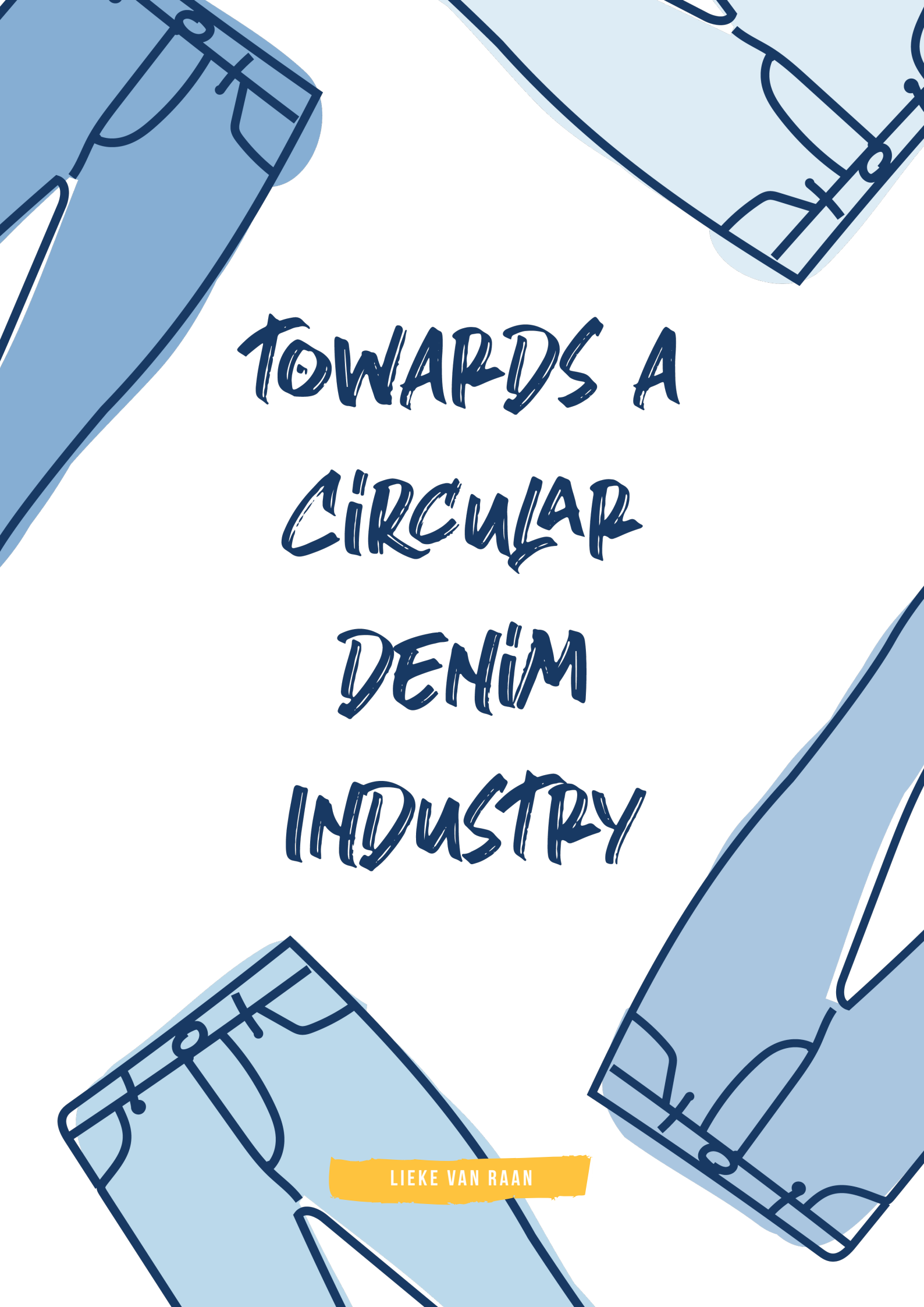


The background of the cover features four stylized, light blue denim jeans with dark blue outlines, positioned in the corners of the page. The jeans are shown from a top-down perspective, with the waistbands and pockets visible. The central text is written in a dark blue, hand-drawn, sketchy font.

TOWARDS A CIRCULAR DENIM INDUSTRY

LIEKE VAN RAAN

TOWARDS A CIRCULAR DENIM INDUSTRY

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Master Thesis by Lieke van Raan

How can the use of

POST CONSUMER
RECYCLED COTTON

be increased in
jeans production?

IN ORDER TO ACCELERATE THE TRANSITION
TOWARDS A CIRCULAR DENIM INDUSTRY

The fashion industry is a vibrant industry that unfortunately has major negative social and environmental consequences. Cotton cultivation specifically consumes enormous amounts of water and makes use of a lot of chemicals. Due to the fast-fashion industry and our linear 'take-make-waste' model, there is a growing demand for and pressure on cotton. On the other hand, the amount of clothes that are discarded and collected in the Netherlands is growing. The growing demand for virgin cotton combined with the enormous amount of discarded textiles asks for a systemic change:

to work towards a more circular system. Moving from a linear to a circular fashion industry will make less resources needed at the beginning of the cycle and less discarded textiles incinerated at the end of the cycle: this will result in less environmental impact of the denim industry on our earth.

House of Denim

This project is executed on behalf of House of Denim; a non-profit organisation that wants to work towards a more sustainable, innovative and collaborative denim industry. Since Amsterdam is internationally known as a Denim city, the Dutch government want to strive towards a more circular denim industry in the Netherlands and has involved House of Denim in this development.

Goal: increasing the use of Post-consumer recycled (PCR) cotton in denim production

The Ministry of I&V and House of Denim have defined the first step towards a circular denim industry: increasing the use of Post-consumer recycled (PCR) cotton in denim production. Increasing the use of PCR cotton in denim production is a complex systemic challenge. Designing for this challenge, asks for a systemic and holistic approach to be able to have a deep understanding of the current system and its complexity. Therefore this project is executed with a relatively new design approach: Systems Oriented Design (SOD).

The main research question in this project is defined as:

How can the demand for post-consumer recycled cotton in jeans production, started from within the Netherlands, be increased by triggering the key actor(s) or interaction(s) within the cycle?

In order to be able to answer this question, the following sub questions have been researched:

1. What does the current landscape of the collection of textiles in the Netherlands, recycling of cotton and the production and consumption of denim look like?
2. What are the key problems in producing, using and selling recycled denim?
3. What are the key actor(s) and interaction(s) within the cycle where interventions could change the current system?

Research

The research part of this project consisted mainly of doing interviews with experts of different parts of the value chain. By getting to know the different points of view of key actors in the system, knowledge about the difficulties in producing and using PCR cotton, the role of all actors and the relations between the actors is gained.

The current landscape is a rich system in which different actors behave according to the environmental, technological and social changes in the world, but also according to their relations and dependencies. Collectors are looking for new market opportunities to make the textile 'waste' used as resource and ensure their business. Mills are reacting on the demand of brands. The pressure on brands to produce as cheap as possible in a limited time, gives no room for innovating and experimenting with recycled textiles. Therefore, no constant material flow from collectors to denim mills is established yet. A group of conscious consumers is developing in the Netherlands, but only a limited amount of consumers is willing to pay more (consumers are used to fast fashion prices), resulting in no substantial supply and demand for recycled denim products.

To have an overview of the rich system we are talking about, a systems map is created called 'The cycle of a pair of jeans' in which all actors, activities, problems are visualised.

Key problems

All the bottlenecks found in the research phase are analysed and a problem network is defined. Three key problems are derived from the problem network.

1. Brands have a negative perception of PCR denim. They perceive it as difficult, expensive and low quality fabric.
2. In order to work with PCR cotton, individual brands are given a complicated logistical challenge that results in a time consuming and expensive process.
3. The use of PCR fabric is not adopted as common practice due to the lacking supply and demand of the fabric. Recycled denim products are not conventional in the shops and consumers do not actively demand it.

Key actors and interactions

To solve these three problems, the key actors and interactions within the value chain are defined. The research phase has shown that the brand is the key-actor who can raise the demand for PCR cotton. However, to start cotton recycling at scale, coordinated and collaborative action is needed. To establish a successful and efficient material flow, the following interactions are important to focus on in a collaborative value chain: brands need to be connected to denim mills that produce recycled denims. Denim mills will need to cooperate with sorting centers in the Netherlands to obtain discarded textiles. Denim mills should be linked to local recycling facilities to get these textiles recycled into PCR fibers.

Design vision

Based on the syntheses of the research, a design vision is defined:

An efficient material flow needs to be established from the sorting centers to the denim mills (independently from the brands), this would make it easier for brands to use PCR denim. Besides that, denim mills need to be motivated to experiment and develop a good PCR fabric. Brands need to be stimulated in an inspiring and educating way to create a demand for recycled fabrics; their negative perception about PCR denim needs to change.

Concept forming

To establish all of the above, an ideation phase took place to generate ideas. The ideas are evaluated on their potential systemic impact to find the most promising ideas. Based on these solutions, a concept was formed. The concept is discussed with stakeholders and build upon the feedback of the stakeholders, iterations of the intervention took place which resulted in one final concept.

The Dutch Denim Programme, a collaborative and action-oriented programme to work towards a Bright Blue loop: a circular denim industry in the Netherlands.

In order to work towards circularity, the Dutch Denim Programme (DDP) will start with triggering brands to create more products with PCR cotton. The programme helps brands by stimulating them and facilitating a collaboration in which PCR denim from Dutch textiles will be developed, by setting up the network and initiating the material flow. Besides that, the DDP will launch the Bright Blue Loop label: a label for PCR denim fabrics and products that contain 20% PCR cotton (made of Dutch garments). It will serve as a way for mills to offer an easy to recognise supply of PCR denims and a way to give brands quality assurance of the PCR fabrics.

The DDP will set up the network of brands, collecting organisations, recycling centers and denim mills. By showing a joint effort, the industry can push the government to contribute to the circular economy by fiscal incentivising the use of PCR cotton. Besides that, the participants and the denim industry in the Netherlands will be known as circular frontrunners, thanks to the publicity that will be created around the programme. Besides the industry focus, the programme will also communicate towards the consumer by doing a marketing campaign for all Bright Blue Loop labeled products, in order to make the consumer aware of the possibility to buy recycled jeans.

To implement the programme, a short term roadmap and long term vision is created. Success indicators are defined.

Validation

To validate the intervention, interviews were conducted. In the interviews, the programme is presented and feedback on different aspects of the programme was gathered. Based on the validation interviews, recommendations for further development were written. In order to further develop the concept, House of Denim is advised to continue with validation with different stakeholders from the value chain. Testing recycling of different textiles and using different recycling methods is needed to validate hypotheses.

Evaluation

The concept is evaluated by looking at the feasibility, viability and desirability of the programme and considering how it how it can solve the three key problems. To conclude:

The Dutch Denim Programma has a lot of potential to increase the use of PCR cotton in denim production. However, the success of the programme depends mainly on the participation and commitment of the actors that need to be involved and the financial structure regarding the material flow and programme.



PREFACE

Dear reader,

I started this journey with three intentions: giving myself a complicated challenge to develop and test my systemic design skills, diving into and getting to know the world of jeans and using my energy, time and competences to contribute to a positive environmental change. These intentions have resulted in a very intense but interesting and exciting process. I got the opportunity to gain knowledge from a large number of industry experts and got the chance to present my research outcomes to the top leaders of the denim industry, which has contributed to my professional and personal development. I want to thank all the people I interviewed for sharing their knowledge and perspective with me. To get to a solution for such a complicated situation has sometimes been demotivating but most of all challenging. I am very happy to know that (a part of) the intervention will be put into action in the coming months, the ultimate reward after this period of hard work.

During the process, I had the pleasure of working with many inspiring people. I would like to thank all of you who helped me along the way. First of all James for the never ending enthusiasm, all the opportunities that you gave me and the fruitful collaboration. Ella, thank you for sharing your knowledge and insights. Your critical look has definitely brought my work to a higher level. Marc, thank you for your curiosity, your interesting stories and your support which helped me to stay positive during the whole project. Furthermore, I would like to thank Lauren, for starting this journey side by side and tackling interview after interview, and Mariette for all the help and support during the process.

It has been a very valuable experience! Enjoy the read!

