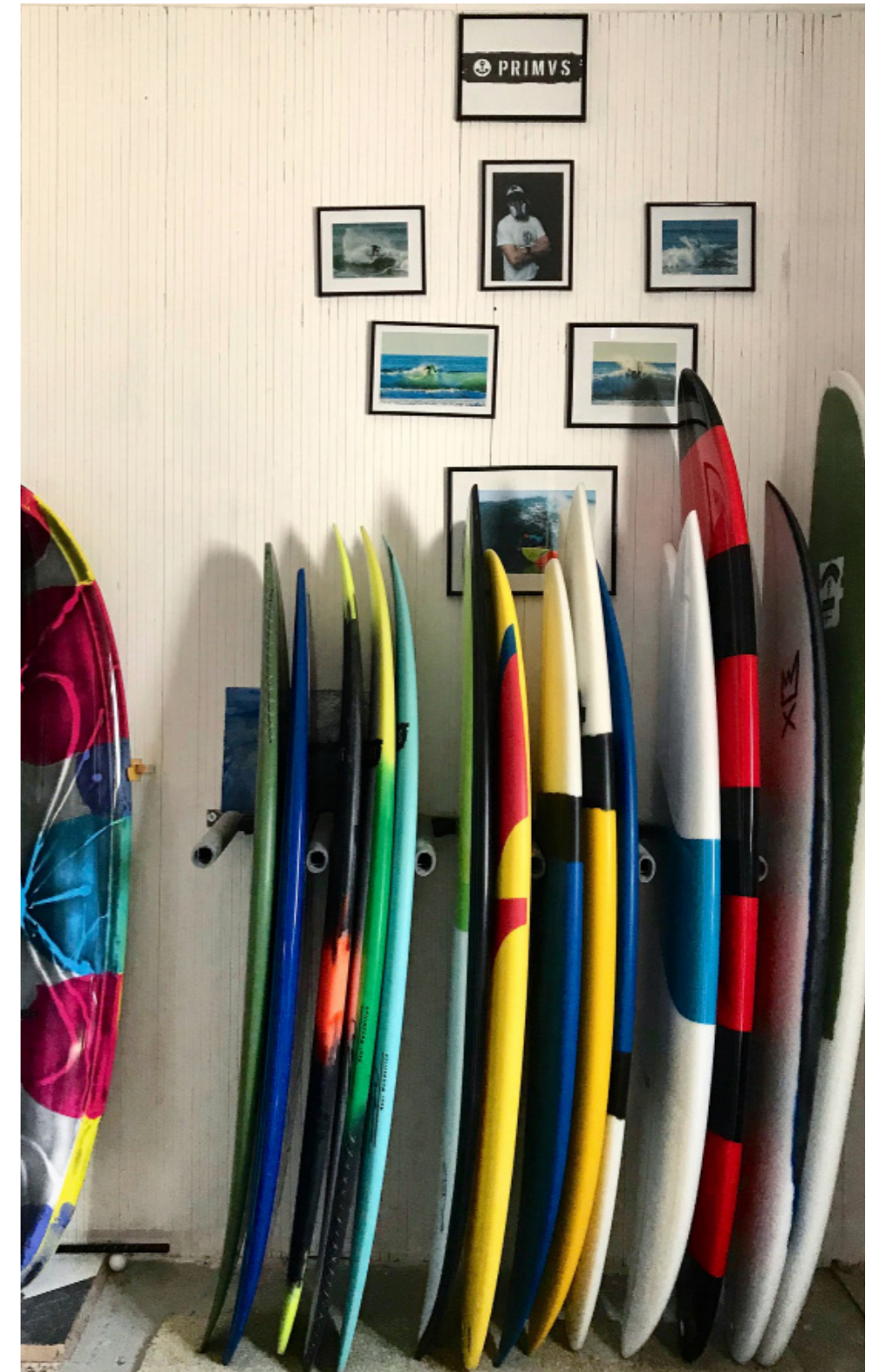
My client, Primvs Surfboards / Homeblown factory is a factory that offers surf blanks, shaping and glassing services. The factory is localised in Portugal, Caparica and it was opened in 2010. There are 7 people working in the factory at the moment. They use in-house engineering and they have designed and build their own equipments.

The factory has tried to solve the problem behind my thesis before. 15 years ago they invented their own bio foam. Biofoam consisted partly of soya. Soya made the foam brown and mainly because of the colour the new method was not a success. At this moment they are producing boards from polyurethane.

The factory makes boards for 8 brands, for example, Bloodbrothers, Lisbon Crooks, Country surfboards, Primvs, Shaperoom. All their clients are companies., they don't receive orders from individuals. 80% of the customers are locals, 20% foreigners (Germany and Hawaii).

Bruno Birra, the owner of the Homeblown factory, started he's own brand Primvs surfboards 3 years ago. Primvs boards are made in the factory. Boards are made only by custom orders, mostly for professional surfers. They are sponsoring 10 athletes at the moment. Primvs used to have it's own shop in Caparica,

but nowadays they do not have stock boards anymore.



1.2 Significance Of The Thesis

Surfboards are made using the same materials and technology that was developed back in the 1950's, which was a time when environmental concerns did not exist.

Many environmental associations consider surf tourism to be a threat to the environment and are opposing the surf tourism industry. This can be a major threat to the growth of the market in future. That is why processes has to be transformed into more sustainable ones.

One of the greatest aspects about surfing is it has no gender, socio-economic or age boundaries. It is global. Surfers come from many different backgrounds and approaches but all rely on the same things. We are like a family connected by our deep respect for and love of the ocean. Keeping plastics out of our second home, restoring healthy environments, getting better value and performance from our products, and working towards healthier practices in our industry are things that

resonate with all surfers. (Jake Moss).

Ecological board would be also a competitive advantage for the company. Users are quality-conscious so marketing would be easy. Average surfer is willing to buy little bit more from a product which is environmentally friendly.

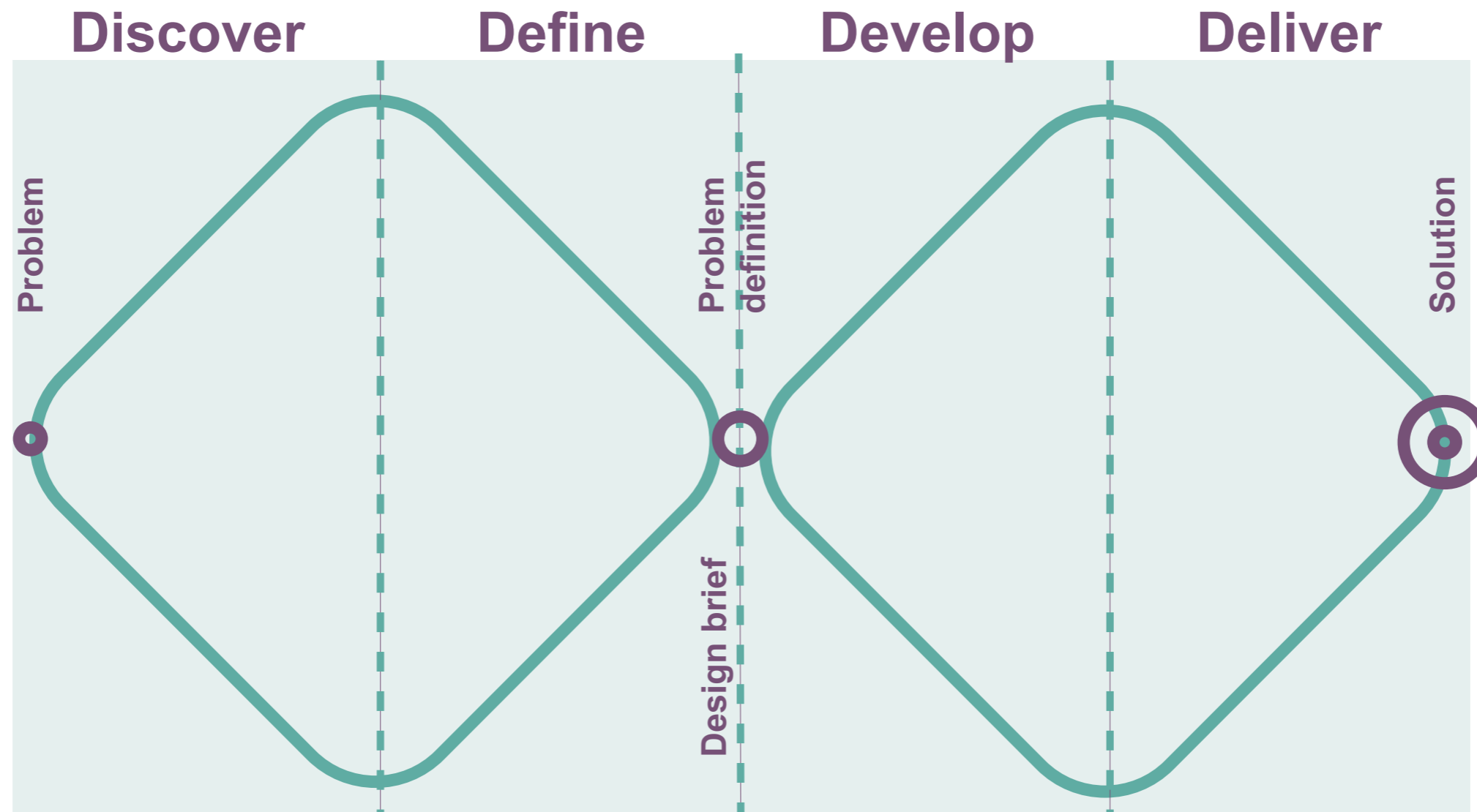
Dalcasio Reis has said that we have new kinds of consumers, who are interested in details. The details relate to factors like how much energy the product consumes, how much waste it generates, and finally how long it will last and how the product is manufactured. (Reis & Wiedemann, 12)

”Recycle-ability in the end product is hugely important otherwise the circle of hypocrisy continues each time we paddle out on boards that will never biodegrade” (Bryson Roberson)

Imagine Surfboards -company began to conduct a research into a better and clea-

ner way to make surfboards, after the founder Corran Addisons' long time friend Frankie Hubbard died from lung cancer as a result of prolonged exposure to fiberglass dust and polyester resin. (Search Magazine).

1.3 Methodological Approach



The Design Council has presented the design process in four phases - Double Diamond shape. I used this method in my studies.

Discover – The first quarter of the Double Diamond model covers the start of the project. Designers try to look at the world in a fresh way, notice new things and gather insights.

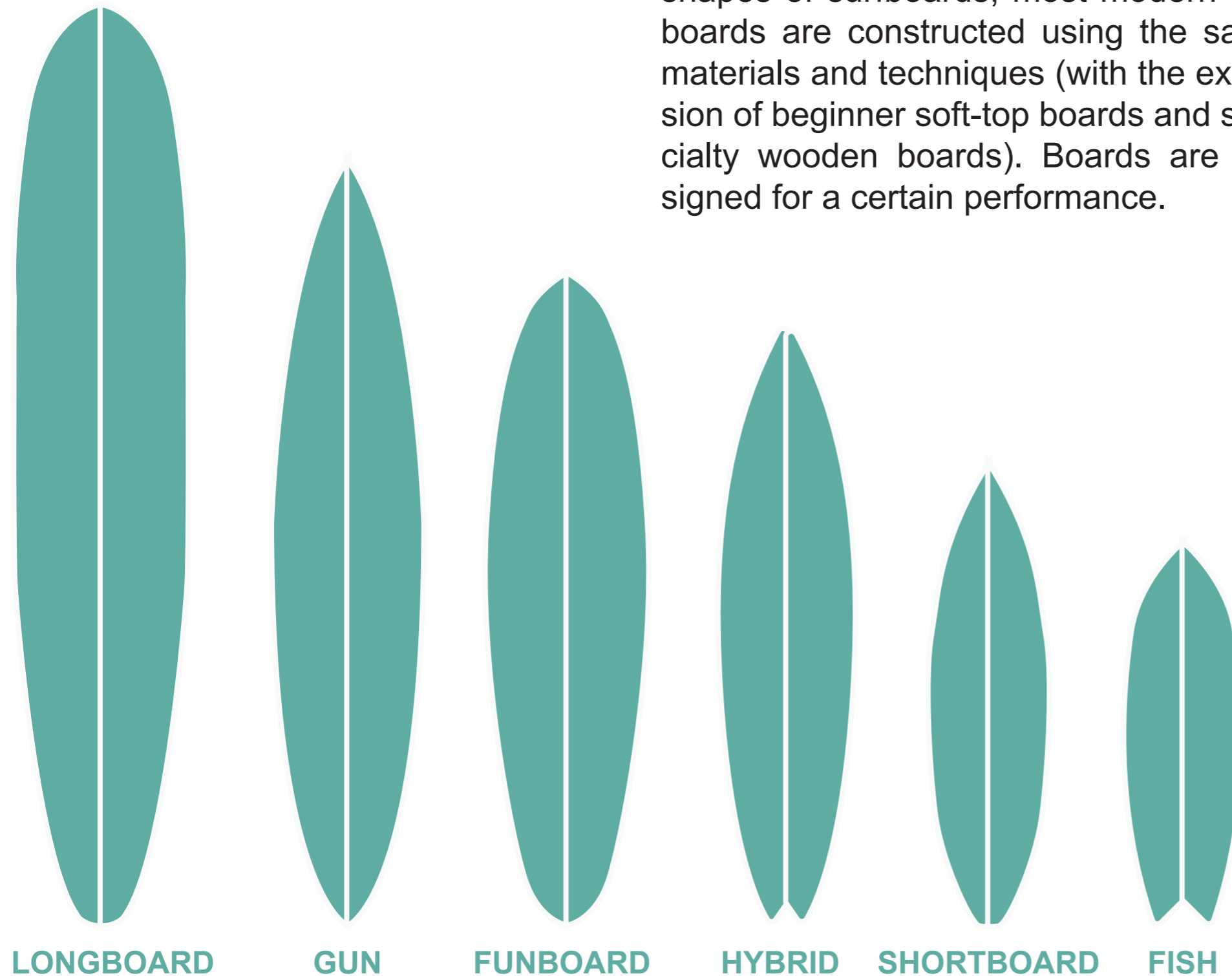
Define – The second quarter represents the definition stage, in which designers try to make sense of all the possibilities identified in the Discover phase.

Develop – The third quarter marks a period of development where solutions or concepts are created, prototyped, tested and iterated.

This process of trial and error helps designers to improve and refine their ideas.

Delivery – The final quarter of the double diamond model is the delivery stage, where the resulting project is finalized, produced and launched.