An introduction to this report

The fashion industry is a dynamic and enormous industry that provides jobs and joy for hundreds of millions around the world. In the last 15 years, the industry has changed. The rising demand from a growing middle class and the development of the 'fast fashion' industry has resulted in a doubling in production over the same period (Ellen MacArthur Foundation, 2017). The fast growing production puts pressure on scarce resource and has a lot of negative environmental and social consequences. A pair of jeans in specific is a very impactful garment. The production of a single pair of jeans made of conventional cotton uses approximately 7000 liters of water, from which a considerable part to grow the cotton. The worldwide growing demand for cotton puts pressure on scarce resources, ecosystems and societies in developing countries.

Simultaneously, there is a growing amount of 'waste'. More and more clothes are discarded and collected in the Netherlands and the quality of the clothes is decreasing. The value of the clothes is dropping and the interest for Dutch discarded textiles abroad is decreasing; Fast fashion is becoming a competitor for our second hand clothes. The current linear clothing system of 'take-make-waste', a steady production growth combined with a decline in utilisation per item results in one garbage truck full of textiles landfilled or burnt every second.

The growing demand for virgin cotton combined with the enormous amount of discarded textiles asks for a systemic change. Working towards a more circular system would work positive for the future of the fashion industry and of our planet. The non-profit organisation House of Denim wants to work towards a brighter blue: it is dedicated to make the denim industry more sustainable, innovative and collaborative. Since no brand or factory can change the industry on its own, House of Denim is focused on a collaboration of the entire value chain to work towards a more sustainable and fair denim industry. Since the Dutch government has the ambition to make the transition towards a circular economy in the Netherlands, the Ministry of I&W has approached House of Denim to join their efforts to realise a systemic change in the denim value chain: the Denim Deal.

This project serves as an investigation of the current situation and the exploration of a possible intervention that House of Denim could execute in collaboration with the Dutch government, in order to contribute to the first step that is defined in working towards a circular denim industry: stimulating the use of Post-Consumer Recycled (PCR) cotton in the production of denim.

Recycling is not just a matter of recovering recyclable material; it's a total economic system (Biddle, 1993). Therefore increasing recycling in the jeans industry is a complex systemic challenge. It is a problem that operates in a system in which different actors influence the situation and each other. Designing for this challenge, asks for a systemic and holistic approach to be

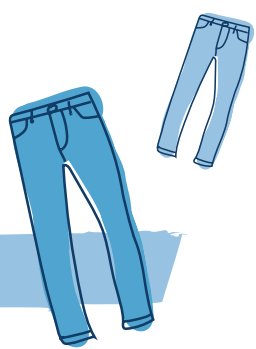
able to have a deep understanding of the current system and its complexity. Therefore this project is executed with a relatively new design approach: Systems Oriented Design (SOD).

The main research question to be answered in this project is:

How can the demand for post-consumer recycled cotton in jeans production, started from within the Netherlands, be increased by triggering the key actor(s) or interaction(s) within the cycle?

The research part of this project aims to find out what are the key problems in producing and using PCR denim and what are the key actor(s) and interaction(s) within the chain where interventions could change the current system. Therefore we need to know what the current landscape of collection of textiles in the Netherlands, recycling of cotton and the production and consumption of denim looks like. With this knowledge in mind, an intervention for House of Denim will be designed that support them in realising a systemic change towards a more circular denim industry.

The main part of this graduation report consists of five chapters. *Chapter one* introduces the graduation project by discussing the client House of Denim, the Denim Deal, the position of this project within the context of a circular denim industry, the project assignment and the project approach. *The second chapter* presents the outcome of the research phase: the lifecycle of a pair of jeans is described and bottlenecks for - and relevance of producing and using PCR cotton are discussed. *In chapter three*, the design brief is formed. A problem network is defined from which three key problems are derived and the key actors and interactions are determined. The design brief is followed by an explanation of the ideation phase. As an introduction to the concept, the ten most important building blocks of the concept are introduced. *The fourth chapter* presents the concept: The Dutch Denim Programme, a collaborative and action-oriented programme to work towards a Bright Blue loop: a circular denim industry in the Netherlands. The overall concept is explained and specific topics are further clarified. A roadmap to implement the intervention is presented. This chapter closes off with recommendations based on evaluation and validation with stakeholders. *In the last chapter* of the main report, the project and its outcome are evaluated. An overall conclusion is given and points of discussion and limitations are mentioned. The chapter is concluded by a reflection of a possible contribution to the design field and a personal reflection. Supporting chapters are written, to go deeper into two topics that could be interesting and relevant for different interested parties. *The first supporting chapter* explains the design approach Systems Oriented Design in more detail and presents a typical SOD process. *In the second supporting chapter* the lifecycle of a pair of jeans is discussed in more detail by elaborating on every step of the value chain.



Definitions & Abbreviations

Giga-mapping	The main tool of Systems Oriented Design; a tool to register, analyze and manage complexity. Extensive mapping across multiple layers and scales with the goal of investigating relations in the system.
Problem network	Network of interrelated problems resulting in a highly complex problem, also known as Wicked problem or problematique.
SOD Systems Oriented Design	A design approach that uses system thinking in order to capture the complexity of a system. It is an approach for designers to deal with and design for complex real-world problems in the modern, rapidly changing society (Sevaldson, 2009).
Systems thinking	A holistic approach to analysis that can help a person to view systems from a broad perspective that includes seeing overall structures, patterns and interrelations in systems, rather than seeing only specific events in the system.
Circular economy	A system that is restorative and regenerative by design, relying on system-wide innovation to minimise resource input, waste, emission and energy leakage by slowing, closing, and narrowing material and energy loops.
Denim Deal	The agreement between the Dutch government and industry to take the first steps towards a circular denim industry: to stimulate recycling of cotton in denim production.
Downcycling	The recycling of materials where the recycled material is of lower quality and functionality than the original material.
Post-consumer textile waste	The garments or textiles discarded after use because they are worn out, damaged, outgrown, or gone out of fashion.
Post-industrial textile waste	Also called Pre-consumer waste. All the waste involved in the manufacturing processes occurring before a garment is ready to be sold and unsold stock and damaged garments from brands, wholesalers and retailers.
PCR Post-consumer recycled	Post-consumer recycled textiles are textiles made from recycled garments or textiles that are discarded after use.
Upcycling	The reuse or recycling of products or materials in such a way as to create a product of higher quality or value than the original.

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PROJECT INTRO- DUCTION

This section will introduce you to this graduation thesis. It starts with an introduction of the four connected entities that are involved in this project (1.1). Then, it describes the client House of Denim (1.2) and introduces the Denim Deal (1.3). This is followed by an explanation of the position of this project within a circular denim industry (1.4). Finally the project assignment with its research questions and scope (1.5), and the project approach is explained (1.6).



Figure 1. Denim manufacturing in Vietnam
Saitex International, The world's cleanest Denim factory

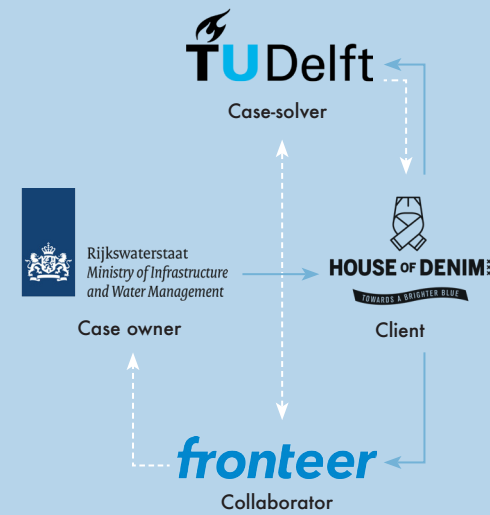
SUMMARY

Chapter 1: project introduction

1.1 COLLABORATION PARTNERS

Four connected entities are involved in this project, showed at the right.

The project is defined, managed and executed by the Case-solver TU Delft, represented by Lieke van Raan, graduating at the faculty of Industrial Design Engineering. The Client is House of Denim, an organisation focused on connecting stakeholders to create a more sustainable denim industry. House of Denim received a case of the Ministry of I&W to develop a Denim deal: an agreement between government and industry to stimulate recycling of textiles in the denim industry. House of Denim brought both the TU Delft and Fronteer Strategy on board to work on the case of the Ministry. This report will be used as research results and as inspirational input for the case of the Ministry, as well for the operations of House of Denim as an organisation.



1.2 CLIENT | HOUSE OF DENIM

The House of Denim Foundation is an independent, not for profit organisation based in Amsterdam. It aims to connect and inspire key stakeholders in the denim industry to take it 'Towards a Brighter Blue': dryer, cleaner & smarter denim.

Amsterdam has developed as the jeans capital of Europe. A big part of the world's biggest denim brands are based in Amsterdam and new innovative brands are flourishing in this capital. Amsterdam as jeans capital has noticed the raising interest for sustainable production and consumption. A jeans specifically is one of the most impactful garments in the fashion industry. A handful of brands, together with James Veenhoff and Mariette Houtink, realized 10 years ago that a change is needed: together, they needed to start working towards a sustainable and fair denim industry. Therefore, they started the House of Denim Foundation.

The House of Denim (HoD) foundation

The HoD foundation is founded to initiate collaborative projects to reduce environmental impact and stimulate adoption of more sustainable innovations, together with a network of partners, sponsors and supporters (Denimcity, 2018). The activities of House of Denim are focused around three pillars:



Advocate
the Good



Collaborate
for the Better

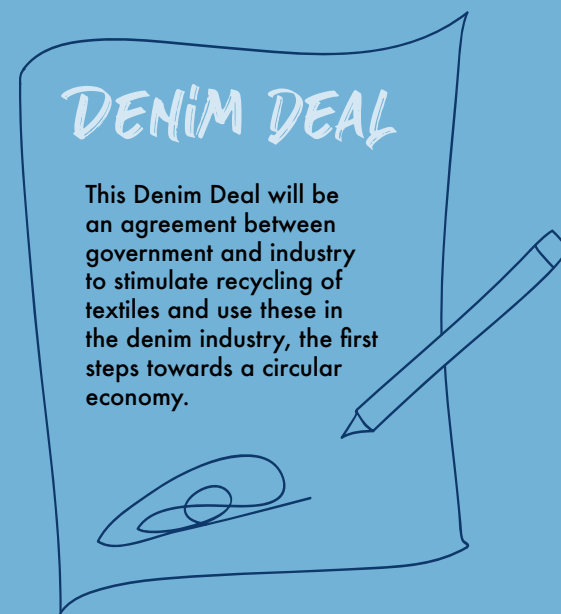


Educate
the Best

1.3 INTRODUCTION OF THE DENIM DEAL

The Ministry of I&W asked House of Denim to collaborate and work towards a Denim Deal: an agreement between government and industry to stimulate recycling of textiles in the denim industry.

The Dutch government collaborates with companies, community organisations and other government bodies to support sustainable innovation. The government can help remove barriers on the way and accelerate the process by closing a so-called Green Deal. Simultaneously the Government is focused on making the economy of the Netherlands more circular. Since Amsterdam is a jeans capital, the Netherlands is a good starting point of a circular denim industry. Therefore, the Ministry of I&W asked House of Denim/Fronteer to collaborate and work towards a green deal focused on denim.



1.4 A CIRCULAR DENIM INDUSTRY

Increasing the recycling of textiles and using this in denim production is chosen as a first step towards a circular denim industry. How does this step relate to a circular economy?

The Ellen MacArthur Foundation proposes different strategies for circular flows: besides recycling, also rethink, redesign, reuse, repair and remanufacture are mentioned. In a circular economy, the value of the material should be kept as high as possible throughout its lifetime. Since recycling reduces the value of the material the most, this should not be the first destination. The foundation created four ambitions for a new textiles economy. One of them is to radically improve recycling, the other ambitions are focused on the other circular flows. When we look at denim, we see that the value of the material is kept as high as possible when a denim product is reused and repaired until it's not

wearable and repairable anymore. To make this happen, repair services, second-hand collections and the first rental options for denim products are developing. Also rethinking the way we design, produce, retail and consume denim products with the goal to make it last longer and/or make it easier to repair, remanufacture or recycle them, contributes to a circular economy.

However, the focus and goal of this thesis is to increase the use of recycled cotton in denim production. The case-solver considers this as one of the essential steps needed to work towards a more circular industry. Current practices should be reconsidered to capture and keep the real value of the products as long as possible, but when the products are at the end of its lifetime, the recycling flow is a good destination. To enable this, recycling in the textiles industry needs to be improved.

1.5 PROJECT ASSIGNMENT

The project assignment is formulated by the student based on the request from the ministry of I&W for a Denim Deal and the wishes of the House of Denim foundation. In the research phase there will be a focus on the following research question:

How can the demand for recycled cotton in jeans production, started from within the Netherlands, be increased by triggering the key actor(s) or interaction(s) within the cycle*?

Increasing recycling in the jeans industry is a complex systemic challenge. Designing for this challenge, asks for a systemic and holistic approach. Therefore this project is executed with a relatively new design approach: Systems Oriented Design (Sevaldson, 2009).

With this systemic approach, the following questions will be researched:

1. What does the current landscape of the collection of textiles in the Netherlands, recycling of cotton and the production and consumption of denim look like?
2. What are the key problems in producing, using and selling recycled denim?
3. What are the key actor(s) and interaction(s) within the cycle where interventions could change the current system?

The scope is defined as:

- Jeans production that is initiated from within the Netherlands
- How to increase recycling of Dutch post-consumer waste
- Stimulating middle to high end denim brands

1.6 PROJECT APPROACH

To capture the complexity of the situation and understand the role of different actors and their interactions, this project is executed with a Systems Oriented Design approach. The project is divided in three phases.

Phase 1: Understand the system | By doing desk research, knowledge is gained about different parts of the system and immediately mapped in so-called Giga-maps: extensive maps to register, analyze and understand information and grasp the complexity of the system. Interviews are held with experts of different parts of the value chain. ZIP analyzes are executed to analyse the maps. A summarizing systems map is created, in which an understanding on the current system, bottlenecks and opportunities for creating and using PCR cotton are shown.

Phase 2: Define where to intervene in the system

The Kingspins Show in Amsterdam has attracted the most important industry leaders to Amsterdam. During this week, findings are presented and discussed in an expert session with 12 international industry leaders. The Kingspins Show is visited and more indept interviews are held. Based on the feedback and extra analysis, the most influential problems are defined: the problem network. Besides that, the target groups are defined and a design vision and design brief are developed.

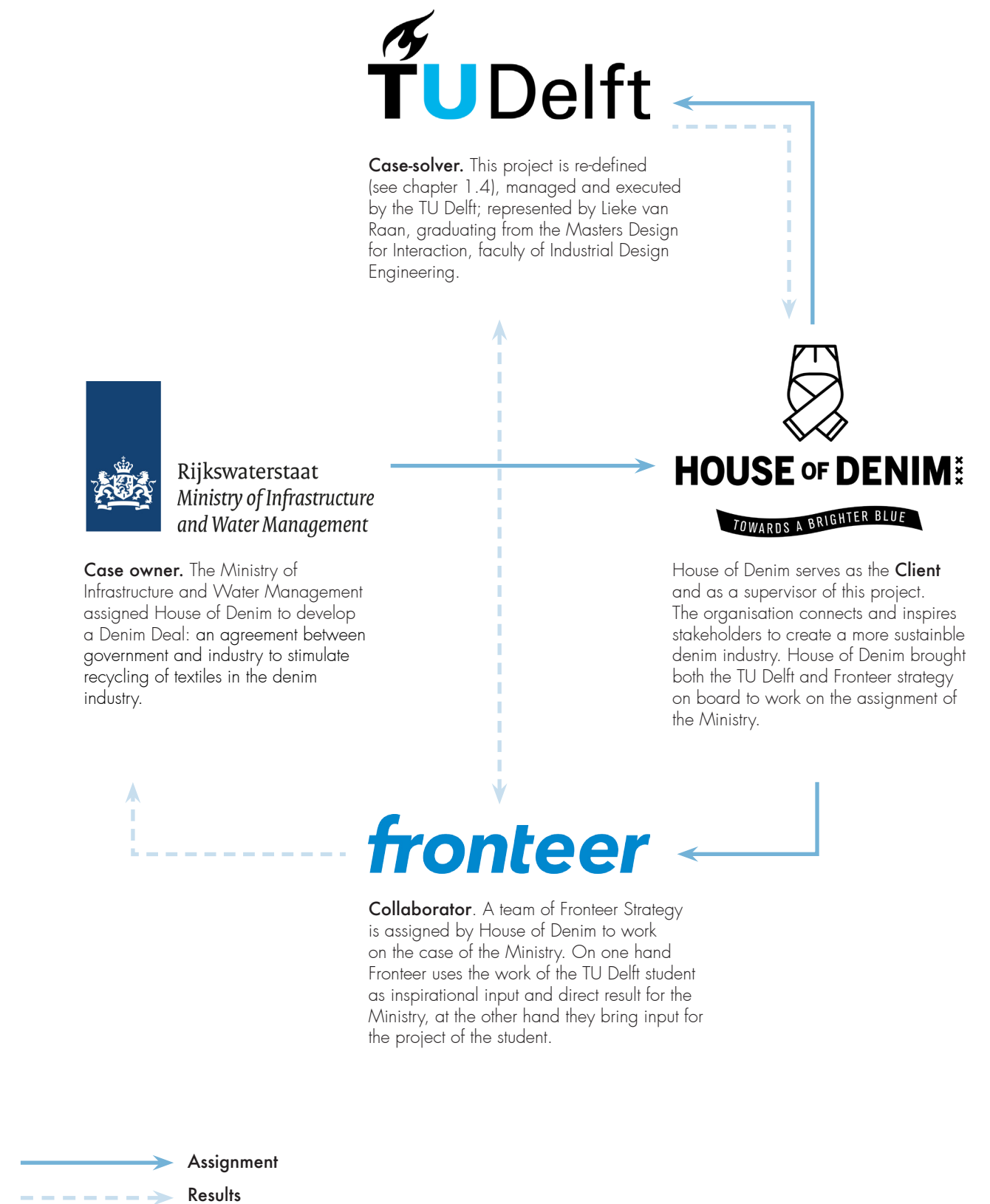
Phase 3: Design the intervention

Ideas to find direct solutions to problems, to work around problems and to create new relations are created. An Impact & Threshold analysis is done to evaluate ideas on their potential impact and threshold. The concept is formed by an iterative process of combining ideas and discussing the concept with stakeholders. The concept is validated by discussing it with (other) different stakeholders and based on the feedback, recommendations are written.

CHAPTER 1.1

COLLABORATION PARTNERS

Four connected entities are involved in this project: the TU Delft (faculty of Industrial Design Engineering), the House of Denim Foundation, Fronteer Strategy and the Ministry of Infrastructure and Water management.



CHAPTER 1.2

CLIENT | HOUSE OF DENIM

The House of Denim Foundation aims to connect and inspire key stakeholders in the denim industry to take it 'Towards a Brighter Blue': to make the denim dryer, cleaner and smarter. It is an independent, not for profit organization based in Amsterdam. But why does it focus on jeans? And why in Amsterdam?

AMSTERDAM

'JEANS CAPITAL OF EUROPE'



A lot of Dutch people may not know it, but Amsterdam is internationally known for its denim. A few years ago, the New York Times noticed that Amsterdam has developed as the 'jeans capital of Europe'.

Amsterdam has the highest number of denim companies per square kilometre in the world (FashionUnited, 2016). Design, retail and wholesale of leading denim brands take place in Amsterdam: Dutch brand such as G-star and Scotch & Soda originate in Amsterdam and international brands such as Tommy Hilfiger, Calvin Klein and Pepe Jeans are present with offices and research centers. Young denim brands such as Denham the Jeanmaker, Kings of Indigo and Tenue de Nimes are flourishing in the Dutch capital. The estimated worldwide denim turnover of the Amsterdam denim companies is about half a billion euro (Gemeente Amsterdam).

Why Amsterdam?

In the nineties, international denim brands came to Amsterdam because of its tax climate. Nowadays a broad network is what is attractive: You can not only find designers, advertisers, photographer and stylists specialised in denim, but also innovation centers and jeans education.

Besides the connections, the Dutch environment is what brings the brands to Amsterdam: the entrepreneurial atmosphere, the high level of english, the international attraction to the city and the 'dutch jeans mentality'. The majority of the Amsterdam population is wearing a pair of jeans more then 4 days a week and the average inhabitant has 6 pairs of jean (Gemeente Amsterdam). That is two times as much as the rest of Europe (Denham, J.). Wearing a pair of jeans all day suits the Dutch down to earth mentality, as stated by Jason Denham. Or would it be the characteristic of the original workers pants: a pair of jeans is resistant for daily cycling?

Sustainable denim industry

While there is more and more fairtrade and ecological food in the supermarkets, sustainable fashion is not common sense yet. The small group of conscious consumers is growing, looking for ethical and sustainable fashion. The jeans captical of Europe is noticing this as well. Especially a pair of jeans is one of the most impactful garments in your closet. For the production of a single pair made of conventional cotton more than 7000 liters of water and a lot of toxic and chemicals are used.

The House of Denim foundation is founded to initiate collaborative projects to reduce environmental impact and stimulate adoption of more sustainable innovations, together with a network of partners, sponsors and supporters (Denimcity, 2018).

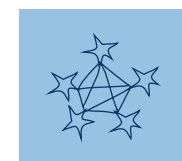
House of Denim is started in 2010 by James Veenhoff and Mariette Hoitink. Both experienced in the fashion industry, they wanted to take the industry a step further. Mariette and James noticed that the denim business in Amsterdam was great and the industry is enormous: it provides jobs and joy for millions of people. But they also saw that jeans is a dirty business. Nobody addressed the waste, working standards and pollution involved.

Unfortunately, no brand or factory can change the industry on it's own. The entire chain needs to collaborate to work towards a more sustainable and fair denim industry. Therefore, they started a platform in Amsterdam to connect and collaborate: the House of Denim foundation. They pulled experts from all around the world to collaboratively develop a strategy: to take denim towards a brighter blue. The activities of House of Denim are focused around three pillars:



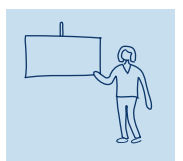
Advocate the Good

Promote best practices and give a voice to the industry as a whole.



Collaborate for the Better

Build a network for industry-wide collaboration on standards, projects and resources.



Educate the Best

Train the future industry and raise the bar on knowledge throughout the current industry

Jean school

The two biggest 'projects' of House of Denim are the physical location Denim City and the Jean school. The House of Denim has set up the one and only Jean school (and Jean School International course) of the world. The three year curriculum is designed together with brands to become a fashion designer specialised in denim. It is realised in partnership with ROCvA and fully accredited by the Dutch government (House of Denim, 2014).

Denim City

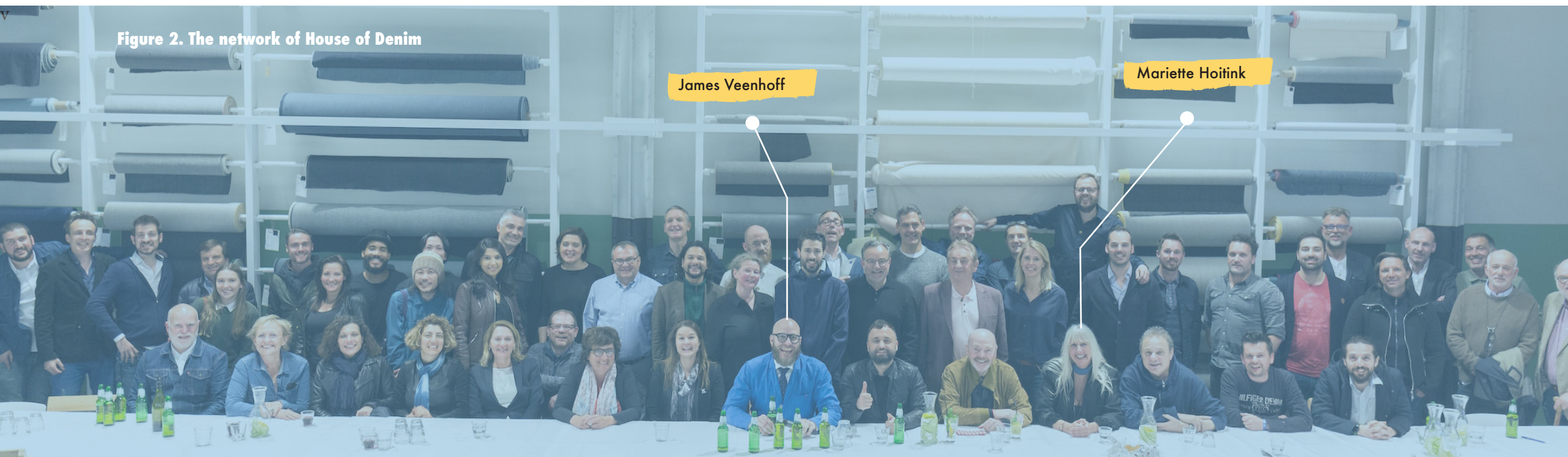
In 2014, House of Denim opened Denim City: a place dedicated to denim innovation in the heart of Amsterdam to physically bring together all different groups: industry experts, talented students and consumers. It is a campus focused on denim craftsmanship, enterprise and sustainable innovation. Since 2017, Denim City works independent from the House of Denim foundation.