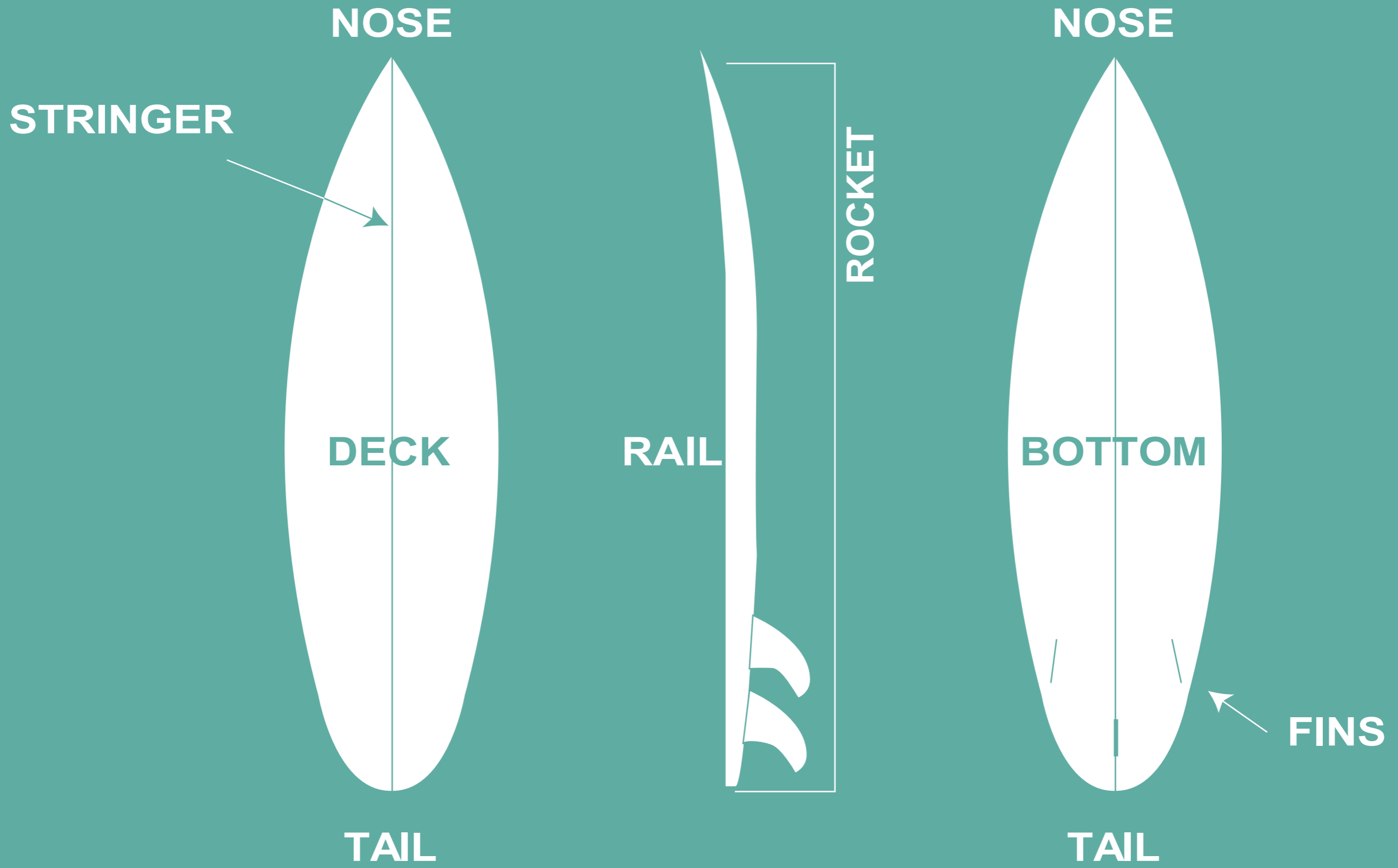
1.4 Surfboards



Although there are unlimited sizes and shapes of surfboards, most modern surfboards are constructed using the same materials and techniques (with the exclusion of beginner soft-top boards and specialty wooden boards). Boards are designed for a certain performance.

The typical modern surfboard is made using polyurethane foam and polyester resin. The manufacturing process in different shapes of boards is basically the same. Therefore the lifecycle of the board is the same.

My client mostly manufactures shortboards, and I'm focusing in my thesis on finding an alternative manufacturing method for their polyurethane boards. My conclusions in this thesis can be adapted to other board types as well.



1.5 Market Analysis

According to Global Surfing Market report, the surf industry is growing. The more surfers there are, the more products are sold. The surfers are aware of the markets and are willing to purchase products online, to get what they want. Still biggest part of the industry is in USA (49% of the markets).

The interest towards surfing is also growing. It's because of attitudes and there's more options available (More surf camps -> more surf travels -> more interest). Surfing is also becoming more popular within woman. This may be due to that it's been coming a fitness trend and the spa's are advertising it as a fitness ritual. Surfing its included in the 2020 Olympic Games to be held in Japan and the sport is getting more followers.

New technologies enables new kinds of ways to engage in the sport. Companies are building artificial waves and wave parks. After these kinds of inventions,

35 million surfers



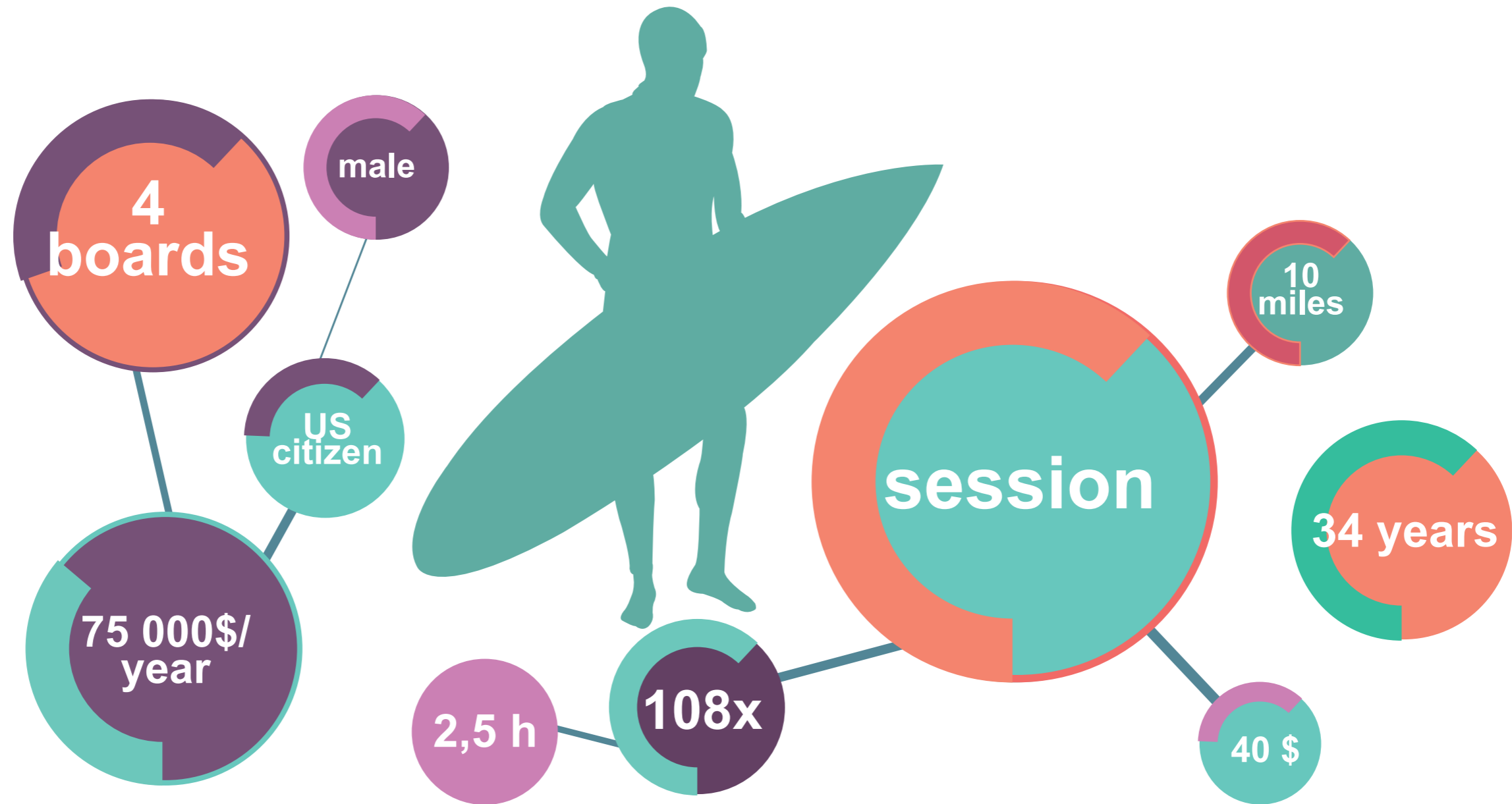
60% casual 40% core

the surfers are no longer dependent on the natural waves.

According to the Global Industry Analysis Inc. report the major share of the surf industry growth will be in the US and Europe. Also the market for the surfing apparel in Europe is expected to surge at a compound annual growth rate of 5%.

The more the industry is growing, the more boards are made and the impact for the environment is growing all the time. When the industry is growing, more companies come into the market and open their new factories. By finding an alternative method to make boards would help also the future companies to invest on environmentally more sustainable processes.

1.6 The Target Group



The Surfrider Foundation conducted a study 2011 of over 5000 U.S. surfers. In that study they defined an average surfer. It is based only on U.S. surfers, but since the U.S. covers half of the market, it can be used as an average.

The average surfer is not the typical customer for companies. Behind the surfer look, there normally is a lifestyle and an ideology which reflects to all of the decisions they make. They are a target group who really knows what they are buying and they are thus willing to make an effort

to have what they want. The users are quality-conscious and are willing to pay little bit more for a product which is environmentally friendly.

1.7 The Life Cycle Of A Board

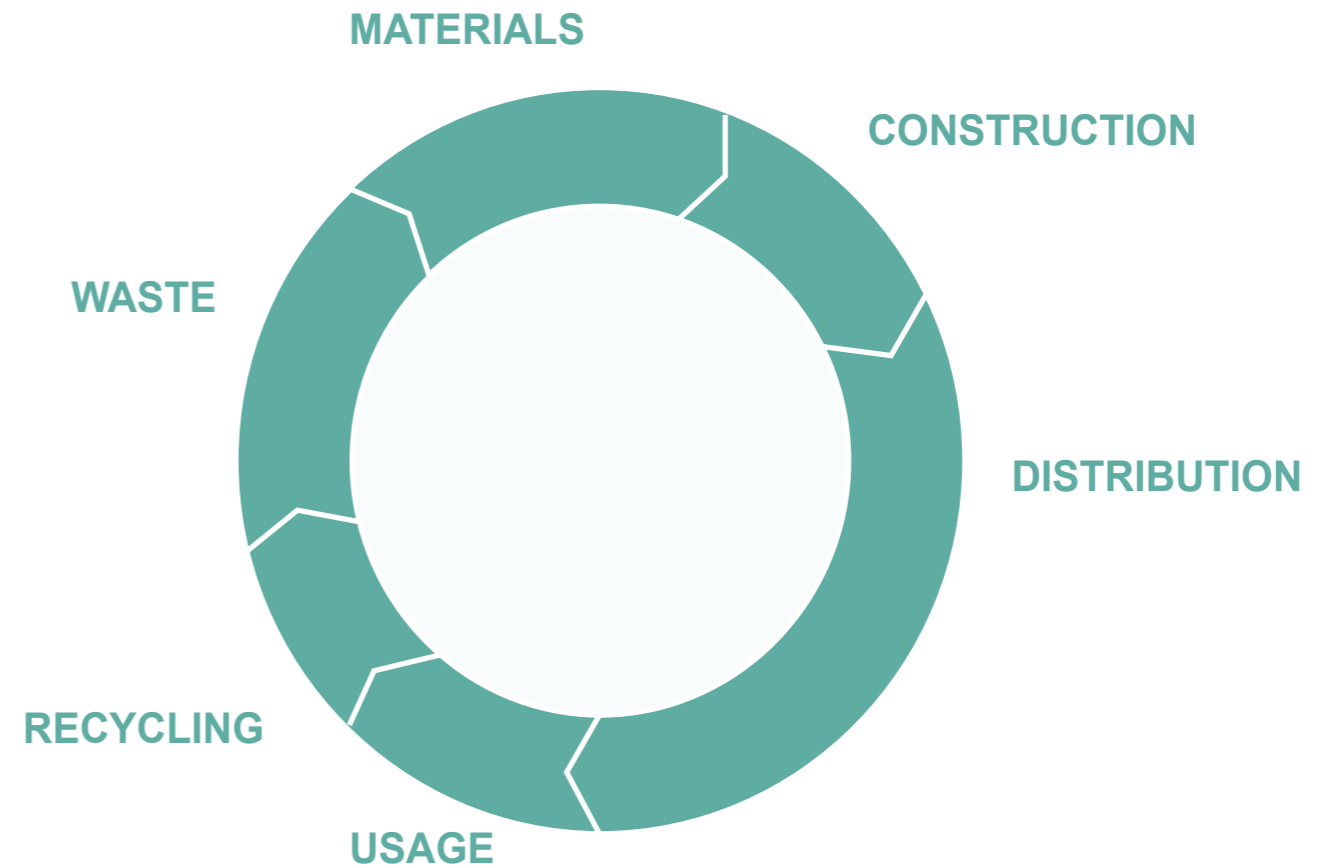
The process of generating, using, and maintaining a surfboard is very energy intensive. Essentially, petroleum is at the base of every material that is used in creating a surfboard.

The average customer uses their board for 2 years, the professional surfer only for 3-6 months. Only 10% of the surfers bring their board to be fixed. The boards are strong normally only professional surfers broke their boards.

Birra told that when a surfer buys a new board, the 'recycling' goes hand and to hand.

"Board doesn't disappear. They give away, sell or put those into their garage."

The shipping and packing process of heavy and bulky petroleum materials deepens the cycle of using non-renewable materials in surfboard production.



	MATERIALS	CONSTRUCTION	DISTRIBUTION	USAGE	WASTE
MATERIALS	PU, wood, fiberglass, resin	Sandpaper, masks, gloves, paintbrushes, stirring sticks, tape	Packaging material	Wax, repairing (fiberglass, resin)	
ENERGY	Mechanical, chemical and thermal	Electricity	Transportation vehicle gasoline	Transportation vehicle gasoline (aeroplanes)	
WASTE	Gas from burning fossil fuels, accidental petroleum spills	Electricity, dust, PU, fiberglass and resin	Gas from burning fossil fuels, accidental petroleum spills	Pieces of board can chip into ocean while broken	Landfills

”A classic surfboard is made of materials that have traveled 9000km before being assembled” NOTOX Surfboards

Some consumers buy their surfboards directly from these local shapers, and typically pick up the board in their vehicle, cutting down on packaging materials and transportation materials between the manufacturer and the consumer.

Using local shapers and local materials would make the lifecycle more sustainable. At this moment most of the shapers order their blanks from overseas.

When you talk about making a surfboard more sustainable you have to remember the whole life cycle. Importing chemicals is dirty. Most of the companies (80%) import blanks from overseas. Transporting the materials is worse for the environment than the materials used.