**"WE ARE A POSITIVE,
GROUP OF DENIM
LOVERS THROUGHOUT
THE INDUSTRY WHO
THINK, TALK AND ACT
TOWARDS CHANGE"
- JAMES VEENHOFF**



Figure 3. Denim City and the logo of House of Denim

Figure 2. The network of House of Denim



Network

The House of Denim is all about networking. They want to drive dialogue about business and sustainability between the actors in the industry. The broad network and the positive position of House of Denim within the network is their strength. But at the other hand, they are fully dependent on their network: the foundation and all its initiatives are realised through collaborative effort and funding; sponsors, donations and subsidies.

CHAPTER 1.3

INTRODUCTION OF THE DENIM DEAL

The Ministry of I&W asked House of Denim to collaborate and work towards a Denim Deal: an agreement between the government and the industry to stimulate the recycling of textiles in the denim industry. The Denim Deal is a denim edition of the so-called Green Deals, in order to work towards a circular fashion economy.

Green deals

The Dutch government collaborates with companies, community organisations and other governmental bodies to support sustainable innovation. The government can help remove barriers on the way and accelerate the process by closing a Green Deal. Since 2011, more than 200 Green Deals are signed (Greendeals, 2019).

Governmental focus on circular economy

Besides stimulating sustainable initiatives, the Government is focused on innovations that contribute to a circular economy. 'Circular economy' is becoming a well-known term. In a circular economy, waste is minimised and resources are reused in order to decrease the depletion of natural resources (Rijksoverheid, n.d.). In 2016, a governmental programme called "Nederland Circulair in 2050" is created. This programme includes a National agreement on the Circular Economy (in Dutch 'grondstoffenakkoord') consisting of 5 transition agendas. One of them is 'consumption goods' which includes the fashion industry.

Besides this program, the Ministry of I&W also contributed to the Sustainable Clothes and Textiles Covenant, which is focussed on making the fashion industry more fair and sustainable. One of the 9 themes described in this covenant is Circular textiles. To give this theme more focus, platform 'Circular Textiles' in collaboration with the government created a roadmap to work towards a circular textiles industry.



Figure 4. Prime Minister Rutte visited Denim City in 2018

"A sustainable future is a circular economy. The government emphasizes the importance of this transition with the programm 'The Netherlands Circular in 2050'. To think of the planet and the people".

- Hanneke op den Brouw Rijkswaterstaat, I&W



Denim deal

The governmental focus on circularity together with the concept of green deals has led to a project to create a Denim Deal. In 2018, Prime minister Rutte visited Denim City and was positively surprised about the organisation. This occasion has led to the government's choice to approach House of Denim for this project.

In order to create the Denim Deal, the current denim industry and it's value chain needs to be mapped to have a clear image of the production and consumption cycle. In addition to this, bottlenecks in the current system for developing or using recycled cotton will be identified. When having a clear view on the current situation and the issues nowadays, the industry and government will collaboratively create a denim deal in which both the government and the industry can determine what steps they can take right now to solve the problems and make the way towards a circular economy easier.



Figure 5. Network event at Denim City

CHAPTER 1.4

A CIRCULAR DENIM INDUSTRY

As explained in the previous chapter, the government is focused on circularity in general and wants to work towards a circular textiles economy. For denim specifically, stimulating the recycling of Dutch worn textiles and using this material in the production of denim is chosen as a first step. How does this step relate to a circular economy?

CIRCULAR ECONOMY

The traditional economic model of several industries is a linear system: the take-make-dispose model. A system in which we take resources to make products, use them and throw them away when we no longer want them. The linear chain of the fashion industry has major drawbacks: consumption of huge quantities of water, resources, energy and chemicals, CO₂ emission, pollution of ground water and an enormous amount of waste. A steady production growth combined with a decline in utilisation per item results in one garbage truck full of textiles landfilled or burnt every second (Ellen MacArthur foundation, 2017). The linear system is no longer working: not only for the environment but also for the people and the businesses. To minimise waste and use less resources, a new economic model is developed: the circular economy. To create this system, which has benefits for everyone but within the limits of the planet, we need to change the way we manage resources, the way we make and use products, and the way we treat materials afterwards. A circular economy closes energy and materials loops to design out waste and pollution.

This section is based upon the point of view of the Ellen MacArthur Foundation. The Ellen MacArthur Foundation is an organisation that works with businesses and governments with the mission to accelerate the transition to a circular economy. Their research is taken as the source of information, since the foundation is investigating a lot in the possibilities of a circular fashion industry (they are currently working on a report about the denim industry). Therefore they are a wellknown organisation within the industry.

Material flows

The organisation explains the different opportunities within the circular economy with the butterfly diagram (see figure 6). This model illustrates the flow of technical and biological materials through the value chain. The technical cycles recover and restore products, components and materials through strategies like **reuse**, **repair**, **remanufacture** or **recycling**. Also mentioned are the strategies **rethink** and **redesign**; using resources more efficiently by changing the way we think about products and production and the way we design products by considering reuse, repair and recycling in the design phase. The Ellen MacArthur Foundation points out that, in general, recycling should be our last resort. Compared to reusing or repairing the product, more energy is used when recycling a product and the value of the product decreases.

A new textiles economy

The foundation has researched the textiles industry specifically and has written a report with a vision on how to build a new textiles economy, based on circular economy principles (A New Textiles Economy: Redesigning fashion's future). It gives the fashion industry a direction and focus for the near future. In a circular textile economy, clothes, textiles, and fibres are kept at their highest value during use and re-enter the cycle. The organisation emphasizes the importance of system-level change and points out that commitment, collaboration and innovation are needed to move in this direction.

CIRCULAR ECONOMY - an industrial system that is restorative by design

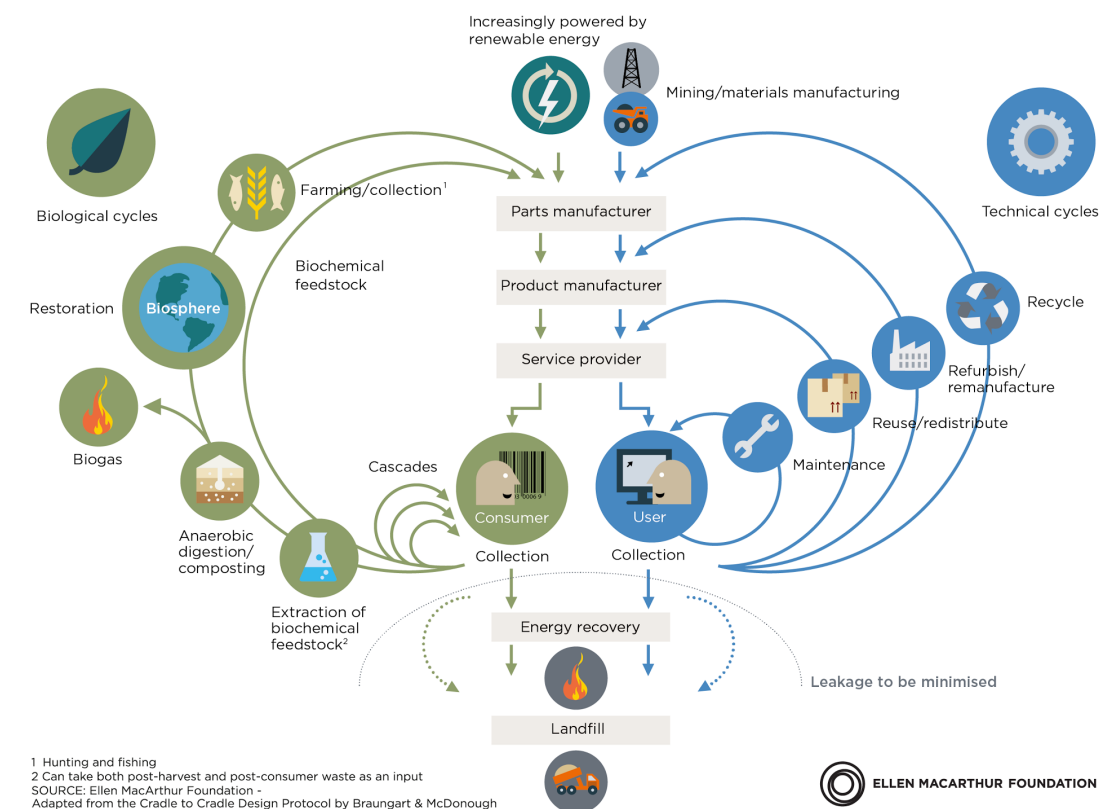


Figure 6. The butterfly model | Source: Ellen MacArthur Foundation

Four ambitions for the textile industry

Within the report, the Ellen MacArthur Foundation created four ambitions for a new textile economy in which different kind of material flows are proposed.

1. Phase out substances of concern (to health or the environment) and phase out microfibre release
2. Increase clothing utilisation
3. Radically improve recycling
4. Make effective use of resources and move to renewable inputs.

When we compare these ambitions with the different material flows, we see that the first ambition is mostly about **rethink** and **redesign**: ensure that the material input is safe and healthy to allow cycling. The second ambition is besides *rethink* and *redesign*, mostly focused on **reuse** and **repair**. By designing and producing more durable clothes and stimulating innovative business models in which clothes can be used for a longer time (by 1 or more users), the real value of the clothes can be captured and the number of times an item is worn can be increased. The 4th ambition is mostly about **rethink**: change the way resources are used and adjust production processes. The 3rd ambition is about **recycling** (& **remanufacture**).

Different ways of recycling textiles

Within this ambition, the report shows there are different recycling approaches in the textile industry, illustrated in the image below.



Fabric recycling (also remanufacturing)
This indicates the disassembling of garments and re-sewing parts of the fabric into new garments.



Yarn recycling
This is the unravelling of yarns; yet only possible for specific types of knitted garments.



Fibre recycling
This level of recycling is often referred to as 'mechanical recycling': shredding textiles back into fibers.



Polymer recycling
In case of cotton, this way is also called 'chemical recycling'; a technology in which textiles are dissolved in chemicals. Cellulose - the polymer that is the main component of cotton - can be separated from polyester and can be formed into new cellulose-based fibres.



Monomer recycling
Another way of chemical recycling. It breaks down polymers into monomers that can serve as resource to produce virgin-quality polymers; yet only possible with polyester.

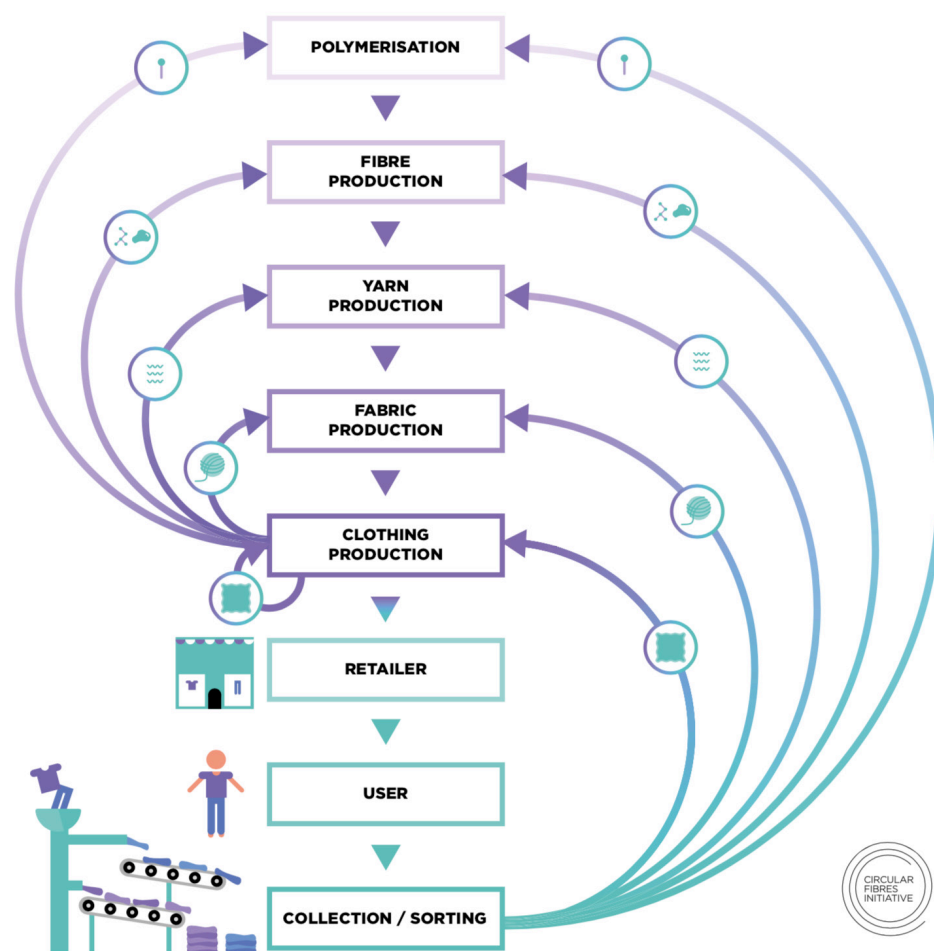


Figure 7. Recycling approaches of the textiles industry | Source: A New Textiles Economy: Redesigning fashion's future, by the Ellen MacArthur Foundation

A CIRCULAR DENIM INDUSTRY



There are different ways to go over a circular denim industry. Besides the most obvious way, recycling, the other material flows capture the value of denim products at a higher level.

By **reusing** and **repairing** a pair of jeans, the real value of the jeans is captured as long as possible; more and more brands have repair services, second-hand collections and the first rental options for denim products have popped up. **Rethink** and **redesign** are strategies applicable to the denim industry; rethink the way we produce and design denim products in a way that makes it last longer and/or make it easier to repair, remanufacture or recycle them. At the sustainable jeans brand Mudjeans, you are able to lease a pair of jeans and when the item is not wearable anymore (after a few users), they are recycled into a new pair of jeans. This is a good example of rethinking the way of consuming and keeping the highest value of the clothes.

Remanufacturing denim products seems an option; for example creating shorts and skirts out of a pair of jeans. The technological threshold is low but it is labour intensive and because the supply of old denim products is not consistent, large-scale production is not likely.

When we consider keeping the value as high as possible, only when clothes can no longer be used, recycling is a good solution. A part of the value of the product can be captured by recycling, and when technologies improve, this part will become bigger. Denim fabric is made from cotton. Making a recycled jeans means that recycled cotton fibers are used. These cotton fibers can come from shredded denim, but also from other cotton textiles. Yarn recycling and monomer recycling are not applicable to cotton. That leaves fiber recycling and polymer recycling as options, also called mechanical and chemical recycling. Since chemical recycling is not yet technologically or economically mature, 'recycling cotton' mostly refers to mechanical recycling, a type of recycling that has been used for nearly 250 years already. We will elaborate on mechanical and chemical recycling in chapter 2.

The position of recycling within a sustainable denim industry

The focus and goal of this thesis is to increase the use of recycled cotton in denim production. At the moment, the interest within the industry for the use of recycled cotton is growing. Mills are innovating sustainably and brands want to be the first one using new sustainable innovations. However, using recycled cotton is seen as a complicated challenge stagnated by technological bottlenecks. Now is the right time to explore if this is

really the case or that the industry can make a shift already, since the industry is 'waiting' and the world is demanding more and more cotton which has negative environmental and social impact. The case-solver, student from TU-Delft, considers this project as one of the essential steps needed to work towards a more circular industry.

Four approaches for improving recycling

To radically improve recycling in the textiles industry, the Ellen MacArthur foundation defined four areas.

1. Align clothing design and recycling processes
2. Pursue technological innovation to improve the economics and quality of recycling
3. Stimulate demand for recycled materials
4. Implement clothing collection at scale.

Besides the four areas, to get clothing recycling really at scale, the Ellen MacArthur foundation has put emphasis on the following:

Cross-value chain action is required to introduce clothing recycling at scale

As stated in the report, worldwide, no clothing-to-clothing recycling operations exist at scale. To establish the four areas mentioned, coordinated action is needed in which different actors in the value chain will be connected.

Focus of this project within the recycling topic

In the long run, all four areas are important to work on in order to improve recycling in the textiles industry. When we look specifically at the denim industry in the Netherlands, the House of Denim foundation and the student believe that on short term there is most to gain by focussing on the third approach: stimulating the demand. This approach also fits best with competencies of the student. That doesn't exclude the other three topics, which are also taken into account and reflected on during the project.



Figure 8. Home insulation material made of recycled denim

CHAPTER 1.5

PROJECT ASSIGNMENT

The project assignment is formulated by the student based on the request from the ministry of I&W for a Denim Deal and the wishes of the House of Denim foundation. The aim is to design an intervention to increase the demand for post-consumer recycled cotton in jeans production, started from within the Netherlands, by triggering the key actors or interactions.

PROJECT ASSIGNMENT

Main question

The goal of this product is to design an intervention to increase the use of recycled cotton in jeans production. As explained in the previous chapter, in the research phase there will be a focus on the following main question:

How can the demand for recycled cotton in jeans production, started from within the Netherlands, be increased by triggering the key actor(s) or interaction(s) within the cycle*?

**The cycle includes the production of cotton, production of fabric (spinning and weaving), production of jeans, laundry, retail, consumption, use, disposal, collecting, sorting, preparing, fiberizing (recycling) and blending this with virgin cotton.*

Research questions

Recycling is not just a matter of recovering recyclable material; it is a total economic system (David Biddle, 1993). Therefore increasing recycling in the jeans industry is a complex systemic challenge. It is a problem that operates in a system including different actors that influence the situation and each other. Designing for this challenge, asks for an systemic and holistic approach to be able to have a deep understanding of the current system and its complexity. Therefore this project is executed with a relatively new design approach in the Netherlands: Systems Oriented Design (Sevaldson, 2009) (explained in supporting chapter 1).

With this systemic approach, the following questions will be researched:

1. What does the current landscape of collection of textiles in the Netherlands, recycling of cotton and the production and consumption of denim look like?
2. What are the key problems in producing, using and selling recycled cotton in denim?
3. What are the key actor(s) and interaction(s) within the chain where interventions could change the current system?

System thinking is used to see the interrelationships throughout the system and to find places within the system that can be tweaked for change. Visualisations are used to understand the systems and communicate the cycle, the actors, the interactions and issues.

Scope

Brands based in the Netherlands

The scope is defined as the jeans production that is initiated from within the Netherlands. The production takes exclusively place outside the Netherlands but the scope includes the denim brands which located are located in Amsterdam or the rest of the Netherlands.

Post-consumer recycled cotton from the Netherlands

When we talk about textile waste, there is a distinction made between post-consumer and post-industrial (or pre-consumer) textile waste (Modint, 2015). Post-industrial waste is all the waste involved in the manufacturing processes occurring before a garment is ready to be sold: waste created during spinning, weaving, cutting, stitching or dyeing. Also unsold stock and damaged garments from brands, wholesalers and retailers is post-industrial waste.

However, the scope of this project is Post-consumer waste: textiles which are discarded after use. Recycling post-consumer cotton waste is the first step to work towards a circular economy in the Netherlands. Therefore this project is focused on how to increase recycling of Dutch Post-consumer waste and use these fibers in production of jeans.

Middle to High End Denim brands

The project is focused on middle to high end denim brands (or fashion brands which are particularly active in denim). Fast-fashion and low-end brands are excluded because of the following reasons:

- House of Denim has a good network of middle to high end brands. The positive connections will increase the willingness of the brands to help in the project and to participate in an intervention later on.
- Middle to High end brand can show the rest of the industry what is possible and work as example for the lower end brands.
- The production of middle to high end brands takes place closer to the Netherlands (Turkey, Spain). Low-end brands often produce in Asia. To ship textiles from the Netherlands all the way to Asia to be recycled doesn't contribute to making the industry more sustainable.
- The low retail prices of fast fashion chains do not give much space for using recycled material.

CHAPTER 1.6

PROJECT APPROACH

This project is executed with the Systems Oriented Design approach. A short introduction on this approach is given followed by an explanation of the process of this project and methods used in this projects. An elaborated explanation of Systems Oriented Design is given in Supporting Chapter 1.

Systems Oriented Design (SOD)

Increasing recycling in an industry is a complex challenge. It is a challenge in which different actors will need to change their way of working. All actors have their own needs, dependencies and interactions and all of them influence the situation in their own way. Designing for a challenge like this, asks for a different approach than a traditional design process. Systems Oriented Design is a suitable approach for this project since it is focused on capturing the complexity and looking at interactions within the system.

Systems Oriented Design (SOD) is an approach for designers to deal with complex problems in the modern, rapidly changing society. The base of SOD is systems thinking: a way of thinking in

which the properties of the parts can only be understood through the dynamics of the whole. It focusses on how parts interact. Techniques and methods from Systems Oriented Design are based on the belief that the complexity derives from interconnectedness of things and it is important to understand the interconnectedness in order to be able to design for the complex problem. Supporting Chapter 1 explains Systems Oriented Design thoroughly and describes a typical SOD process.

SOD is a relatively young field of design. The case-solver of this project, student from the TU Delft, is educated in this specific field of design in Norway at AHO, Oslo school of Architecture and Design. She brought this way of working to the TU Delft. SOD methods are combined with design methods educated at the TU Delft. In this chapter, the process of this project is explained and the SOD related methods that are used are described.

Process

The process is divided in three phases.

Phase 1: Understand the system

Phase 2: Define where to intervene in the system

Phase 3: Design the intervention

The three phases are visualised at the next page. Phase 1 starts after the project assignment has been developed.

Phase 1: Understand the system

In the first phase, research is conducted to understand the current situation. Desk research is done and experts of every part of the value chain are interviewed. Information is captured and analysed by mapping.

BRAIN DUMP

Pre-existing knowledge and knowledge gained during the preparation of the project is mapped in a so-called Brindump (Acaroglu, 2017). This map is used to define spots in the system that need deeper research.