“You should support locals when buying resin, blanks, and woods. That’s one way of making a surfboard more sustainable. This is one of the main motives why I started to make my own blanks. If you ask me why I don’t sell

my blanks to all around Portugal...the reason is that my blanks are more ecological so they start yellowing after 3 months and companies want their blanks to stay white as long as possible.” Birra

The carbon footprint of surfing does not only include the board manufacturing. A major part of the footprint is accumulated when the surfers travel overseas to find waves. The Airlines charge hundreds of euros per surfboard, per flight. In addition, they generally break the surfboards in the cargo holds. As a result, most surfers choose to fly without a board, and buy one at the destination, which they dispose of before returning home. Imagine Surfboards tried to solve this problem by creating a surf board that splits into 2 or three pieces, that fits into a “standard size” protective case, and can be checked into flights as regular baggage for no extra cost.



2. Materials & Methods

2.1 Manufacturing Process

The typical surfboard has a rigid polyurethane foam core with an outer shell of fiberglass cloth and polyester resins. A stringer is added into the middle of the surfboard to give more strength.

The process is mostly carried out by using environmentally harmful products. During the manufacturing, the workers are surrounded by dust and toxics. A lot of materials are wasted and those are un-recyclable.

The Homeblown factory orders materials from big chemical companies overseas. Companies are located in Germany, Holland, Spain, Sweden and USA. There are not many companies to choose from. Those big companies are controlling the chemical industry. They rule the world according to Birra.

50% of a board is loss during the process. The biggest percentage of the loss comes from foam dust. The other part of loss con-

sist of resin drops, dust and fiberglass. The fiber glass rest over can be used for repairing old boards.

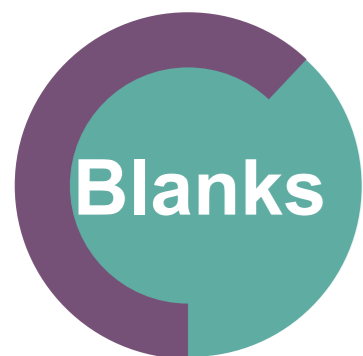
The factory has ordered a company to start recycling the rest over materials and chemicals. That makes the process less harmful for the workers and the waste is recycled properly. Each month the recycling company comes to pick the rest over material. The factory also got a machine that cleans the painting instruments and recycles the rest over paint and acetone.



”Being a board generated purely from petroleum, the current process for creating surfboards is not sustainable.” Paik

Manufacturing Process





BLANKS

Blanks are made normally of polyurethane foam or expanded polystyrene (EPS) foam by inception and moulding. PU foam is becoming more usual because it is much easier to shape and more constant to work with. Although EPS foam is much lighter than PU and the performance of the board is why it is different. The Factory uses PU foam for blanks.

Polyurethane

Polyurethanes are thermoset polymers formed from di-isocyanates and polyfunctional compounds containing numerous hydroxy-groups. The major use of polyurethanes is a rigid or flexible foams. (Nicholson, 19)

The factory has developed a foam system that is based on MDI (methylene di-phenyl di-isocyanate) rather than TDI (toluene di-isocyanate). This decision was based

on the world's increasing concern regarding both the short and long term health hazards of isocyanates in general, and TDI in particular.

MDI is by far the least hazardous of the commonly available isocyanates, since its vapour pressure (which is an indication of how easily it evaporates) is some 2500 times less than that of TDI at ambient temperatures. This fact makes handling, storage and utilisation of the chemical much safer and thereby much easier especially regarding unforeseen occurrences, such as accidental spillages. (Homeblown)

Polystyrene

Polystyrene (PS) foam is a lighter alternative to traditional Polyurethane foam. However, it takes about two to four times the labor to shape.

Expanded, or beaded, foam (EPS/Styrofoam) is a relatively inexpensive and inc-

redibly lightweight surfboard core. However, very few hand shapers use EPS foam, because it is difficult to work with. Surfboards made from EPS foam are typically molded by machines. EPS also has an open cell foam, meaning that is very water absorbent. To combat this issue, shapers who use EPS foam must add extra layers of fiberglass and epoxy resin to prevent any dings from penetrating deep enough to reach the foam. (Surfscience)

The blank comprises ~26% of the carbon footprint of a surfboard. Moreover, ~96% of the impact of foam comes from the raw materials extraction and processing. Therefore, the best way to reduce the impact of the blank comes from using recycled content. (Sustainable Surf). When asked from Birra what he thinks is the most difficult part of the process to change more sustainable he said 'Blanks, no doubt'.

Blanks

Adding
stringer

CNC

Shaping

Glasing

STRINGER

The stringer serves to increase the board's overall strength and reduce its flexibility. Some boards have multiple stringers.

Stringers are made of plywood. Plywood is glued directional because they have to be resistant and flexible. Stringer is glued with polyurethane glue in middle of a half cutter blank



Blanks

Adding stringer

CNC

Shaping

Glasing

SHAPING

After the stringer has been glued, the polyurethane blank is cut into a raw shape by using CNC machine. After that the shaper shapes the board with sandpapers to its final shape.

Changing design will effect the performance of a surfboard.

Shaping produces dust and waste that is harmful for the workers.



Blanks

Adding
stringer

CNC

Shaping

Glasing

FINISHING

The most common types of resin are Polyester and Epoxy. Most surfboards use polyester resin because it is very easy to work with and has been the industry standard since the 1960's. A small percentage of surfboards use epoxy resins. Epoxy resins are technically superior to polyester resins because they are stronger, more durable, and have significantly less toxic emissions. However polyester resin remains the industry standard because it is very inexpensive and builders are extremely familiar with using it. (Sustainable Surf).

When resin is painted on over fiberglass, it creates a watertight and pressure resistant seal that protects the board.

Fiberglass

The vast majority of surfboards use fiberglass cloth impregnated with resin to create the hard shell of the board. Fiberglass is made from silicon dioxide, otherwise known as glass, and processed at high temperatures. Cheaper and more flexible than carbon fiber, it is stronger than many metals by weight, and can be molded into complex shapes.

Epoxy resins

Epoxy resin systems comprise two parts; one incorporates the three membered epoxy ring and the other is a hardener which cross-links with the epoxy. The resin component is produced as a result of a condensation polymerization reaction between epichlorohydrin and a polyhedric compound such as bisphenol A. (Simpson, 309)



Blanks

Adding
stringer

CNC

Shaping

Glasing

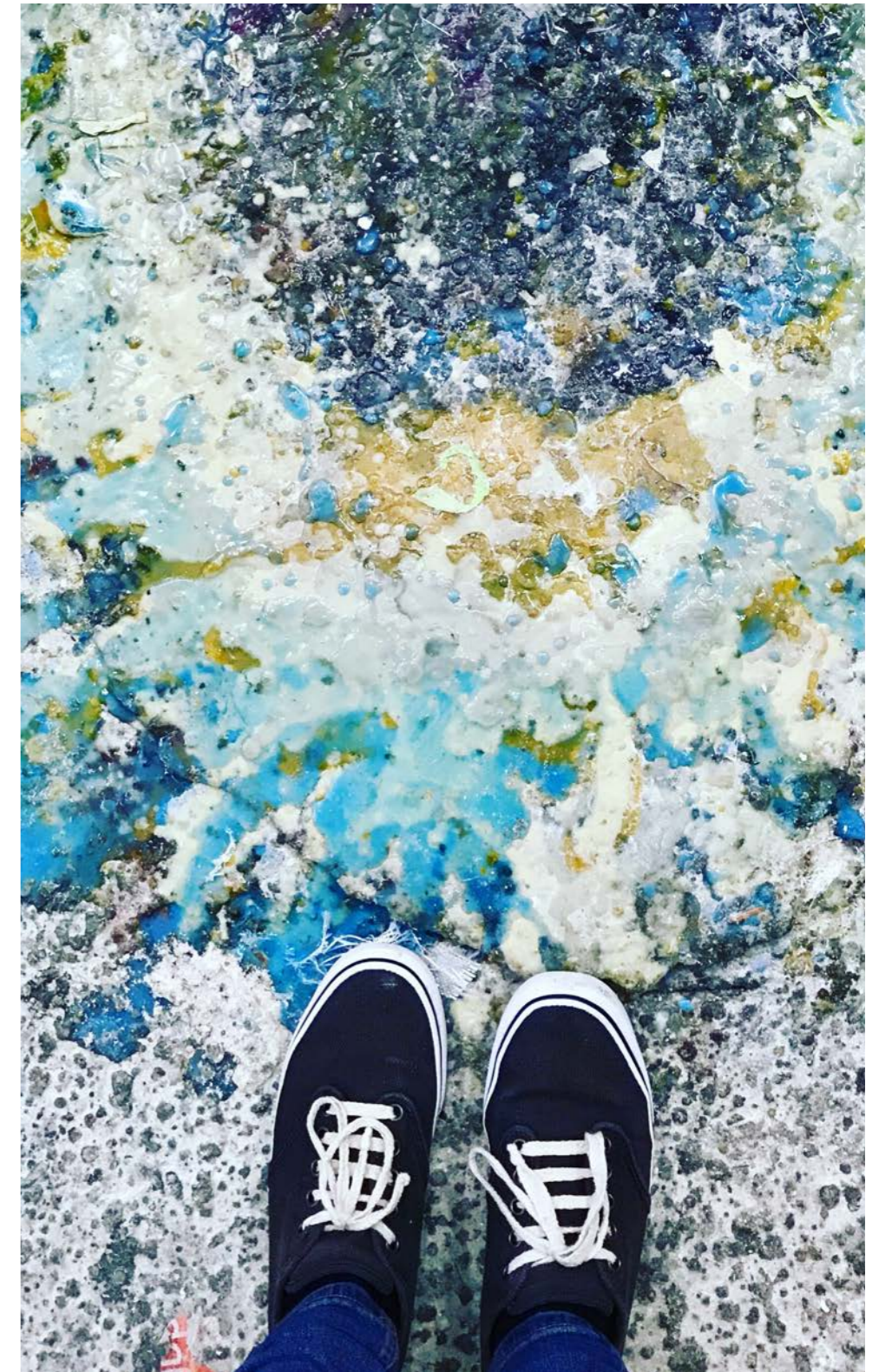
Epoxy resins are high resistant for temperatures, good structural strength and hardness. Epoxy has tendency to discolour.

Epoxy resin emits up to 50% fewer VOC than polystyrene resin. It is also stronger, which combined with a compression molding process allows us to make the boards which are either lighter, or stronger for the same weight as traditional surfboards. (Imagine surf)

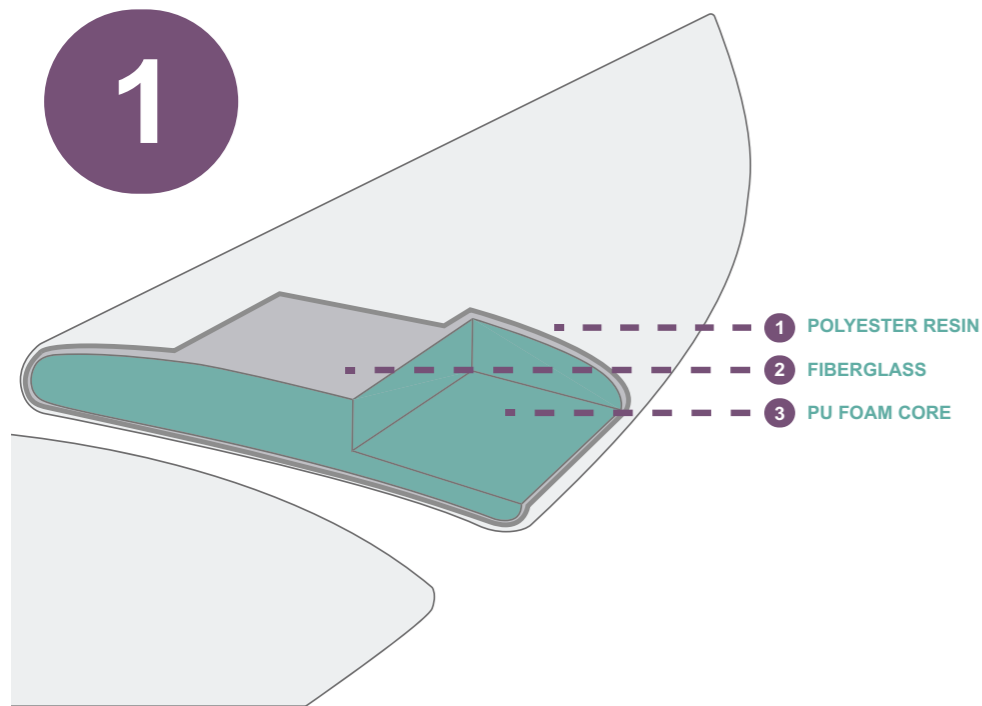
Polyester resins

Polyester resins are unsaturated synthetic resins formed by the reaction of dibasic organic acids and polyhydric alcohols. (Wikipedia).

Polyester resins are used because they are low cost, those have adequate resistance to water, variety of chemicals and weathering and ageing.



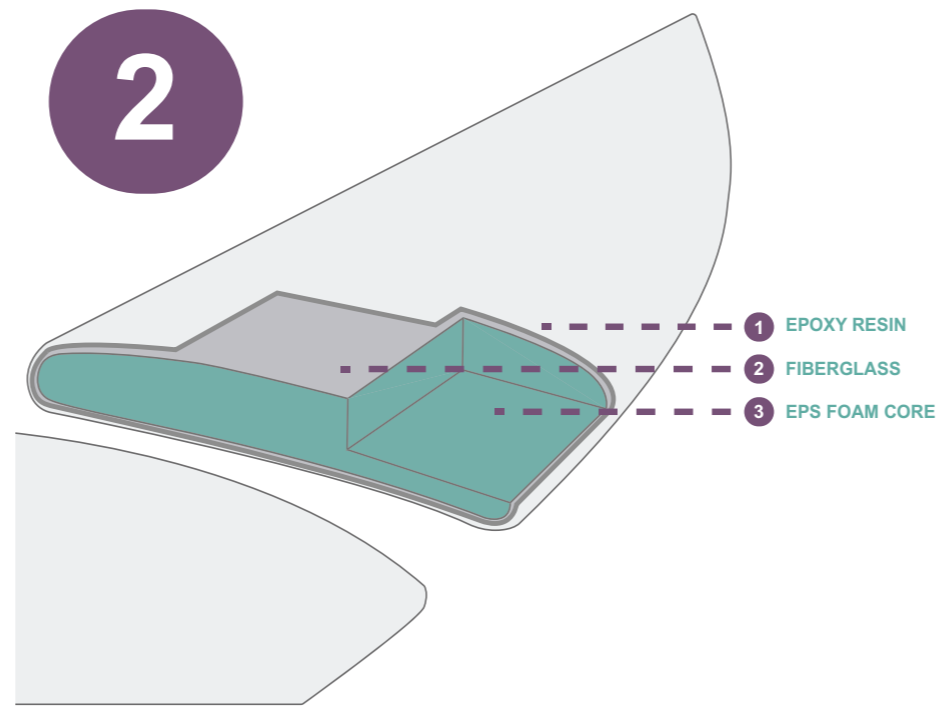
2.2 Traditional Board Structures



There are three different typical ways to build a surfboard. Two first methods are used normally in smaller factories around the world, the third one in big factories/series production.