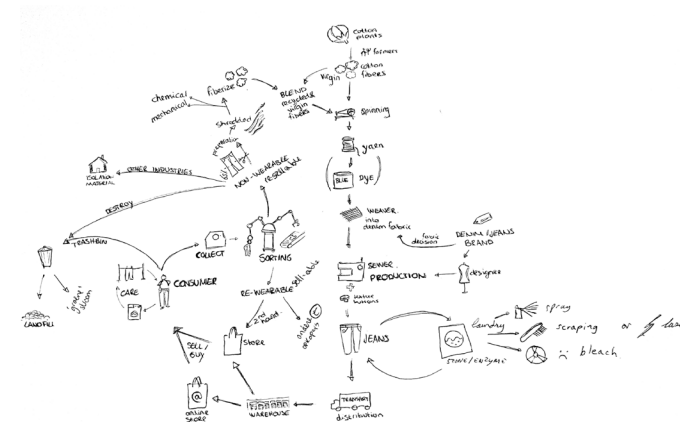


Figure 9. Braindump map

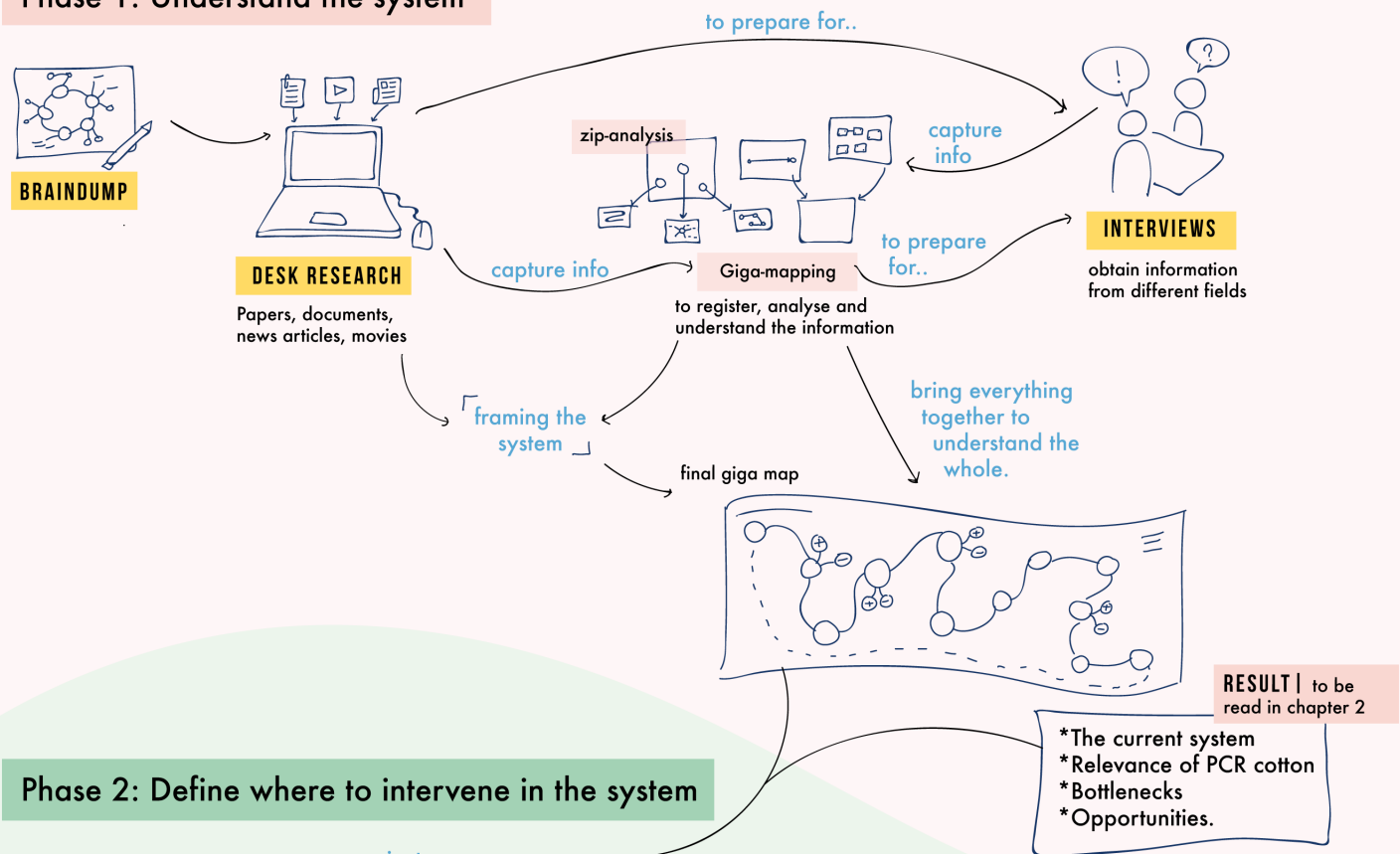
DESK RESEARCH

Thorough research is executed with the goal to fully understand the system around the use of recycled cotton in jeans production. It started with literature and internet research to gain knowledge of...

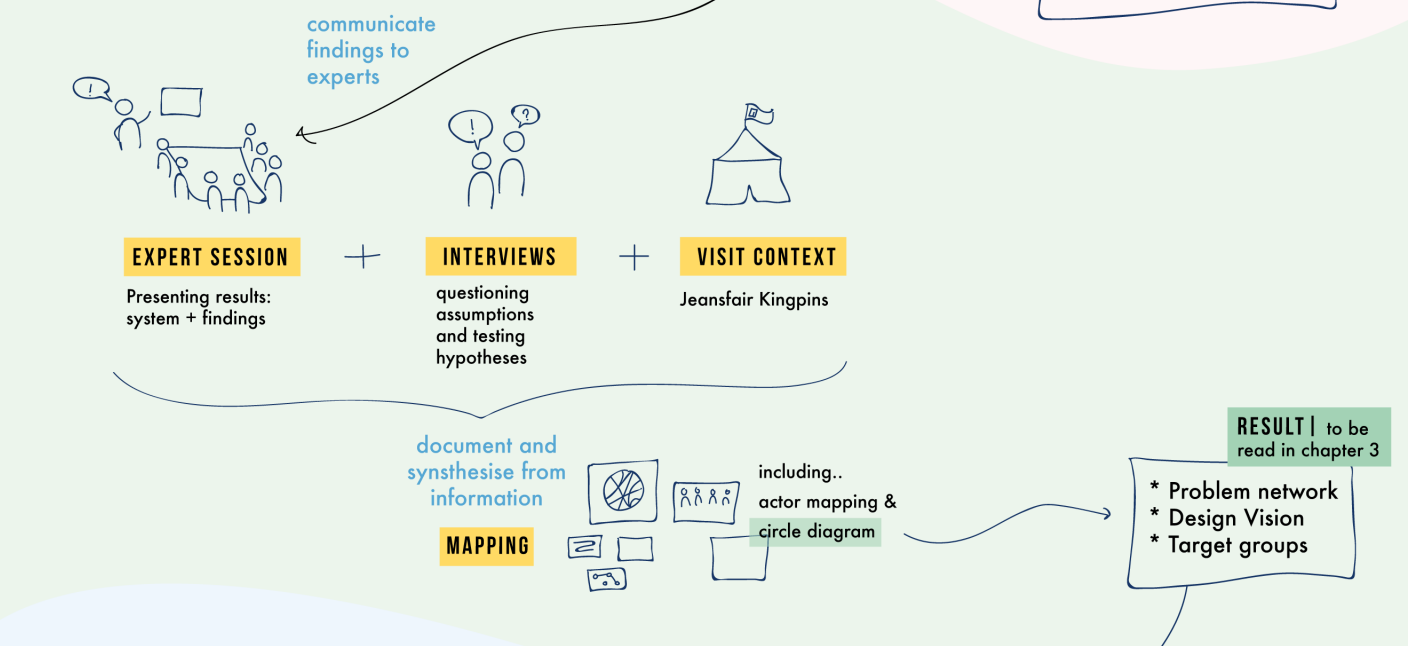
- The production process of denim products
- The environmental impact of a jeans
- The consumption of jeans
- The general collecting and sorting process
- The recycling process of cotton textiles
- The challenges of recycling cotton
- The material flow through the whole cycle
- The important players (brands, factories, collectors)
- Sustainable brands
- The role and ambitions of (non-sustainable) brands
- Current benchmarks and labels
- Current initiatives, agreements, collaborations, strategies
- The role of the government

The information is gained through research published by
 academical researchers, brands, circular initiatives, governmental
 institutions, branche organisation and charity organisations.
 Besides official documents, also news articles, blogs and youtube
 videos are used to understand the full world of jeans.

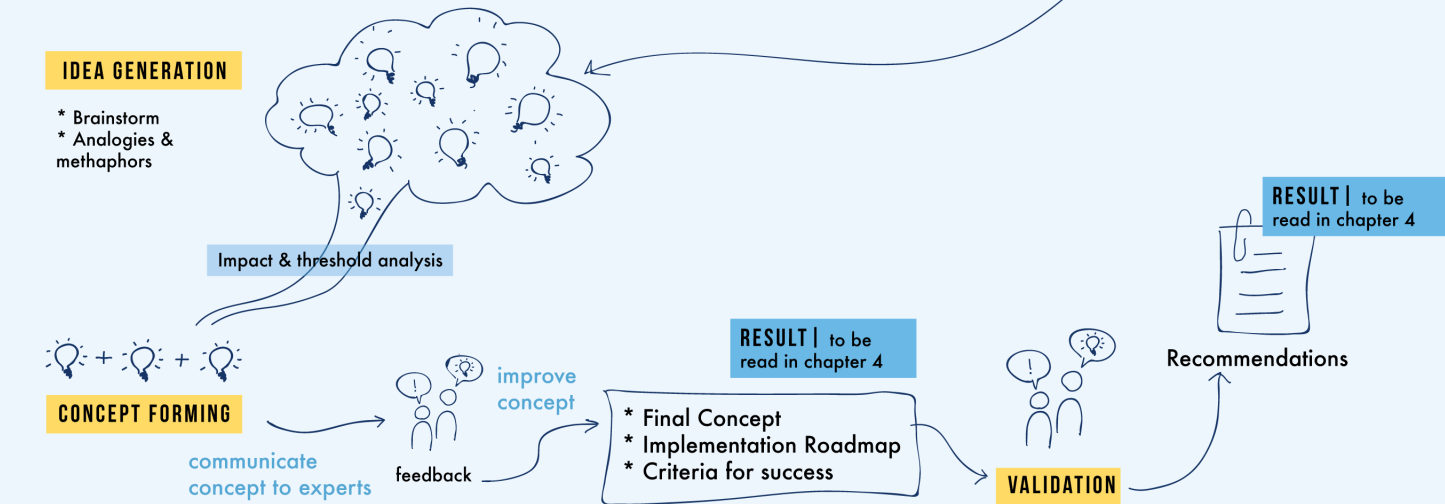
Phase 1: Understand the system



Phase 2: Define where to intervene in the system



Phase 3: Design the intervention



GIGA-MAPPING

Knowledge gained by desk research (and interviews later on) is immediately mapped to process the information, to fully understand it, give it a place within the system, see connections and to not loose any detailed information. Mapping in this extent is called Giga-mapping in the world of SOD.

Giga-mapping

Designers have an advantage for thinking about complex problems: they are able to visualise information. Our mental capacity is limited; putting complex material on paper in a visual way helps with accessing, understanding and communicating information and keeping attention to the details (Sevaldson, B. 2011). Visual practise is essential for systemic design interventions. The most central tool in Systems Oriented Design is Gigamapping: a tool to register, analyze and manage complexity. Giga-mapping is creating a big cloud of information, including the details. 'Normal' mapping tries to order and simplify problems, while Giga-mapping does not intend to 'tame' the issue but to grasp the complexity of the problem.

Different kind of maps are created: image maps, causal loop diagrams and a total organisation map (Sevaldson, B.). Several maps are analyzed and combined into a timeline map (lifecycle of a jeans) with SWOT (Oxford University Press, 2010) elements. The strengths, weaknesses, opportunities and challenges of different actors in the system are defined. Also good case examples are put on the maps. By filling knowledge gaps, new unknown areas were identified. In this way, mapping helped to define the expert network needed and to prepare well-grounded interview questions.

INTERVIEWS

In the first phase, 13 extensive interviews are held (see 'project contributors' at page 138 for the list of interview participants). Brands, denim mills, sortings centers, chemical companies and other industry experts are involved; actors of all different parts of the value chain. By doing these interviews, different viewpoints and agenda's are explored. The different angles have led to an understanding of how the interactions lead to the system's behavior.

All interviews are followed by processing the results into transcripts and expanding or creating new maps to see new relations and cause-and-effects. Giga-maps are not only about big maps full of information, but also about merging different maps to make sense out of them. In this way, a deeper understanding is created than in a normal exploration phase of a design process. During the process of mapping and interviewing, ZIP analyzes are executed.

ZIP analysis

A ZIP analysis is a method to find potential areas in Giga-maps for interventions (Sevaldson, B.). ZIP stands for Zoom, Ideas and Painpoints. The general idea of a ZIP analysis is to systematically investigate the map and mark points where more knowledge is needed, where Painpoints are identified or where Ideas for interventions or innovation pop up. ZIP points can also be marked during developing a map.

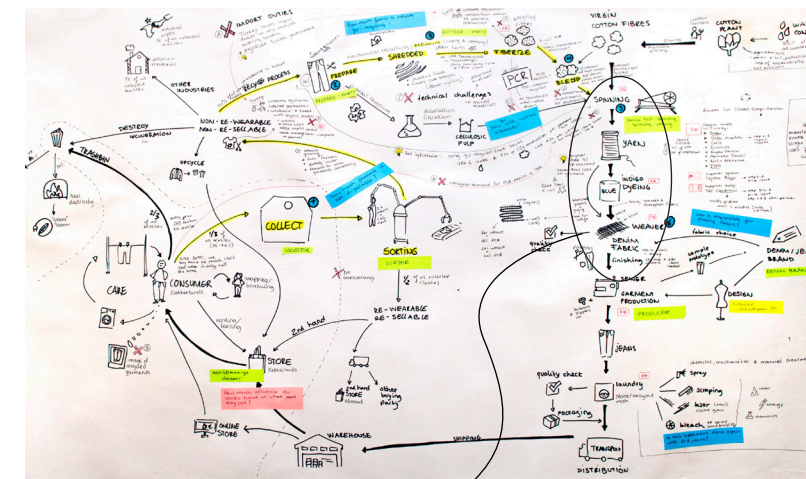


Figure 10. Map of material flow Cycle of pair of jeans

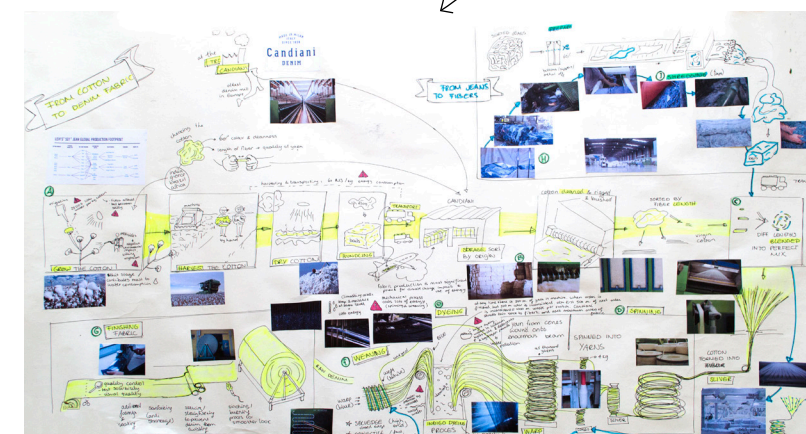


Figure 11. Example of 'Zoom' Image map of the production of jeans

Final Giga-map

Out of the first maps and interviews, a summarizing system map is created. Media is switched, from analog to digital. Switching media accelerates the process and interpretation of the maps. This summarizing map is made visual appealing to be able to use for communication. On the Giga-map, the full cycle of a pair of jeans is displayed including all the bottlenecks and opportunities for recycling cotton and using recycled cotton in jeans production. The final Giga-map is the answer on research question 1. All giga-maps can be found in appendix A.