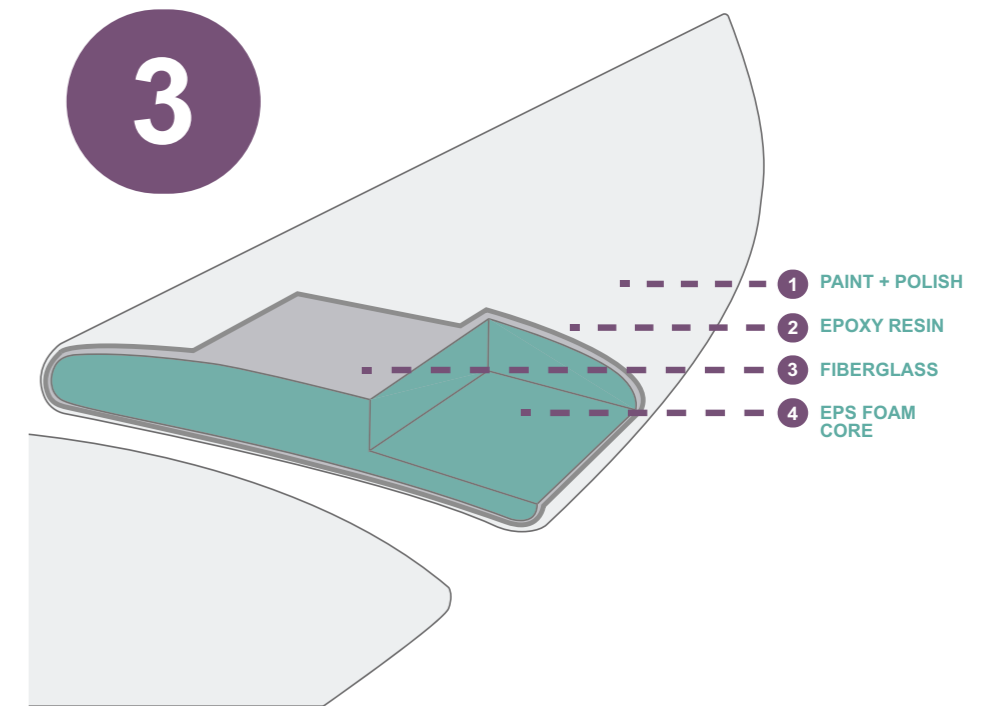
First traditional surfboard structure is made with polyurethane foam core and finished with polyester resin and fiberglass. This method is typical in custom boards.

Second traditional surfboard structure is made with EPS foam core and finished



with epoxy resin and fiberglass. This method is also typical in custom boards.

Third traditional surfboard structure is made with EPS foam core and finished with epoxy resin and fiberglass. The board is painted and polished after glazing. Method differs from the second structure because the finishing is made using vacuum method. Also the core is normally with low density and the quality is lower than in the first two methods.



This method is used by big mass series production factories in China. These boards are typically the cheaper ones. Brands like NSP and Torq use this method.

2.3 Polymers And The Environment

Pollution is defined as the introduction by man into the environment of substances liable to cause hazards to human health, harm living resources and ecological systems, damage structure or amenity, or interfere with legitimate use of the environment. This all-embracing definition includes the impact of polymers on the environment, both in the original form as raw materials and in their finished form. (Nicholson, 173)

According to the life cycle analysis conducted by California-based non-profit group Sustainable Surf, a typical 6'0" short board, weighing approximately 2.5 kilograms emits over 270 kilograms of CO₂ during its lifecycle, spanning from manufacturing to disposal. (Mellis, Charlotte. 05/2016)

Recovery and reuse of synthetic polymers are the most acceptable way of handling the waste. Polymers can be recycled without significant loss of their properties.

One way is also to develop polymers that are biodegradable. Both the chemical structure and composition that determine whether the synthetic polymers are biodegradable. Problems for the environment are not only technical, they are also political and economical.

The polymers produces harmful VOC's (Volatile organic compounds) that are organic chemicals that have a high vapor pressure at an ordinary room temperature. Respiratory, allergic, or immune effects in infants or children are associated with the man-made VOCs and other indoor or outdoor air pollutants.

There are mainly three types of disposal technology, namely landfill, incineration and recycling in the world. Polyurethanes are flammable and they burn with toxic flame, so incineration is not the best alternative.



(PIC 1)

2.4 Developing The Industry

Manufacturers are currently focusing on the development of innovative materials and technical fabrics to design trendy and high-performing surf wear.

Innovations have already been made into the board design: for example, high-performance carbon fiber based boards. Eco-friendly surfboard materials and production techniques are becoming more usual.

A huge trend occurring that in the surf industry is the uptake of sustainable textiles and materials. A handful of leading companies has taken the leap of faith towards sustainability and beginning experimenting with innovative fabrics. Very rapidly, sustainability is becoming a norm in the surf industry. (Mellis, Charlotte. 2016)

The average surfer is ecological and interested in environment so there's already a need for eco-friendly products. Markets are nowadays global, so products can be

purchased overseas via the web shops. This opens the doors for finding right kind of customers.

Birra does not think the industry is going to change a lot. Market is growing, there are more brands coming to the market, it will be a war between prizes. Companies cannot make too many modifications to the construction because the end prize matters. He does not think people have money to spend for innovating new materials.

”Surfboards have been sold for the same prize as they were 20years ago. At the same time prices for the materials has been rising because the price for petrol has gone up. Each time there's more people making surfboards, more people try to survive. Average price for a surfboard is 400 euros in Portugal, 550 euros in the world. Because of the competition, companies cant raise the prices.”

Birra explained that there are two ways for a company to grow prices. You need to have 20 years experience or international sponsoring rider riding your board and winning prizes. Normal marketing does not work in the surf industry. Maybe theres is a percentage that would buy more expensive ecological board. But it may not be enough.

The industry is undeniably growing, now-one can deny it. Birra believes surf is going to be in top 3 sports in the world in 10 years. The market is also going to change around it at the same time to more aware of the environment.

In the past there have been attempts to produce more ecological boards but most of the attempts have failed because the boards did not perform well and looked bad because of the colour.

The challenge is to create an ecological surfboard that looks and feels exactly the

same as what the customers are familiar with. To achieve this, the board needs to accomplish the following in descending order of importance:

- 1. Provide at least the same level of performance as traditional boards**
- 2. Look like a traditional board**
- 3. Be made from recycled or sustainable materials wherever possible**
- 4. Last longer and need to be replaced less often**
- 5. Getting rid of the loss material**

By getting rid of the loss materials, the factory would also save money as well. The process should be carried out more efficiently. This could help to cut the production costs also and the end prize should not have to grow that much.

There has to appear new solutions of raw materials if we want to make the industry more sustainable.

”There could be chemical revolution, like PU but using different material than petrol as a base. And the material should be white. It’s little difficult to make the industry more sustainable because everything we use is based on petrol. Or you go back to making surfboards with wood.” Birra

2.5 Methods

My research is based on inclusive observation, that I executed in the factory, as well as benchmarking, interviews and research (literature, reports, articles and statistics).

I conducted the background research by inclusive observation in the factory. I became familiar with the process and the materials. I conducted research of the surf industry and the market overall. Thus, I created a solid base for my research.

The next step was to discover the industry and other industries, which have changed their practices by making the process more sustainable, by benchmarking.

After the benchmarking I conducted deeper research on the data and defined the materials and optional materials that could be used. (See results chapter).

After gathering sufficient amount of information, I started to analyse the data and

tried to develop the most suitable materials and processes for the industry.

In the "Solutions" chapter I present (delivered) three different concepts and alternative manufacturing methods.

In the final chapter I summarise my thoughts and draw conclusions.

‘Design is what links creativity and innovation. It shapes ideas to become practical and attractive propositions for users or customers. Design may be described as creativity deployed to a specific end.’ The Cox Review

As the name 'New wave of the sustainable surf industry' tells, I'm trying to find a way to make the industry more greener. I'm narrowing my thesis to the factory's process and finding an alternative solution to make surfboards which are nowadays made using polyurethane core. My focus will be in the core of the board and

the process around it because alternative finishing methods has already been tested more.

How to make a surfboard by using sustainable materials in an effective way, to minimise the ecological footprint?

This research question includes all the five requirements mentioned in the previous chapter.

2.6 Benchmarking

I gathered some examples of companies which are working in sustainable way in the surf industry and also couple companies in different industries which has changed their processes into more sustainable.

Sustainable surf - ecoboard

Sustainable Surf is a California-based non-profit charity organisation. Their mission is to be the catalyst that transforms surf culture into a powerful force for protecting the ocean playground.

They make their foam blanks from at least 25% recycled foam or at least 25% biological content. An alternative blank structure is made from majority content (75%) renewable materials such as wood, bamboo, or similar types of structural bio-content. They use for finishing a resin that is made from at least 25% biological content.



Vissla

Vissla is a California based surf brand. They strive to minimise their environmental impact and protect the oceans and waves that raised us.

Vissla has EcoSeas wetsuits which includes a water-repellant body lining made from recycled bottles.

Vissla is also partner with the Surfrider Foundation in conjunction with the Surf Industry Coastal Defender Program. Vissla is willing to find a way to make ecological surfboards in the future and they annually have Upcycle contest where competitors

Moss research surfboards

Moss Research Surfboards is a grassroots organisation with global reach, committed to producing the highest quality products, whose mission is to minimise our environmental impact by innovating and implementing the most sustainable practices possible.

Moss Eco-Flex® received 2010 a Gold Level Endorsement of Sustainability, it set a benchmark for the surfboard industry. They use recycled Foam Core and Zero VOC Plant-Based Epoxy. They also use natural fiber reinforcements, bamboo and repurposed fins. They say that their complete Eco-Flex construction process produces 90% less VOC's. According to the company, their boards are approximately 70% plant-based and recycled waste-stream materials.

50-100% recycled foam core -reconstituted industrial waste and packing scraps.

EPS foam is blown with steam using no MDI or TDI (diisocyanates). The process produces no CFC's and 80% less VOC's. (Moss Research).

Earth technologies

Earth Technologies is an award winning environmentally friendly high performance surfboard and stand up paddle board factory. They use Super Sap bio epoxies for finishing. Blanks are made out of recycled foam. Sustainably harvested veneers, organic plant based cloths, and a volcanic rock based composite are some of the key ingredients going into their green boards. Earth Technologies has a campaign "Switch To Zero Waste".

There is companies that provide eco-friendly sustainable composite materials, such as Sustainable Composites Ltd. They have also build a 'eco-board' a balsa cored, hemp coated surfboard for the Eden Project. (Sustainable Composites Ltd.)



(PIC: 3)

Richpeoplethings

Richpeoplethings is a Spanish factory who are creating new and environmentally friendly ways for their manufacturing processes. They want to make a call to all the companies and establishments that use this raw material on a daily basis, so that instead of being wasted they are sent to arrive or they themselves go to collect them periodically.

For this reason, Richpeoplethings is creating a network of collaborators "Corkllectors" throughout the Spanish territory for this purpose.

The objective of this social enterprise is to contribute to the revaluation of cork as a noble raw material, participating in the beginning of an ecological movement that aims to sow and distribute solidarity among the most needy.

Imagine Surfboards

Imagine Surfboards is one of the trend-setters when talking about ecological surfboards. Like mentioned earlier in the introduction chapter, they started to develop more sustainable ways to build boards, after their friend died because of polymers. Nowadays, they build surfboards from wood composite.

Patagonia

Patagonia is an American clothing company that sells outdoor clothing marketed as sustainable. They are auditing their materials and methods to make their products, taking responsibility for the entire lifecycle of their products and examining how they use resources in their buildings and facilities.

Patagonia's 'green' wetsuits use renewable natural rubber from hevea trees grown



(PIC:4)

in compliance with Forest Stewardship Council standards. According to Patagonia, the breakthrough material creates 80% fewer CO2 emissions than neoprene, the oil-based synthetic rubber used in most conventional wetsuits.

California's Surf Organic Boards

Surf Organic boards use a technology developed by Ecovative Design called Mycofoam (see chapter 3.1). They make their boards out of mushrooms.

Organic Dynamic

Organic Dynamic is Wellington based surfboard company that make custom surfboards for local surfers from locally sourced, environmentally friendly materials.

They use 100% recyclable polystyrene. They take all the offcuts and make them densit blocks that they cut on a CNC

machine They use Entropy Bio-resin, which is made by using green chemistry techniques and has less than half the environmental impact of other epoxies.

Nike

Once Nike was the company targeted by labor activists, campus organisers and anti-globalization forces for allowing its suppliers in poor countries to abuse and exploit workers. Nowadays Nike is a corporate-sustainability leader.

In their website they say that they are *"pushing the limits of sustainable performance innovation"*.

Hurley is part of the Nike company, so hopefully in the future they will start investing more in the sustainable development. Hurley is a big brand in the surf industry, making wetsuits and apparels.

Kimberly Clark

Kimberly Clark, a company that makes Kleenex, Scott tissues, Huggies and Pull-Ups, is a good example of a company that also changed their production methods because of activists. The company was accused of destroying ancient forests for throwaway products.

The company was already moving towards sourcing more recycled and certified fiber before the activists came along, but the campaign really did accelerate their work and our progress.

Greenpeace, says the company's actions have had a ripple effect on other companies in the tissue-product sector.

3. Results

3.1 Alternative Materials - Blanks

1. Recycling old blanks

California based start-up company, called Green Foam Blanks, collects polyurethane cuttings from surfboard factories and uses a proprietary process, mixing the trimmings with virgin foam to create a blank that is 60 to 65 percent recycled waste. (Woody Todd, 2009)

”Recycling EPS Foam can be a solution and a method to make a surfboard but a lot of tests regarding it still have to be proven. And taking care when you work with EPS foam, you always have to glass it with epoxy resin. So that means that the construction cost will go up.” Birra

Earth Technologies does recycling of old foam in a different way: EPS is put into a mulching machine that breaks down the material to smaller pieces called “re-grind”. Loose re-grind pieces are conveyed into a holding bag and fed down

into a machine that compresses the re-grind into highly dense rectangular blocks (20pcf). The blocks of recycled EPS are then reprocessed into Envirofoam that is remanufactured into blanks on the same equipment that makes the Virgin EPS blanks. Envirofoam material can be recycled and reprocessed into a usable blank material over and over. (Earth Tech)

”Your next flatscreen T.V. will be packed with styrofoam which you can take to many drop off points and have that packaging sent to plants where they break down the styrofoam and repurpose it into massive foam blocks which can be cut into blanks that are just as good as “virgin” foam.” Boardcave.

The problem with this recycling method is that it does not work with PU, only with .EPS/styrofoam is said to be more environmentally sustainable than standard PU/PE board and it can be made from recycled material. Problem with EPS



foam is that you can not glass an EPS board with Polyester resin. EPS is also harder material to shape.

Birra said that he uses EPS blanks sometimes if the customer wants. He still prefers PU as a material because it is more flex, more dense, and materials are cheaper. With EPS you have to use epoxy resin. EPS also has a tendency to be dumped quicker. PU is stronger.

When asked why the PU blanks cannot be recycled as easily as EPS, Birra believes it is because the PU blank sucks the resin into it.

Imagine Surf makes their cores from 100% recycled polystyrene (EPS), which are extruded, not blown. They say that by extruding, the core is 100% waterproof. A damaged board will not absorb any water, therefore, making it last longer than either a traditional polyurethane or EPS core both of which absorb water to a greater

or lesser degree. The cores can be recycled again after the boards is no longer rideable.

”Water resistance is always a problem. Once a blank starts to suck water is like a sponge, it starts to rotten. Homeblown blanks are already waterproof. It doesn’t mean that it doesn’t suck water at all. It just sucks less water.” Birra



(PIC: 5)

2. Plant based materials added to polyurethane

Moss Eco-Flex surfboards uses 70% plant-based and recycled waste-stream materials.

Ice-Nine used to make blanks made out of sugar – sugar-based polyols, to create organic polyurethane. This invention wasn't good after all. Sugar as a material was difficult, when the product was in contact with water. Once the board is broken, it rots very quickly because the sugar sucks the water into the boards.

I asked from Birra what he thinks of plant based materials in PU blanks and he's thoughts were:

"It can work but it's not easy. It's basically just chemistry. It can affect into the structure but you can't know before testing. For example like We quit ma-

king Biofoam because nobody wanted a yellow blank, it was more expensive to make and amount of orders was small."

So the question with the plant based materials is that is the market ready for non-white boards? White board means in the industry a new board. Will the trend change in the future? Or alternatively, could there be a white plant based material available? So far I did not find answers to those questions. If the colour is the problem, the board could be painted, it just costs more.

"When you have a board that is brown, there's already a cost (painting in white) that you cannot control. It's just cheaper to make a white board, it needs less work so it's quicker to make." Birra



3. Natural materials

Wood?

Wood has been a principal material in the construction of surfboards since ancient Hawaiians started to shape wave-riding tools.

A wooden structure results an even lower environmental impact than from a recycled foam blank. However, the performance of the wooden board is different. Generally, a hollow wood surfboard is 30% to 300% heavier than a standard foam and resin surfboard. There are many companies making wooden boards, like for example, Imagine Surf. They build boards from custom wood composites.

”Only board what you can make 100% ecological is wooden one. Never say never but it’s unlikely that wooden boards will run the market, cause of the weight and the flexibly. It’s heavy, it’s

not white, doesn’t have same performance than PU and it’s more expensive.” Birra

Because of the performance, wood cannot be suggested as the answer to replace the average PU boards unless they invent a technique to build lighter wooden boards in the future.



(PIC: 7)

Cork?

Cork is the phellem layer of bark tissue that is harvested for commercial use primarily from oak trees. It is waterproof, buoyant, elastic, fire resistant and unique in its appearance. Because cork is harvested only from the bark of the cork oak tree (which means the tree keeps on living and helping to clean our air) it is one of the most highly renewable and eco-friendly resources on the planet. Cork it is both recyclable and biodegradable. This means that even during the manufacturing process, cork waste is reused and ground to make agglomerated cork products, never going to waste. Because of its flexibility, it can easily replace harmful and pollutant materials, like plastic. (Corcor).

Spanish company Richpeoplethings has started to build boards made 100% out of cork. They say cork is a good material because it's completely natural, recyclable and biodegradable, it does not absorb wa-

ter and, therefore, it does not rot, it resists and absorbs impacts thanks to the superb elasticity provided by the cell structure of the cork itself and the cork tree is one the trees with the biggest carbon dioxide absorption capacity.

Amorim Cork Composites is also developing cork surfboards for the Hawaiian surfer Garrett McNamara (see picture 8). This project was launched in 2013 with a view to designing high efficiency surfboards making use of Portuguese raw materials and technology, thus enabling Garrett McNamara to face the most extreme surfing conditions that exist in Nazaré.

The cork surfboards are developed using a stringer entirely made of cork to replace the traditional wood stringers. This, in addition to the flexibility that cork offers which translates into a board that feels light and responsive.

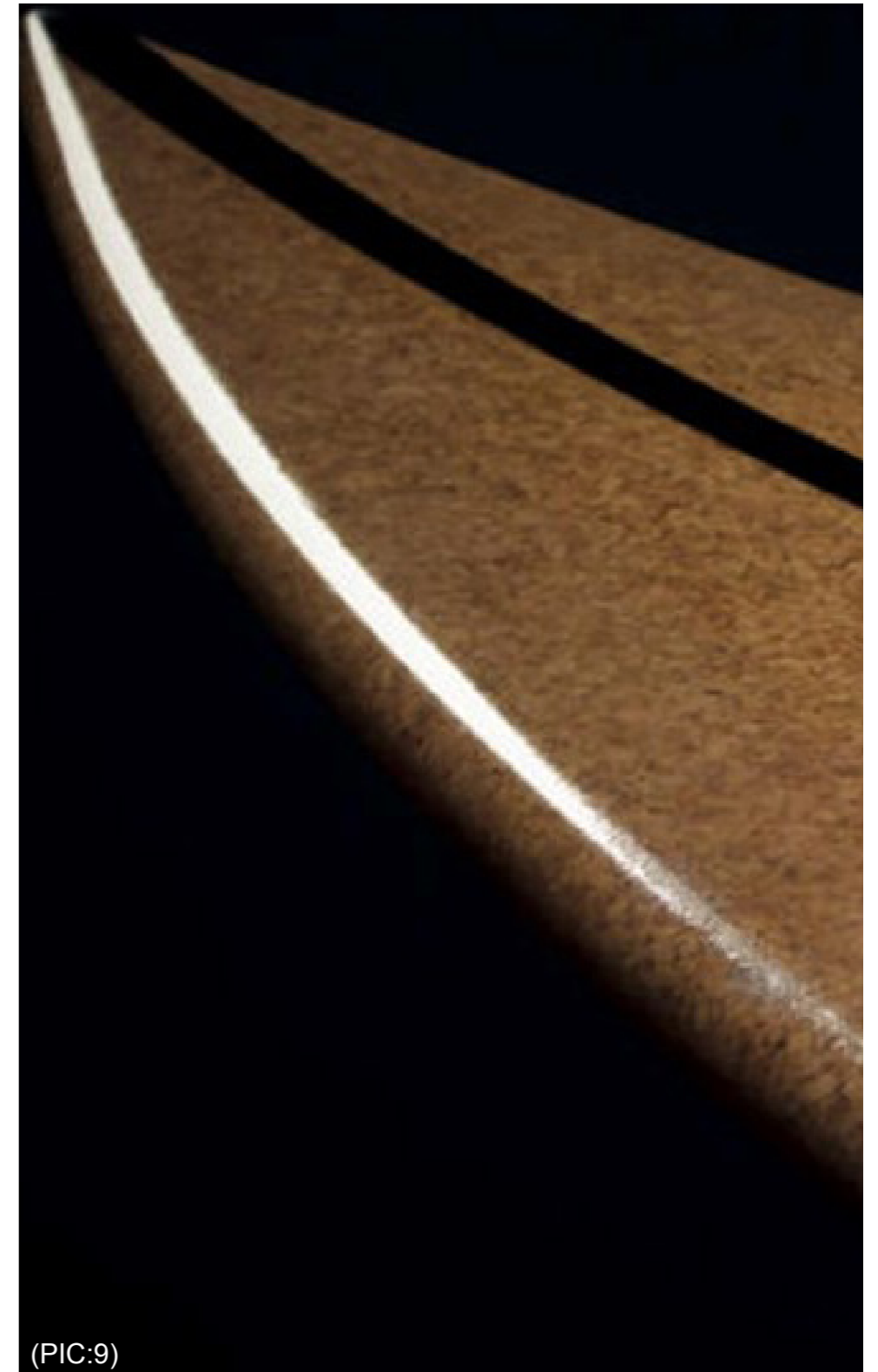


(PIC:8)

Sound too good to be true. Like the company's name 'Richpeoplethings' tells, it's expensive to build cork boards and it's hard to adapt to serial manufacturing.

Moreover, cork as a material is not easy to find. When thinking about sustainability, the material should be bought locally. Then biggest producer is Portugal so it could be a potential alternative material in southwestern Europe.

"It's more environmentally friendly, but very expensive material. And the performance is different. It could never be the same price as PU because you need a lot of work before you even have a blank." Birra



(PIC:9)

Mushrooms?

Ecovative developed its eco-friendly Mycelium material to replace all types of expanded foam plastics. Essentially a glue made from fungus roots, Mycelium to bind plant-based materials (usually crop waste like plant stalks and seed husks) into the finished product. They say it is very strong material that floats and repels water just as effectively as the foam plastics. They are currently “collaborating with the industry’s top surfboard manufacturers and shapers” to have their boards out there.

The process sounds to be simple, recycled material is put into a mould and leaved it to settle for 10 days in order to pull out a final product that is consistent and resistant. It is “foam” grown from agricultural waste that has been inoculated with mushroom mycelium. It can grow into nearly any shape rather easily, with minimum tools. The material is quite remarkable. It is being used in products all

over the world from computer packaging to insulation to bricks. What really makes it special is that it is biodegradable, sustainable, and 100% natural. (California’s Surf Organic Boards).

Surf Organic boards are already using this technology to make their boards out of mushrooms.

”Making mushroom boards can be a hobby but you can’t live with that. You could start making that but at the beginning it would be 10% of your business. Now-one wants to put all of their money into that risky thing. Maybe the hobby would be a main product in the future.” Birra



(PIC:10)

3.2 Alternative Materials - Finishing

Bio-based resin

Moss Eco-Flex surfboards uses plant-based resin, derived from waste stream resources such as pine sap and rapid-renewable plant oils (used in the bio fuel industry). (Moss Research)

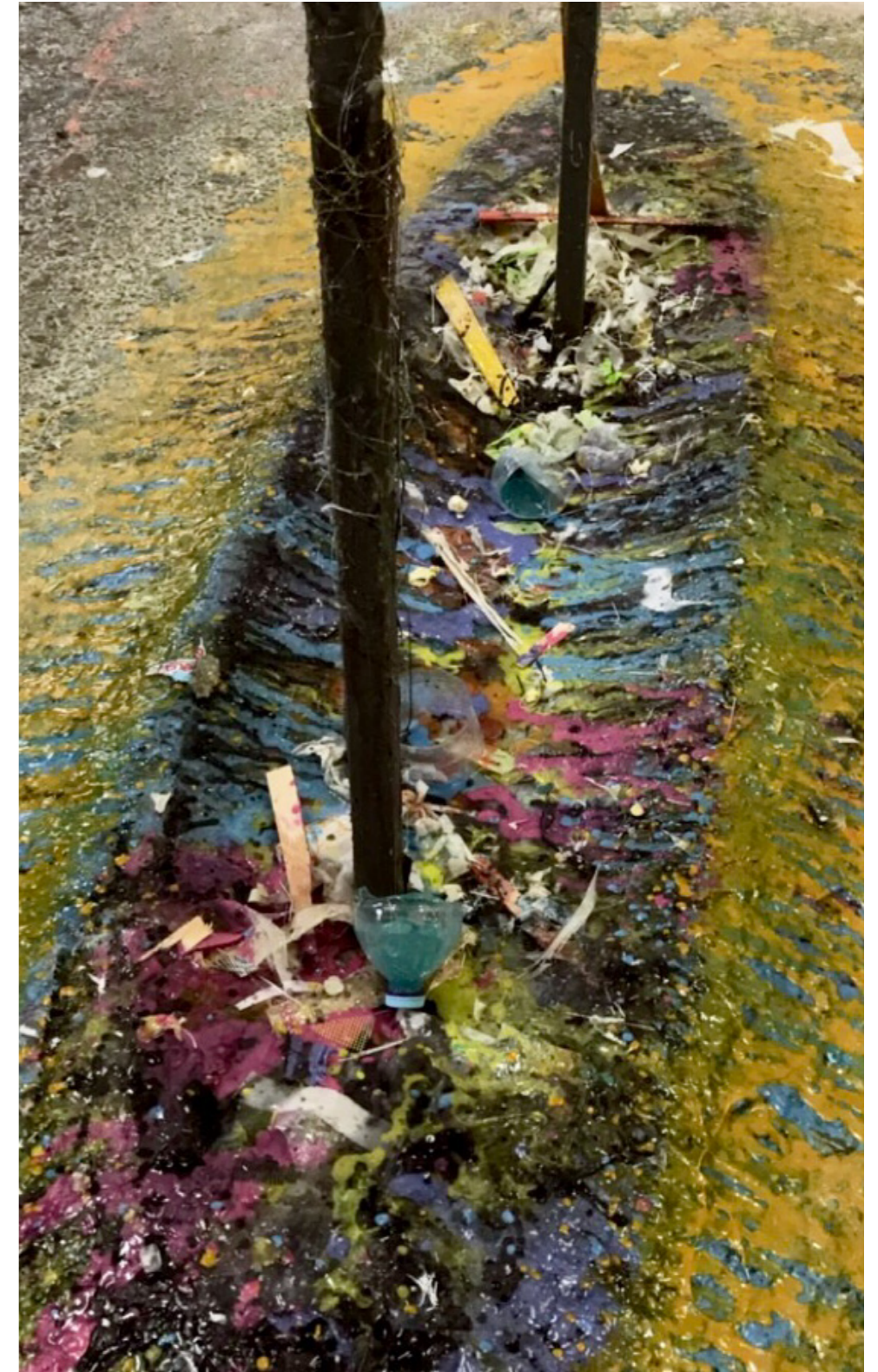
Super Sap made by Entropy Resin is an epoxy resin partially made from the waste byproducts of the pulp and paper industry and the biofuels industry, with total biological content varying between 25-50% depending on the specific resin used.

They replace petroleum based carbon with renewable plant-based carbon. The raw materials going into our resins are co-products or waste products of other industrially important processes. Bio-resin epoxy resin performs essentially the same as pure petroleum-based epoxy resins. Lifecycle Analysis on Super Sap shows at least a 50% reduction in CO2 emissions compared to normal resins. (Entropy Resins)

When talking about bio based resin, we have to remember that it is never 100% ecological because it's based on petrol.

"We have tested ecological Epoxy resin and it wasn't bad. Problem was the price. If it would be cheaper we would use it for some boards. Polyester is always different and can't be replaced. We use polyester resin more because it dries faster." Birra

According to Imagine Surf, bio-based resins are not as strong, and are not clear as the epoxy, resulting in boards, which are no longer lasting and not completely clear (white).