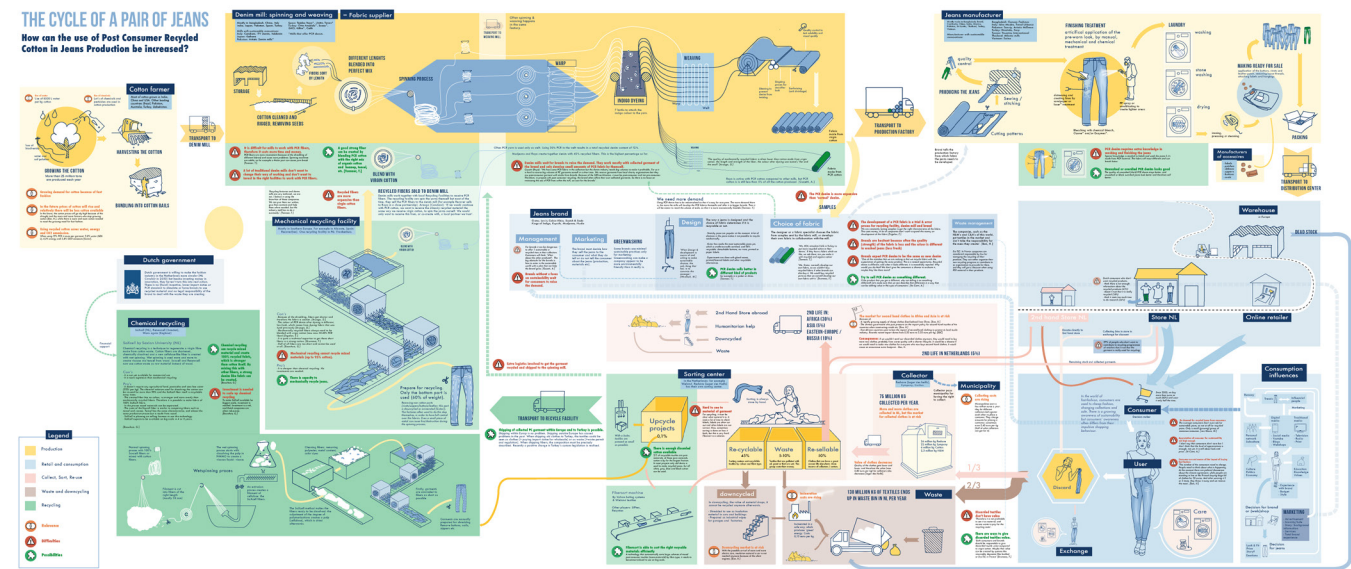


Figure 12. The final Giga-map: The cycle of a pair of jeans.

Phase 2: Define where to intervene in the system

In the second phase is determined which problems need to be tackled, what actors need to be focuses on and what the intervention should accomplish.

EXPERT SESSION

At the beginning of the second phase, one of the biggest jeans-related events of Europe took place in Amsterdam: the Kingpins Show. This is a denim trade show organised once per year where denim mills display their new collections. This is also the place where pioneers show their new innovations, brands come to look for and buy new fabrics and the newest trends are picked up. This event has attracted the most important industry leaders from Europe and Asia to Amsterdam during this week.

To prepare for this week, the first solution areas are defined, derived from the final Giga-map. The map, bottlenecks, opportunities and solution areas are presented in an expert session to 12 international industry leaders during the House of Denim Advisory Board meeting. The presentation was followed by a thorough discussion among the industry leaders about the solution areas and the general idea of using recycled cotton in jeans production. A short pitch at a Leadership Breakfast, also

RESULTS OF PHASE 1 | To be read in chapter 2

- Understanding and visualisation of the current system
- Points of relevance for creating and using PCR cotton
- Bottlenecks in creating and using PCR cotton
- Opportunities for creating and using PCR cotton.



organised by House of Denim, for 50 industry leaders, have lead to interesting conversations during the rest of the Kingpins week.

VISIT CONTEXT

The Kingpins show itself gave more inside information about the context of the problem, since a lot of trade about normal, sustainable and/or recycled fabrics take place as such events.

INTERVIEWS

During this week, five more extensive interviews are held (among others Frank Belochi, president of Calvin Klein and Tommy Hilfiger). In these interviews, findings are discussed and hypotheses are tested. During the Kingpins show, short conversations with more than 10 different denim manufacturers and denim mills have lead to interesting extra insights.

MAPPING

Usefull feedback and a lot of extra information is gained during the expert session and the Kingpins Show. This knowledge is processed: based on the final Gigamap, the expert session and interviews during the Kingpins Show a list of all bottlenecks and challenges of recycling cotton and using recycled cotton is created (see appendix B). To synthesise the extra information, new maps are created. An interconnected circle diagram is made.

Interconnected circle diagram

This diagram can be created to discover relationships and find important parts in the system for your problem area. This map allows for deep exploration of relationships and cause and effect in system dynamics and shows key flows in the system (Acaroglu, 2017). An interconnected circle diagram can be made by documenting 'parts' of the system on little pieces of paper that you can move around. The pieces are placed on the circle, clusters can be made if that is needed. Connections are drawn between the parts and by doing this, dynamic relationships that you didn't think about before can be discovered, as well as areas of more relevance for your intervention (for examples parts that are clearly more connected than other parts).

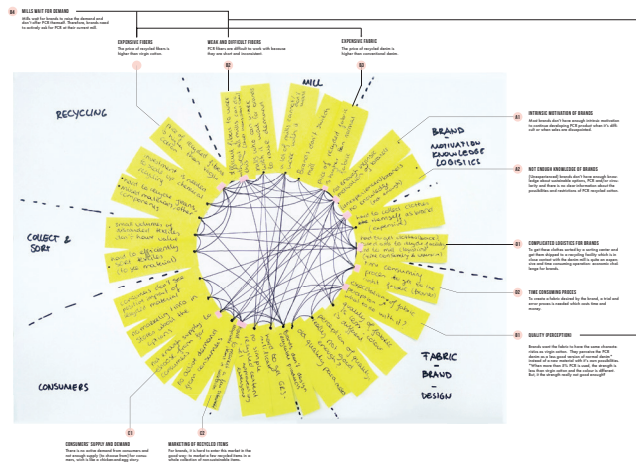


Figure 16. Interconnected Circle Diagram

In this project, the full list of identified bottlenecks is placed as parts on the circle (figure 16). Relations are drawn if problems cause other problems. In this way, the most interrelated problems are defined. The most interrelated problems do not necessarily have to be the most important problems but they have for sure a lot of influence on the situation since solving these problems would make solving the other problems easier.

The problem network

Based on the interconnected circle diagram plus synthesis from the Gigamap and feedback during the Kingpins week, the most important problems are defined. To be able to design for all these important problems, it is important to know how these problems relate to each other; how they cause, reinforce or reduce one and another. Therefore, the problem network is established (See figure 17). In order to communicate the problematics of the situation clearly to stakeholders, the problem network is analyzed and three key problems are identified. With this, research question 2 is answered (What are the biggest issues in producing, using and selling recycled cotton in denim?).

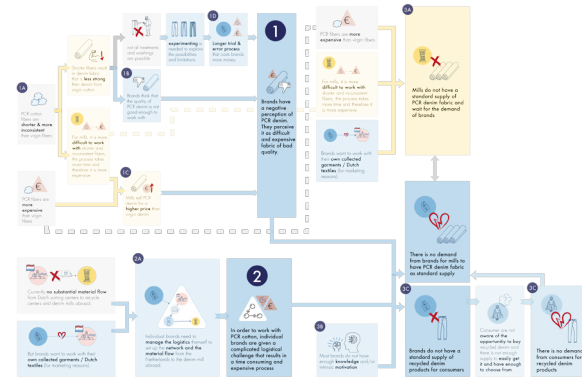


Figure 17. Problem network

Actor mapping

To be able to answer research question 3 (What are the key actor(s) and interaction(s) within the chain where interventions could change the current system?) an actor mapping is made to define the different types within one actor. For example, within the brand-actor their are different types of brands who have a different attitudes towards using recycled cotton. The mapping is based upon the interviews and additional information from desk reserach. Within the map, the type of actors that have potential to focus on in the intervention are indicated. The actormapping is discussed with the client to validate the assumptions made and the defined categories. Based on problem network, the key actors and interaction are determined. With the help of the actor map, within those key actors; the target group is defined.

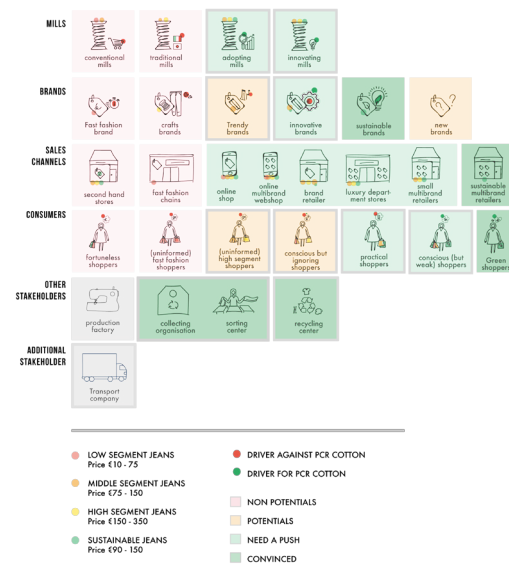


Figure 18. Actor mapping

Design vision & design brief

At this point, the problems that the intervention should solve and the target group that the the intervention should focus on is defined. Now, a conclusion is drawn about what the design should accomplish in the future. Therefore, a design vision in the form of a Future perfect story is created (Tassoul, M. 2009). Based on all above, a design brief is written.

RESULTS OF PHASE 2 | To be read in chapter 3

- Problem network
- Target groups
- Design vision
- Design brief

Phase 3: Design the intervention

IDEA GENERATION

Ideas are already developed during the proces: ideas to find direct solutions to problems, to use potential factors to work around problems and to create new relations in the system. Extra ideas are formed by brainstorming and finding solutions for every part of the problem network. To prevent finding only obvious solutions, the Analogies & metaphors method (Delft Design Guide) is used. The define which ideas could have a positive impact on the current system, an Impact & Threshold analysis is conducted.

Impact & Threshold analysis

This is an evaluation tool in which ideas are analyzed according to the impact the idea could have and the threshold of the idea. Every idea is ranked by 20 parameters, for example the systemic short term impact but also counter effects or ripple effects. Not only economical but also technological, cultural and organisational thresholds are taken into consideration.

CONCEPT FORMING

The different scores of the impact & threshold analysis can be plotted in a graph to see which ideas are most promising: ideas that have high impact but a low threshold. These ideas together have formed the first version of the concept.

This concept is elaborated by looking at the possible impact on the system. The concept is discussed and evaluated with different stakeholders to improve the different aspects of the concept and iterate. An implementation roadmap is created: a step by step guide for House of Denim to implement the concept. Besides that, criteria for succes are defined.

VALIDATION

To write further recommendations for House of Denim, the concept is validated with different stakeholders: brands, mills and collectors. Based on the feedback, extra recommendations are written.