Natural fibers

One study puts the CO2 impact of fiberglass at 5% of the total for a surfboard. Alternatives to fiberglass exist, such as woven bamboo cloth, hemp cloth, and bamboo veneer. These alternatives have varying impacts on performance, durability, and visual appearance. Because the overall CO2 footprint contribution of fiberglass is only 5%, alternatives to fiberglass are unlikely to result in any major environmental benefit through displacing fiberglass alone. (Sustainable Surf).

Natural fibers also have technical strengths, such as good vibration damping capability and low bulk density. There's for example white Biotex flax available, jute or hemp fibers.

"I have never tried alternatives for fiberglass but I know there's different materials available. Maybe the other fiber could be even better with the per-

formance but the problem is the colour." Birra

Imagine Surf says that they have tested several natural fibers and it has lead them to bamboo fibers. A bamboo plantation absorbs 5x more carbon dioxide and puts out 35% more oxygen than the equivalent plantation of trees. Bamboo is also one of nature's most resistant fibers, and we were able to weave these fibers together in such a way as to create a very active and responsive flex pattern in the surfboards. Bamboo fiber is also biodegradable and can be disposed of after the boards life is over.

A French surfboard company Notox uses flax fiber in their boards and they claim that the flax works better than fiberglass. They keep their boards brown and use the ecological look as their favour (Picture 10). Flax fiber can be bought also in white.



(PIC: 11)

3.3 Alternative Production Methods

When finding solutions to make the process more greener, we should also see how the process could be changed. With or without changing the materials used.

“Why did we start our design process with the object and not with looking at the system first?” Reis & Wiedemann

We can also focus on recycling part. The following question arose: how to get rid of the loss material? At this moment most of the loss material has been unrecyclable in the factory.

Reusing the loss material

Earth Technologies has a campaign “Switch To Zero Waste” and they are raising money via Kickstarter. Their goal is to become the world’s first Zero Waste Surfboard and SUP production facility. They want to incorporate a production waste breakdown system using an industrial shredder, particle reducer, and a vacuum in-

fusion system that will ensure that all of their trash will be upcycled in to useable product such as fins, bodysurfing handplanes, and other products.

They send their fine particulate waste (shaping dust and wood scrap-stringer waste and veneer off cuts) to a farm where meal worms eat the waste. Just this new system in place alone reduces their waste by 30%.

They separate and categorise all of their production waste and trash (excess resin, resinated fiberglass scrap, gloves, resin containers, stir sticks, resinated tape and sanding dust). It then goes into a three step operation: shredding, finer particle separation and then densification through the use of a vacuum infusion system.

Their trash is separated into small enough particulates it goes into molds for products. It then is infused with bio-based epoxy. From these molds they are literally



turning our excess production waste and trash into functional products.

Customers bring their old epoxy board (traditional poly boards cannot be recycled!) in for recycling so we can dispose of it, instead of it ending up in the landfill where it will not biodegrade. We several options to recycle it. Boards brought for recycling get stripped of their fiberglass shell and then either get shaped down into a new smaller board, turned into Handplanes or just plain old food for the meal worms in The Living Earth Systems. (Ryan Harris).

Meal worms

The scientists have discovered that mealworms could hold the key to eliminating plastic pollution worldwide. Mealworms can eat nothing but Styrofoam, then excrete it as biodegradable worm poop, while fulfilling their nutritional requirements at the same time. Tons of plastic eating bugs exist, but this is the

first confirmation by researchers that what the mealworms excrete is all natural, and plastic/styrofoam do not hurt the worms at all, not even a little bit.

3D Printing

Red Bull teamed up with printing company Proto3000 and tried to create a 3D printed surfboard. They were able to reduce a good deal of the weight by using a honeycomb pattern infill, but it was still a bit heavier than ideal. Right now, they're working on developing a dissolvable foam core to reduce the weight.

Current surfboard production methods involve foam cutting and molding, which can suffer from human error, so Red Bull's idea was to perfect the process by using digital technology instead. (Scott, Clare).



(PIC: 12)

Imperial College London has also built a 3D printed board. The surfboard project received seed funding from NASA. Some of the sections were 3D printed from plastic bottles melted down and extruded into filament, and the rest of it was printed with filament from ALGIX, which creates materials from an invasive diatomic algae. (Scott, Clare)

“We believe that 3D printing in the sports industry has a great future, not necessarily seeing 3D printed end use parts in the consumer market due to costs, but definitely as part of the manufacturing and design process for professionals,” (Tam, Caius)

The materials for the 3D printing should be developed to give good performance for the board. The problem with the 3D printed board is the weight. If the structure could be solved so that the weight is not an issue, 3D printing could become more usual technique in the surf industry.

”I think 3D printing is the future. The shaper will be the one doing the 3D model. At the moment it’s still too expensive.” Birra

4. Analysis

4.1 The New Wave of the Industry

In the past, there has been many attempts to build more ecological boards. The biggest issue with the development has been money. Like Birra said, the end price for the product and the colour (whiteness) has been the key figures. Will this change? Will the surfers attitude change or are they already willing to pay more of a sustainable board? Now the companies working with more greener ways are basically small factories/ indie shapers and the boards are not that easy to find.

If the green wave would grow and sustainable boards would be more available, maybe the attitude would also change. Also the industry is growing because more and more people start to surf. I believe that the values and attitude will change also bit by bit. When there's more customers, the need for greener (niche) market will also grow. We live also in a decade where the people (customers) have power to make a change.

“Hard-hitting activist campaigns against big corporations have become part of the sustainability landscape. Some change the world. Some change little. Telling the difference between one and the other isn't easy.” (Gunther).

Other industries have already changed their production methods and materials because because of the customers, for example, the fashion industry. Nobody in would want to buy products that are made in abusive conditions. So why would the surf industry be different? My opinion is that if there would be alternatives available, marketing campaigns would undergo a big change.

When talking about making the industry more sustainable, companies need to do collaboration. Every shaper should help when developing a green technology in order to raise awareness and actually inform people of the idea.

“It's difficult to develop a product from scratch, without scratch. We sincerely hope more companies and indie shapers (especially those that can make a large impact on reducing our impact) will join the cause.” Surf Organic Boards

Birra believes that making the industry greener is difficult:

“It's like the car industry, war between petrol and electric (alternative) cars has been going on for almost as long as there has been cars. A car running with water already developed, but the developer found dead. Petrol companies are trying to influence so that the industries doesn't get rid of the petrol. Before the monopoly decides that they wants, it doesn't change.” Birra

I believe the biggest problem is between our ears. The attitudes must change. My opinion is that the brownish ecological col-

our will be a marketing advantage in the future. People are willing to pay little bit more to have a sustainable option. First the ecological look in the boards can be seen as an luxury but the eco trend will grow when there's more products available. The average surfers have money to spend and when their values change, they will change their buying behaviour as well.

I think that the industry will change also in other way in the future. Carrying your own board overseas is expensive and problematic (possible damages). Also, the number of casual surfers will grow. That is why I think that the rental surfboards will be a bigger thing in the future.

Like when you compare the industry with snowboarding. Many people are happy to rent the gear when they reach the destination. This could also affect the surfmarket and change the problem with the end price of the product. Maybe rental com-

panies could use ecological boards as an advantage and advertise them as an ecological option. Nowadays there are not that many rental options available.

4.2 Analysis Blanks

	PU FOAM	RECYCLED FOAM	PLANT BASED FOAM	MUSHROOMS	CORK	WOOD
ECO VALUE	0	2	1	2	2	2
PERFORMANCE	0	-1	1	1	2	-1
COLOR	0	0	-1	-1	-1	-1
PRICE	0	1	-1	-1	-1	-1
LOCAL AVAILABILITY	0	1	1	1	-1	1
	0	3	1	2	1	0

According to the analysis the best alternatives for blanks would be recycled foam and mushrooms. Although the colour affects to the results and I do not believe it is going to be an obstacle in the future.

With recycled foam the problem is that it doesn't work easily with PU. It would be environmentally good option because the loss material could be used in an effective way.

But would the performance be as good as new?

Mushrooms sound like an interesting new option. The price would probably be low after investing into the manufacturing equipments and after that it could be produced locally. I think this could be a good option in the future. The process should be transformed into bigger scale so that it

would work with series production.

I see cork as a good alternative but the process is not that applicable to series production. At least not yet. As a material it has the same problem as most of the alternative methods -the colour.

4.3 Analysis Finishing

	FIBERGLASS & RESIN	BIO RESIN	BIOTEX FLAX FIBER	BAMBOO FIBER	HEMP FIBER
ECO VALUE	0	2	2	2	2
PERFORMANCE	0	-1	1	2	1
COLOR	0	0	0	0	0
PRICE	0	1	0	-1	-1
LOCAL AVAILABILITY	0	1	-1	-1	-1
	0	3	2	2	1

According to the analysis the best alternatives for finishing would be bioresin and bamboo/flax fiber. Bamboo fiber has had good results according to Imagine Surf. Flax fiber has not been tested that much, but it can be bought also with white color.

The problems with bio resin and alternative fibers is the price. Also the local availability is weak. However as nowadays the

factory is importing all the materials, there wouldn't be change in the transportation footprint.

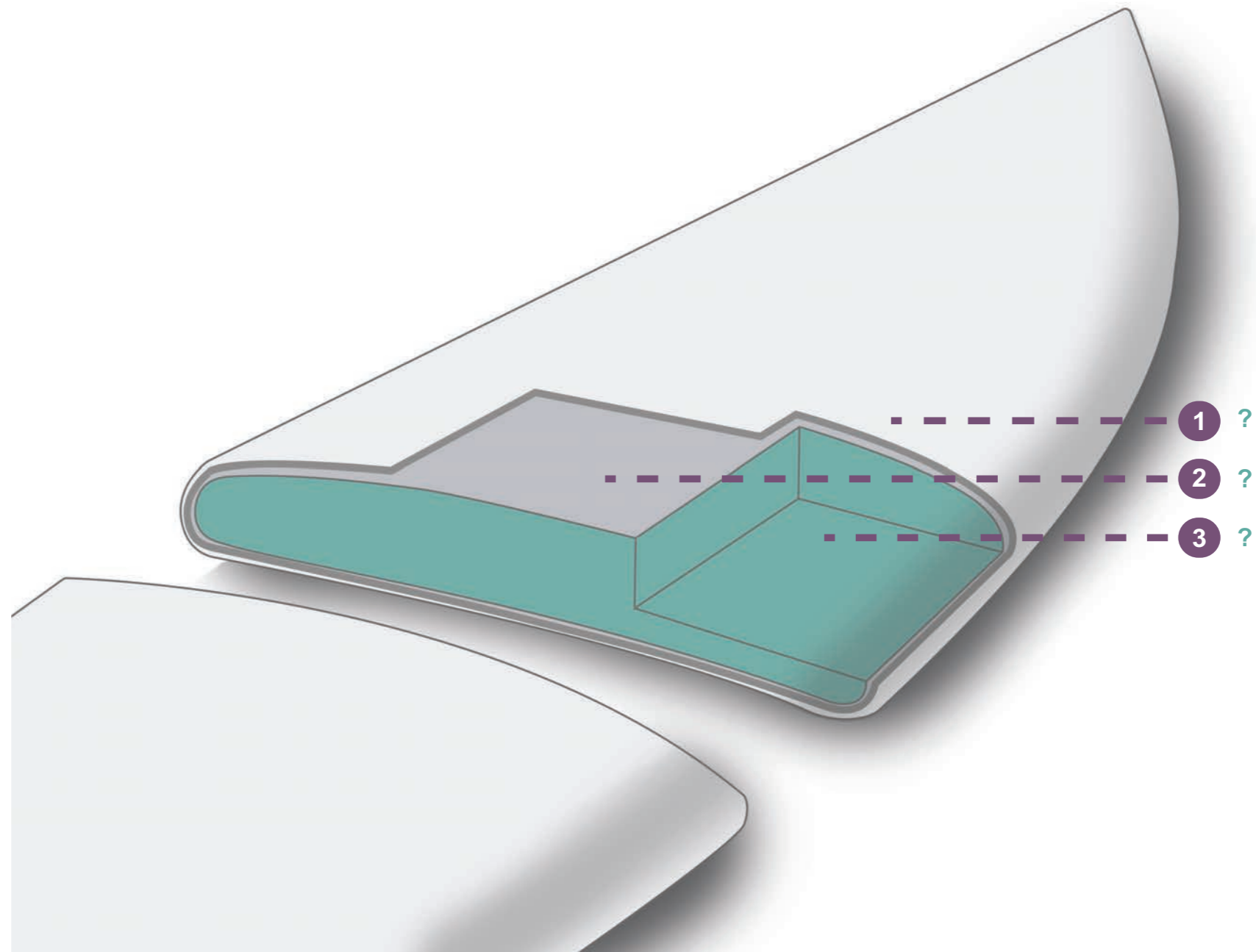
5. Solutions

5.1 Material Solutions - Concepts

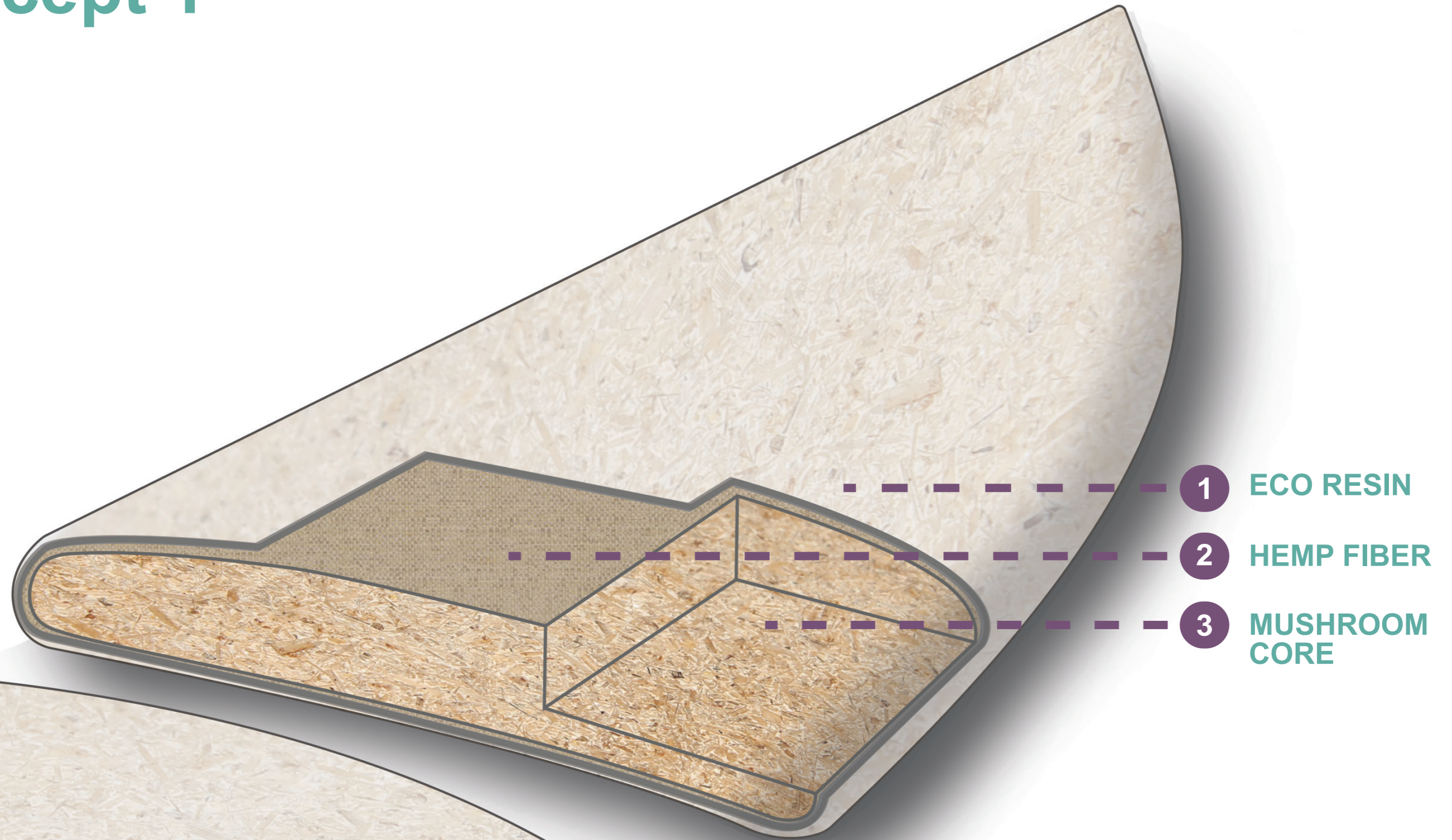
I developed three possible alternative concepts according to my study. With these concepts, I present alternative materials for resin, fiber glass and foam. I did not express my opinion with the stringer, which is already made of wood.

The following concepts are categorized according to the core material:

1. Concept - Mushroom
2. Concept - Cork
3. Concept - 3D print

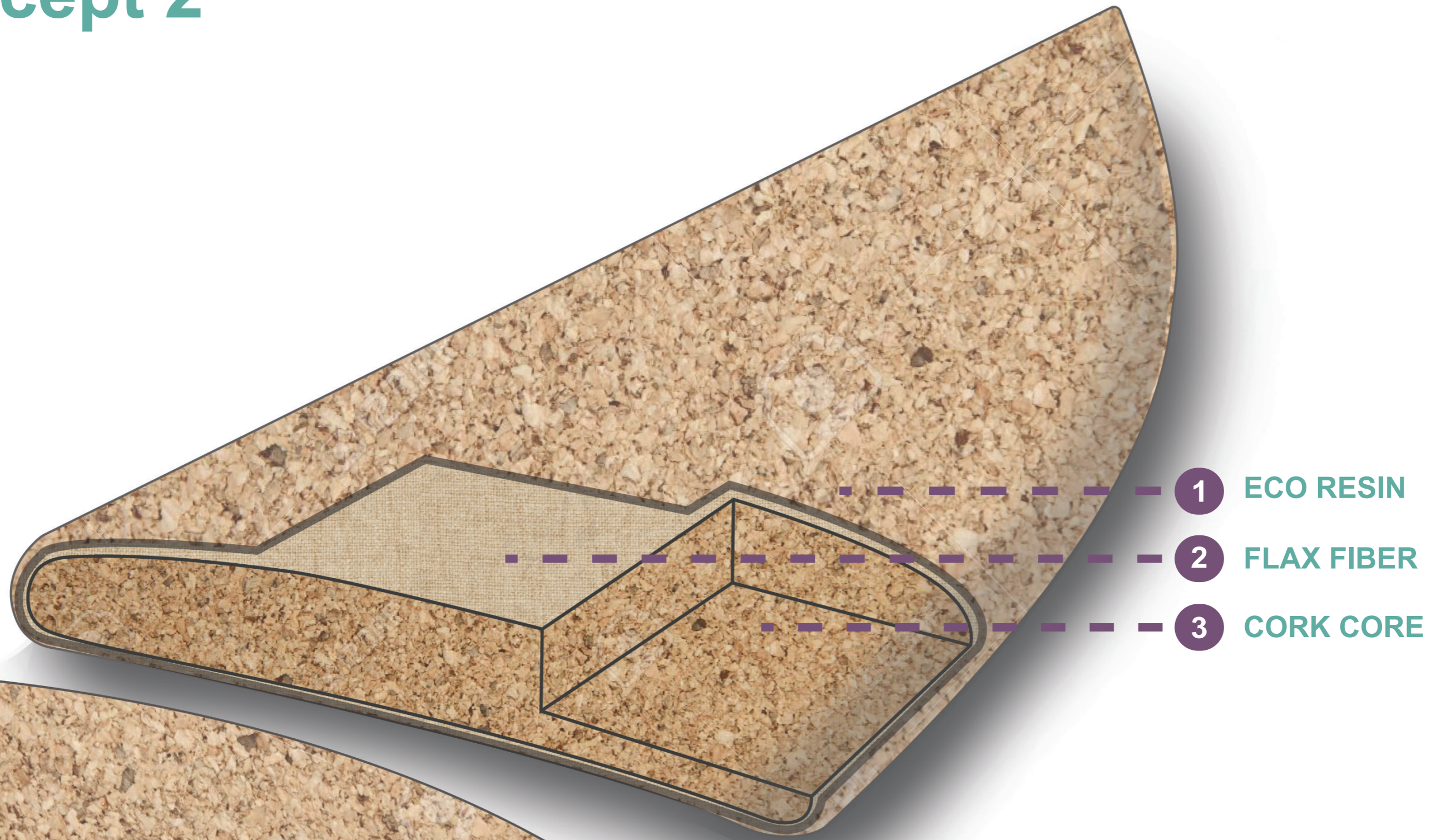


Concept 1



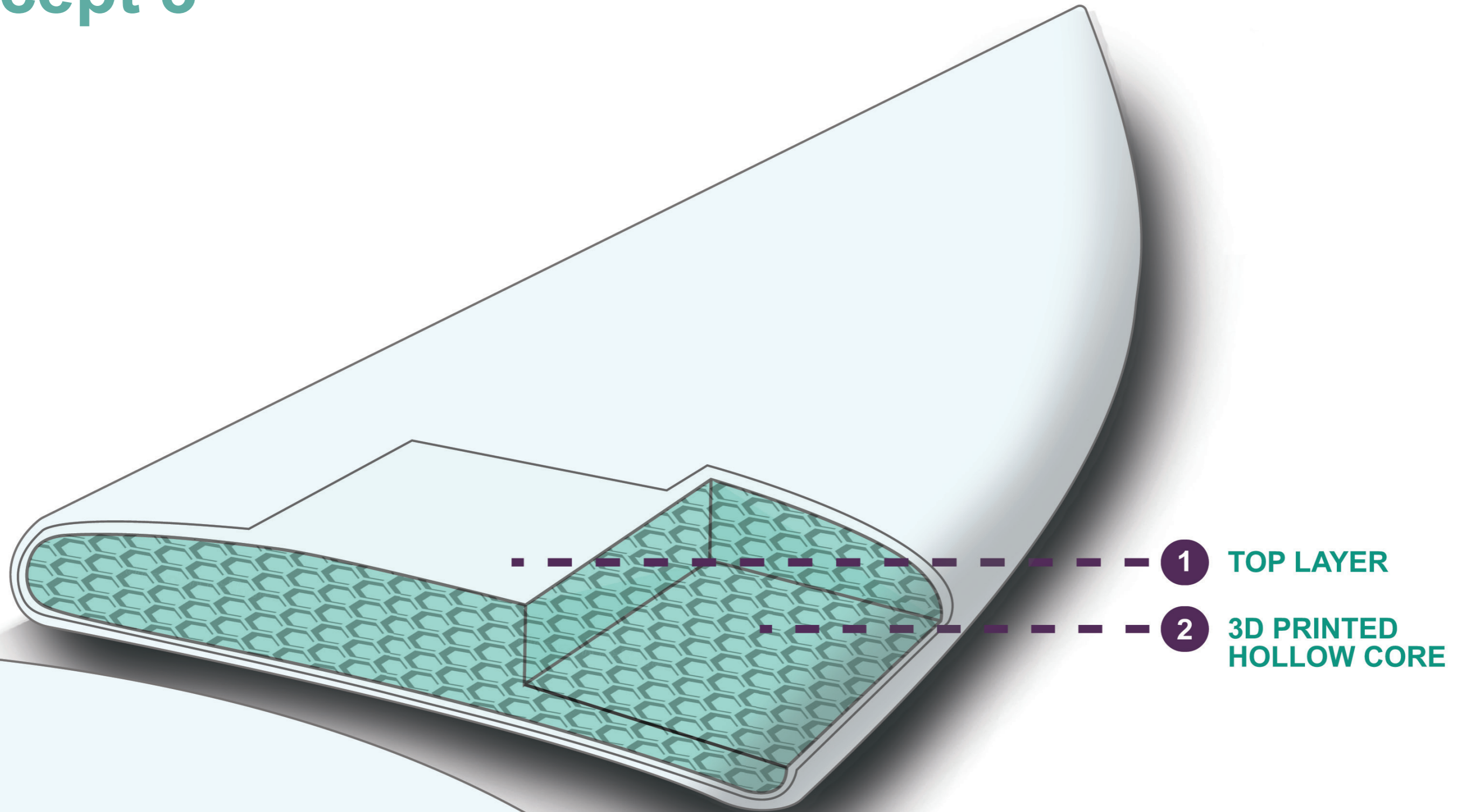
The core would be made by molding mycelium with agricultural waste. The mushroom core would be wrapped with hemp fiber and eco resin. The colour would be brown and it could be used as an advantage in marketing.

Concept 2



The core would be made from cork. It would be wrapped with flax fiber and eco resin. The beautiful cork core would be visible and it could be used as an advantage in marketing.

Concept 3



Board would be 3D printed from recycled plastic. The hollow (honeycomb structure) core would be covered with solid layer to seal it. Result would be a white board.

5.2 Solutions To Production

Reusing the materials and getting rid of the loss materials is an effective way to make the industry more sustainable. The solutions that I founded are unfortunately not adaptable for all production. For example reusing the foam 100% is at the moment only possible for epoxy boards. If the board cannot be manufactured with only recycled foam, a better alternative would be to use plant based materials inside the foam.

Meal worms are an effective way to get rid of the styrofoam but it doesn't work with other materials. These still don't solve the problem with polyurethane foam.

Most of the industries struggle with the same problems than the surf industry. The solutions will and can be found from other disciplines. Scientist are trying to solve the problems by chemistry, biology etc. By finding out, for example, how the meal worms body converts hazardous plastic into harmless biodegradable orga-

nic waste. If we study the chemical environment inside the mealworms' gut that makes this possible, it could lead to the development of far more advanced recycling techniques in the future.

If we could replicate the complex mechanisms inside the stomachs of mealworms that break down plastic, and scale it up to an industrial level, most of the hard work of melting down plastic bottles to produce new ones would be gone.

Birra doesn't think there will be a worm that would eat the PU or other solution like that. Because PU has isocyanates which are poisoned.

Different usage for the loss material should be invented/designed. There are already companies using resin drops in products like jewelry, loss foam used in handplanes etc.

"Kelly Slater's wave park entrance is made out of loss foam. The loss material could be used in isolation, construction. In Portugal there isn't companies doing that, but in Brazil there already is." Birra

3D printing would be an alternative to get rid of the loss material of the shaping.

What if there wouldn't be any loss after all?

6. Conclusions

Conclusion and Further Development

There's not a new material available, which would suit perfectly for the series production at the moment. All of the materials I found have potential, but they should be developed.

Surfboard factories have been working in the same way for centuries and trying to convince them to change their processes is hard. If there is not a 'ready' material to replace PU, the first step of the sustainable manufacturing is big.

Most of the materials have their downsides as well. Like for example EPS is harder to shape than PU, even though it's more ecological and can be recycled. Also with EPS the problem is that, Epoxy resin has to be used. And like Birra said, the epoxy resin has its limitations with the drying time.

New materials need to be tested also inside the water. Surfers have to be happy with the performance. The problem mostly

is that the surfers are used to use certain type of boards with certain performance, and they are not that into changing that feeling. With good experiences in trying new kind of boards, the trust in the sustainable manufacturing would grow.

Investments should be made and as I realised the money is always an issue in the surf industry like in any other businesses. If the owner of the company doesn't believe in the development, they will not invest in new practices. The companies working with the new materials must have an emotional value reasons behind their actions. Thus, marketing should be done to make people more aware of the problem. The change in values could come from new customers. If there is interest in buying more sustainable products, the factories would be more motivated in developing greener boards. At the moment the attitude is that it is all about the end prize for the product.

When trying to make the industry more

greener, we should think with a wider perspective. Other kind of companies should become involved in the business to help the industry. By this I mean, for example, recycling companies and farmers (who could help with the organic materials). Also chemical (petrol) companies should start developing more sustainable materials. Co-operation is an easier aspect to solve but the big chemical companies need pressure from the markets to make a change.

A new international study by Unilever reveals that a third of consumers (33%) are now choosing to buy from brands they believe are doing social or environmental good. (Unilever)

Next steps to make the industry more sustainable would be to have surfers more aware of the downsides of the industry. If the attitude of the customers has already changed in other industries, why wouldn't they act the same way when buying a

surfboard?

The attitude inside the industry must change first, so that the shapers are willing to give up from their old practices and try new materials (for example, mushroom and cork).

I feel that the most interesting material was the mushroom. It could change the industry in the future. It can also be used in different industrial purposes so the interest in developing the material further is big. It was implemented to displace styro-foam from packaging market. It doesn't look like a smooth material yet, but if the cell structure could be developed into smaller one, it would be easier to work with.

As a material mushroom is good because boards will eventually decompose when broken, discarded, or lost in the ocean, effectively reducing toxic marine debris.

3D printing will change the market in the future, that's for sure. However, investing into the machines is expensive so the step is big for the companies. Also printed boards have to be designed light and it will take time to find out the perfect structure.

The materials for the printing are developing all the time, so in the future there might be a light ecological material available. For now, the tests have been made with plastic materials.

My study shows that there's many ways to make the industry greener. Some methods work better in certain locations because of the availability of the materials (like cork). So there's not only one and only good way to make the board sustainable. Most of the interesting alternative materials are not yet developed enough to be taken into serial production in the surf industry. However, the interest is so big in other industries that possibly we will see results in development in the next years.

References

Homeblown Factory blog: <http://homeblownpt.blogspot.fi>

Primvs brand <http://www.primvs.pt>

Moss Eco-Flex Technology. 2016. Moss Research. <http://www.mossresearch.com/about-moss-research/technology/>

Nicholson, John. 1991. The Chemistry of Polymers. Letchworth. RSC Paperbacks

Simpson, W.G. 1995 Plastics and Resin Compositions. Cambridge. The Royal Society of Chemistry.

Ulrich, Karl, Eppinger Steven 2008. Product Design and Development. McGraw-Hill (213).

Reis, Dalcacio. Wiedemann, Julius 2010. Product Design in the sustainable Era. Taschen. Köln.

Woody Todd. Surf's Up, Waste's Down. The New York Times. 19.11.2009 <http://www.nytimes.com/2009/11/19/business/energy-environment/19SURF.html>

Design Council. <https://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond>

Roberson, Bryson. 01/2014. Questioning "Green" And What Plastics Mean In the Surfing World. <http://www.mossresearch.com/2014/01/09/questioning-green/>

Surfboard Design Guide. 2008. Surf Science. <http://www.surfscience.com/topics/surfboard-design/>

Surfing- A Global Strategic Business Report. 1.6.2016. <http://www.strategyr.com/pressMCP-6536.asp>

Surf-First/ the Surfrider Foundation. 2011. A Socioeconomic and Recreational Profile of Surfers in the United States. Report. [http://surfridercdn.surfrider.org/images/uploads/publications/surfrider_report_v13\(1\).pdf](http://surfridercdn.surfrider.org/images/uploads/publications/surfrider_report_v13(1).pdf)

Techavio. 2016. Global Surfboard Market 2016-2020 Research

Mellis, Charlotte. 05/2016. The Sustainable Swell: Ecological Ingenuity in the Surf Industry. Good On You. <https://goodonyou.eco/ecological-ingenuity-surf-industry/>

Balch, Oliver. 05/2017. 'Green' wetsuits: surf brands looking to renewable materials over neoprene. The Guardian.

The Guardian. 2017. Green wetsuits. <https://www.theguardian.com/sustainable-business/2017/may/25/green-wetsuits-surf-brands-looking-to-renewable-materials-over-neoprene>

Sustainable Surf. 2018. Guide to “ECOBOARD” surfboards. <http://sustainablesurf.org/featured-pages-parent/ecoboard/guide-to-eco-surfboards/>

Entropyresins. 2018. Why use Super Sap? <https://entropyresins.com/why-use-super-sap/>

Sustainable Composites Ltd. 2013. Eco friendly sustainable composite materials. ' <http://www.suscomp.com/index.htm>

Surfers Path. 05/2017. Ice-Nine Acquires Planet-Minded Maker of Sugar-Based Blanks. Article. <https://surferspath.com/news/industry/ice-nine-acquires-planet-minded-maker-of-sugar-based-blanks.html#Z8OWBh5Gk8gDq0JA.97>

Harris Ryan. Earth Technologies. Becoming the First Zero Waste Surfboard Production Facility. <https://www.kickstarter.com/projects/392366111/becoming-the-first-zero-waste-surfboard-production>

Paik, Kaitlyn. 2014. Investigating the Raw Materials of Surfboards. <http://www.designlife-cycle.com/surfboards/>

Boardcave. 2015. PU or Epoxy: Which one is best? <http://www.boardcave.com/the-surfers-corner/pu-or-epoxy-which-one-is-best/>

Eidon Surf. 2014. Surfing on ‘shrooms: growing the next crop of eco-friendly surfboards. <http://www.eidonsurf.com/2014/07/10/surfing-on-shrooms-growing-the-next-crop-of-eco-friendly-surfboards/>

Infomystic. 2017. Plastic Eating Worms Might Just Save The Earth. <https://infomystic.org/news/plastic-eating-worms-might-just-save-the-earth/>

Search Magazine. 2009. The worlds most ecological surfboard. <http://www.searchmagazine.se/news/view/301>

King, Alex. 2015. Are mushroom boards the future of surfing? <http://www.huckmagazine.com/ride/surf/why-i-do-what-i-do-surf/mushroom-boards-next-big-surfing-innovation/>

Gunther, Marc. 2015. Under pressure: campaigns that persuaded companies to change the world. <https://www.theguardian.com/sustainable-business/2015/feb/09/corporate-ngo-campaign-environment-climate-change>

Scott, Clare. Tam, Caius. 2017. Proto3000 Teams Up with Red Bull for 3D Printed Surfboard. <https://3dprint.com/176817/proto3000-red-bull-surfboard/>

Notox surfboards. 2018. <http://www.notox.fr/en/fair-boards/>

Unilever. 2017. London. Press release. <https://www.unilever.com/news/press-releases/2017/report-shows-a-third-of-consumers-prefer-sustainable-brands.html>

Corkor. 2018. <https://www.corkor.com/blogs/corkor/is-cork-eco-friendly>

Pictures:

Picture 1: Monterey Bay Aquarium 2017. <https://www.montereybayaquarium.org/members/shorelines/shorelines-spring-2017/ocean-plastic-pollution>

Picture 2: Vissla. 2018. www.vissla.com

Picture 3: Earth technologies. <http://earthtechsurf.com>

Picture 4: Richpeoplethings. <http://www.richpeoplethings.net>

Picture 5: Homeblown Factory. <http://homeblown.pt>

Picture 6: Eidon Surf. <http://eidonsurf.com/wp-content/uploads/2014/07/Eidon-Blog-Ecovative-Fungus-Mycelium-surfboard-infographic.jpg>

Picture 7: The Inertia. <https://www.theinertia.com/surf/kevin-cunningham-spirare-sustainable-surfboards/>

Picture 8: Wikipedia. <https://upload.wikimedia.org/wikipedia/commons/5/57/1-Arraiolos-0050.jpg>

Picture 9: Amorium Cork Composites. <https://amorimcorkcomposites.com/en/innovation/case-studies/mcnamara-s-cork-surf-board/>

Picture 10: Huck Magazine. <http://www.huckmagazine.com/ride/surf/why-i-do-what-i-do-surf/mushroom-boards-next-big-surfing-innovation/v>

Picture 11: Notox Surfboards. <https://fi.pinterest.com/pin/521854675547971443/>

Picture 12: 3D Print. <https://3dprint.com/176817/proto3000-red-bull-surfboard/>

Pictures and graphich not mentioned in the list, are taken/made by me.

ATTACHMENT 1

Terms

Blank is 'raw piece' of polyurethane foam which is molded into a shape.

Polyurethanes are thermoset polymers formed from di-isocyanates and polyfunctional compounds containing numerous hydroxy-groups. The major use of polyurethanes is a rigid or flexible foams.

Stringer is the thin strip of wood that traditionally runs down the middle of the surfboard

Resin is natural or synthetic organic compound consisting of a noncrystalline or viscous liquid substance.

Fiberglass is a common type of fiber-reinforced plastic using glass fiber. The fibers may be randomly arranged, flattened into a sheet or woven into a fabric.

Surf is the wave activity in the area between the shoreline and outer limit of breakers. It may refer to a breaking wave in shallow water, upon the shore, or in the area in which waves break. It can also refer to the sport surfing.

Surfing is a surface water sport in which the wave rider, referred to as a surfer, rides on the forward or deep face of a moving wave, which is usually carrying the surfer towards the shore.

Surfboard is an elongated platform used in the sport of surfing.

Sustainability is defined as a requirement of our generation to manage the resource base such that the average quality of life that we ensure ourselves can potentially be shared by all future generations.

Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat or light. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants.

Interview to Bruno Birra 29.1.2018

For how many companies (brands) is The Homeblown Factory making surfboards?

We make boards for 8 brands, for example, Bloodbrothers, Lisbon Crooks, Country surfboards, Primvs, Shaperoom.

What is the average percent of local customers? How about foreigners? Is all of the orders coming via a company or do individuals order boards as well?

All our clients are companies. We don't get orders from individuals. From our customers 80% are locals, 20% Foreigners (Germany and Hawaii)

When was Primvs surfboards started? How many athletes is Primvs sponsoring at the moment?

Brand started 3 years ago. We are sponsoring 10 athletes at the moment. All of the boards that are made are custom orders. We don't have stock boards anymore.

What is the life cycle of a surfboard? How many years is an average board used? How many brings their broken boards to be fixed?

Average customer uses their board for 2years, professional surfer only for 3-6 months. Only 10% of the surfers bring their board to be fixed. Boards are strong normally only professional surfers broke their boards.

Do you know how the surfers get rid of their old used boards?

Hand to hand. Board doesn't disappear. They give away, sell or put those into their garage.

Where do you order your materials (are they local companies or do you order those overseas)? Why did you choose materials what you're using at the moment? Polyurethane? Resin?

I order my materials from big chemical companies overseas. Companies are located in Germany, Holland, Spain, Sweden and USA. There's not many companies to choose from. Those big companies are controlling the chemical industry. They rule the world and start wars.

What is your estimate that how many percent of the materials used in a surfboard is loss? How do you get rid of the loss material?

50% of a board is loss during the process. From the blank when it's cut becomes a lot of dust, fiberglass, resin.

Biggest percentage of loss comes from foam dust. Resin drops 25% dust, 10%. Resin 10% fiberglass. Fiber glass rest over can be used for repairing old boards.

I have ordered a company to start recycling the rest over materials and chemicals. That makes the process less harmful for the workers and the waste is recycled properly. Each month the company comes to pick the rest over material. I also got a machine that cleans the painting instruments and recycles the rest over paint and acetone.

How do you think the industry will change in the future?

I don't think its going to change a lot because all the constructions of the boards. Market is growing, there's more brands coming to the market, it will be a war between prizes. Companies cannot do too much modifications to the construction because the end prize matters. I don't think people have money to spend for innovating new materials.

There has to appear new solutions of raw materials. There could be chemical revolution, like PU but using different material than petrol as a base. And it should be white.

What is your opinion about making the industry more sustainable?

It's little difficult because everything we use is based of petrol. Or you go back to making surfboards with wood. Biggest problem is the money. If you want to sell boards, you need to have competitive prize.

Surfboards have been sold for the same prize as they were 20years ago. At the same time prices for the materials has been rising because the price for petrol has gone up. Each time there's more people making surfboard, more people try to survive. Average price for a surfboard is 400 euros in Portugal, 550 euros in the world. Because of the competition, companies cant raise the prices for their boards.

Theres two waves for a company to grow prices. You have to have 20 years experience or international sponsoring rider riding your board and winning prizes. Normal marketing doesn't work in surf industry. Maybe theres a percentage who would buy more expensive ecological board.

But it won't be enough.

I believe surf is going to be in top 3 sports in the world in 10 years (after Football, tennis ect).

When you talk about making a surfboard more sustainable you have to remember the whole life cycle. Importing chemicals is dirty. When I start to make a surfblank, I don't think how dirty it is. Most of the companies (80%) import blanks from overseas. Transporting the materials is worse for the environment than the materials used. You should support locals when buying resin, blanks, and woods. That's one way of making a surfboard more sustainable. This is one of the main motives why I started to make my own blanks. If you ask me why I don't sell my blanks to all around Portugal...the reason is that my blanks are more ecological so they start yellowing after 3 months and companies want their blanks to stay white as long as possible.

Which part of the process is going to be most difficult to change more sustainable?

Blanks, no doubt. Even though our blanks are already MDI not TDI.

Do you think blanks could be made from recycled materials?

I'm not sure but it's not going to be same blank than when it's new. I think the construction is going to be different (Color, density air inside).

Moss research is using 70% plant based materials in their polyurethane blanks. Your Biofoam consisted of 25% plant based materials. Could it work to raise the amount of plant based materials in Biofoam? Would it affect into the structure? Did you stop making Biofoam only because of the color and lack of customers?

It can work but it's not easy. It's just chemistry. It can affect into the structure. Can't know before testing. For example like the company who made sugar based foams realized it after couple years. Once the board is broken, it rots very quickly because the sugar sucks the water into the boards. We quit making Biofoam because nobody wanted a yellow blank, it was more expensive to make and amount of orders was small.

What do you think about using wood as a material for surfboards? Is the performance very different? Can it be used for professional boards?

Only board what you can make 100% ecological is wooden one. Cause of the weight and the flexibility. It's heavy, it's not white, doesn't have same performance than PU, it's more expensive. Never say never but it's unlikely that wooden boards will run the market.

There is ecological resins available. Why doesn't Homeblown use ecological resins? Have you tested those? How was the performance?

It's never 100% ecological. We have tested ecological Epoxy resin and it wasn't bad. Problem was the prize. If it would be cheaper we would use it for some boards. Polyester is always different. We use polyester more because it dries faster.

Have you tried different kind of fibers (except the fiberglass) for finishing? Do you think for example hemp fiber would have same performance than the glass fiber?

I have never tried but I know there's different materials available. Fiber should be white and I think hemp fiber is brown. Maybe the other fiber could be even better with the performance but the problem is the color.

Interview to Bruno Birra 5.3.2018

EPS/ styrofoam is said to be more environmentally sustainable than standard PU/PE board and it can be made from recycled material. Why don't you use EPS? Why styrofoam can be recycled but PU doesn't?

I use both, I produce PU and buy EPS blanks elsewhere. I use PU more because I produce it myself. I prefer PU because it's more flex, more dense, and materials are cheaper. With EPS you have to use epoxy resin. EPS also gets dumped more quicker. PU is stronger. Shaping is normally different, EPS is much more difficult to shape.

I don't know. When you put resin and fibreglass, the blank sucks resin and the fibreglass gets stucked into it. It's hard to recycle.

Imagine Surf makes their cores from 100% recycled polystyrene, which are extruded, not blown. They say that by extruding, the core is 100% waterproof. What is your opinion on this? Do you feel that the water resistance is a problem in PU?

Water resistance is always a problem. Once a blank starts to suck water is like a sponge, it starts to rotten. Homeblown blanks are already waterproof. It doesn't mean that it doesn't suck water at all. It just sucks less water. I don't believe that Imagine surfs blanks are 100% waterproof.

If the colour is the problem in biofoam, why don't you paint the boards? What percentage of your boards are not white?

You should ask that from the clients. White board means in the industry a new board. 80% use white boards, but it's changing. It's a marketing thing. If you have a board that is brown, there's already a cost that you cannot control. It's cheaper to make white board, less work, and it's quicker.

What do you think about cork as a material? Could it be used in series production?

No ofcourse not. It's more environmentally friendly but very expensive material. And the performance is different. It could never be the same price as PU because you need a lot of work before you even have a blank.

What do you think about mushroom as a material? Could it be used in series production?

Making mushroom boards can be a hobby but you can't live with that. You could start making that but at the beginning it would be 10% of your business. Nowone wants to put all of their money into that risky thing. Maybe the hobby would be a main product in the future.

What would be the best alternative to get rid of the loss material with PU?

I don't think there will be a worm that would eat the PU or other solution like that. Because PU has isocyanates which are poisoned.

Kelly Slaters wave pools entrance is made of loss foam. The loss material could be used in isolation, construction. In Portugal there isn't compa nies doing that, but in Brazil there already is.

Do you think 3D printing will change the industry in the future?

I think that is the future. The shaper will be the one doing the 3D model. At the moment it's still too expensive.

Making the industry greener is difficult. It's like the car industry, war between petrol and electric (alternative) cars has been going on for as long as there has been cars. A car running with water already developed but the developer found dead. Petrol companies are trying to influence so that the industries doesn't get rid of the petrol. Before the monopoly decide they want to do different way, it doesn't change.