RESULTS OF PHASE 3 | To be read in chapter 4

- Final concept
- Implementation roadmap
- Criteria for design
- Recommendations

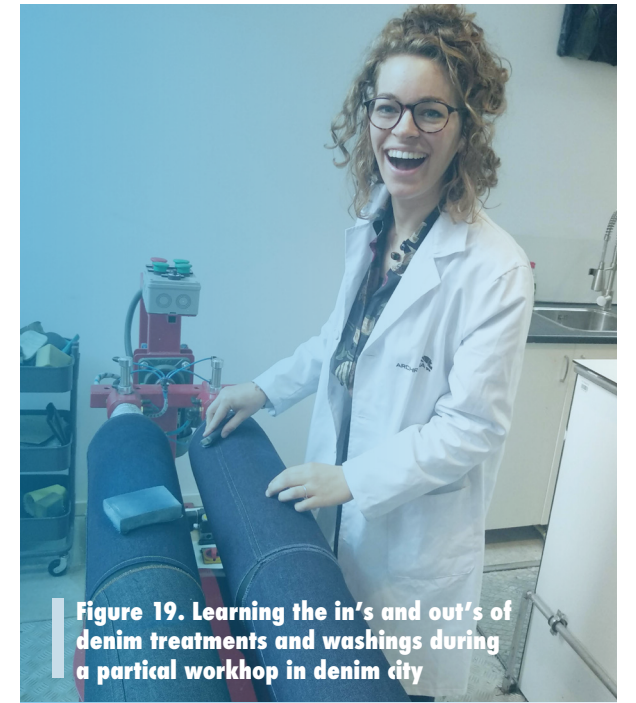


Figure 19. Learning the in's and out's of denim treatments and washings during a partial workshop in denim city

CONTEXT: THE WORLD OF JEANS

In this section you will get to know the world of jeans. It starts with a brief explanation of the origin and development of jeans (2.1). This is followed by going through the whole life cycle (2.2). Production, retailing, consumption, collecting, sorting and recycling will be explained. Difficulties for recycling cotton and using recycled cotton will be discussed. It closes off with explaining the relevance of using PCR cotton in denim production (2.3).

CONTEXT: THE WORLD OF JEANS

2.1 A SHORT INTRODUCTION TO THE WORLD OF JEANS

In the 17th century weavers in Nîmes, France, tried to reproduce a typical Italian fabric. An unsuccessful attempt led to a unique sturdy cotton fabric: Denim. Levi Strauss used this fabric to make pants for gold miners and together with Jacob Davis, he got the idea to make the pants even stronger, by placing copper rivets at the places where pants mostly rip: the jeans is born.

During the development of jeans, the garment has had political and cultural importance. The image changed from workers pants to rebelliousness: it was a symbol for protest, freedom and individuality. During the years, a choice for a typical brand or style defined to which cultural group you belonged to. In the sixties, fashion trends started to move faster and this was the

start of massive textiles mills in developing countries. In the 90ties, fast fashion came up rapidly; shops expanded exponentially into big fast-fashion chains. Making use of overseas sweatshop labor, cheap jeans are produced with incredibly high volumes, which is always combined with unjust labour practises, using an enormous amount of water, using lots of chemicals and producing a massive volume of waste.

The jeans has become a mainstream item in the closet and it is available for everyone: expensive high quality but also cheap fast fashion jeans are on the market nowadays. A slow movement has started with consumers concerned about sustainable and fair production. The industry has reacted and is innovating and investing in more sustainable ways of washing and finishing jeans.

destinations. A part will be used as second hand clothes, a part is incinerated and a part is shipped to a recycle facility. The mechanical **recycler** shreds the jeans. The recycled fibers are mostly downcycled by using it in low-value applications. Only a very small part is used in upcycling projects, since shredding denim results in very short and inconsistent fibers which makes the strength of the yarn less. Because this is not common practise, PCR fibers are more expensive and less available than virgin fibers.

In an upcycling project, the PCR fibers are shipped to a **denim mill** which blends the fibers with virgin fibers and makes new denim out of it. For the mill it is more difficult to work with PCR fibers due to the short length.

The **(jeans) brand** is involved in almost every step. The brand is the driver of the chain and has interactions with every actor of the cycle. Since there is no material flow established from the Netherlands to denim mills, if the brand want to use PCR denim, they needs to establish a network of sorting center, recycling facility and denim mill and get the textiles shipped from one place to the other. This logistical process is quite an expensive and time consuming operation for a brand. Mills wait for brands

to raise the demand and have only a small offer of PCR denim made of locally collected garments.

When a material flow is established, a time consuming trial and error process starts to get to a good PCR fabric. In the industry there is a disagreement amongst brands and mills about the quality of PCR denim: up to what percentage of PCR fibers is the strength of the fabric good enough?

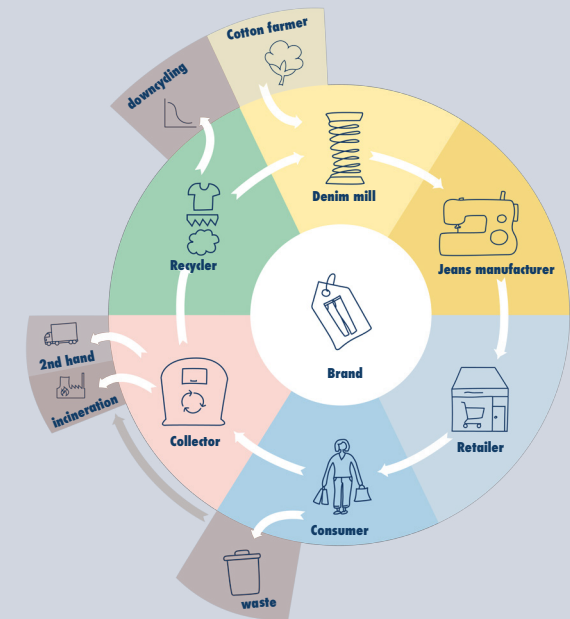
Brands in general perceive the PCR denim as an inferior version of conventional denim instead of a new material with its own possibilities. Since producing products of PCR denim is more expensive and difficult and the quality is lower, brands are not motivated to do this. Besides that, brands often lack knowledge about sustainable options, PCR denim and/or circularity.

There are currently two certifications for recycled content in textiles: The Global Recycle Standard (GRS) and the Recycled Claim Standard (RCS), both executed by Textile Exchange. Since GRS is highly challenging and RCS is not well-known, PCR fabrics are often not certified regarding the recycled content.

2.2 THE LIFECYCLE OF A JEANS

The full cycle of jeans involves many steps and stakeholders.

As mentioned before, denim is made of cotton. Therefore the cycle starts at the **cotton farmer**. Cotton cultivation leads to extreme consumption of water and chemicals. From the cotton farmer it is transported to a denim mill. In the **denim mill** traditional spinning, chemical dyeing and weaving takes place. The result: denim fabric. This is shipped to the **jeans manufacturer**. Here it gets cut into pieces and sewn into completed jeans. Then, the jeans is ready for finishing to get the right appearance. The finished jeans is transported to warehouses from where it is send to **retailers** and wholesalers. They sell it to the consumer. The **consumer** is wearing the jeans and when the user does not want the jeans anymore, he or she gives it to someone else for a second life, throws it in the bin or donates it to a collecting organisation. The **collector** sorts the textiles manually and gives it different



3.3 THE RELEVANCE OF PCR

Why does the use of PCR cotton needs to be stimulated?

Growing demand for cotton and less environmental impact
Because of the fast fashion development, the demand for cotton is still increasing: more and more cotton is needed to meet the growing need. Predicted is, that there is not enough cotton, water, or 'anything' to continue producing like we are doing now. Besides that, avoiding cotton cultivation leads to saving hundreds of liters waters and the use of less chemicals.

Using discarded textiles
Using discarded textiles for recycling reduces the amount of textiles incinerated. It prevents valuable materials from being destroyed. Using discarded textiles also reduces the need for land space.

Business
Besides the environmental impact of incinerating textiles, recycling more textiles can stimulate the business of collecting positively. Being able to sell more garments for recycling would ensure the

business of collecting. But not only for collectors, also for brands and textile companies it makes good business sense to invest in a circular industry.

A step towards a circular economy
Recycling more post-consumer waste and using this in denim production is one of the steps needed to work towards a circular economy. The ability to produce denim with a high percentage of PCR cotton is limited by a technological bottleneck. However, promising new technologies are about to be commercialised and promise to revolutionise the textile industry in the future. We need to make the industry, the consumers and the government ready for once new technologies are improved and up-scaled. Besides that, we need to stimulate it by increasing the demand for recycled materials: this will accelerate the developments and expand the availability of the technologies we need.

CHAPTER 2.1

A SHORT INTRODUCTION TO THE WORLD OF JEANS

This section will give a brief introduction in the origin and development of jeans. From workers pants, to a symbol for rebelliousness. From a status symbol to a mainstream item in everyone's closet.

FROM WORKERS PANTS TO (FAST) FASHION ITEM



So, we are talking about jeans. Everybody owns jeans. But what actually defines jeans? What is the origin? And how did they develop?

The origin of denim and jeans

In the 17th century, weavers in Nîmes, France, tried to reproduce a typical Italian fabric. An unsuccessful attempt led to a unique sturdy cotton fabric: a fabric using a twill weave of one blue thread (dyed with Indigo) (called the warp) and one white thread (called the weft). In this way, the fabric had a unique blue colour on one side and was white on the other side. They called the fabric Serge de Nîmes, which has later become 'Denim'. In 1851, Levi Strauss moved from Germany to America and started a business in pants for gold miners and other workers. He used the strong cotton Serge de Nîmes from France. Together with Jacob Davis, he got the idea to make the pants even stronger, by placing copper rivets at the places where pants mostly rip: the jeans is born. The copper rivets and the tight twill weave of a blue warp and white weft are still characteristics of jeans. This leads to a unique aspect of denim: when wearing the jeans, the blue color of jeans fades to white on places that have friction.

Political and cultural importance

During the development of jeans, the garment had political and cultural importance. In the beginning of the 20th century, Levi's got their first competitors by new brands putting jeans on the market for cowboys, miners and farmers. In the 30s, Hollywood has popularised jeans and the first women's jeans were put on the market by Levi's, a symbol for a contribution to women's fight for equality. The Second World War brought jeans to Europe. In the fifties, the image of jeans changed from workers pants to rebelliousness. The hippie movement embraced jeans and it became a symbol for protest, freedom and individuality. In the 80s and 90s, the first designer brands launched jeans. Having designer jeans was a status symbol. But also in these days, another denim culture developed, hip-hop jeans: baggy and wide-legged. A personal choice for a typical brand or style defined to which cultural group you belonged to.

The dark side of jeans

In the sixties, fashion trends started to move faster and this was the start of massive textile mills in developing countries so that America and Europe could save money by outsourcing their labour. In these days the worn appearance became a hit and different finishings and washings were developed, which caused a negative impact on the environment because of the use of chemicals and large amounts of water. In the 90s, fast fashion came up rapidly; shops expanded exponentially into big fast-

fashion chains. The fast fashion businesses started to develop cheap jeans with lower quality; cheaper denim made from a mix of cotton and polyester fibers. Making use of overseas sweatshop labour, 30 euro jeans are produced in incredibly high volumes, which is always combined with unjust labour practices, using an enormous amount of water, using lots of chemicals and producing a massive volume of waste. Where once Italy and America were the producing countries, the mass production moved to China, Bangladesh, Turkey, Brazil, India and Vietnam. Local mills and craftsmen are priced out.

Nowadays

Since the day jeans entered in leisure wear, they never left the streets. Different styles have come and left. It could be this diversity that has made the jeans survive all fashion changes and economic challenges. Expensive high quality but also cheap fast fashion jeans are on the market nowadays: it is available for everyone and the jeans has become a mainstream item in the closet. Because the modern consumer is used to stretchy clothes, most denim are 89% cotton and 2% elastane nowadays. Levi's, Diesel and G-star are the biggest denim brands worldwide (FashionUnited, 2016). The size of the global denim industry is 56.2 billion dollars (Goldman, 2017).

Sustainable denim

A slow movement has started with consumers being concerned about sustainable and fair production. The industry has reacted and is innovating and investing in more sustainable ways of washing and finishing jeans. New denim brands with the same concerns have popped up, such as Kuyichi (2001) and Mudjeans (2012). Also premium denim brands have implemented sustainable practices.

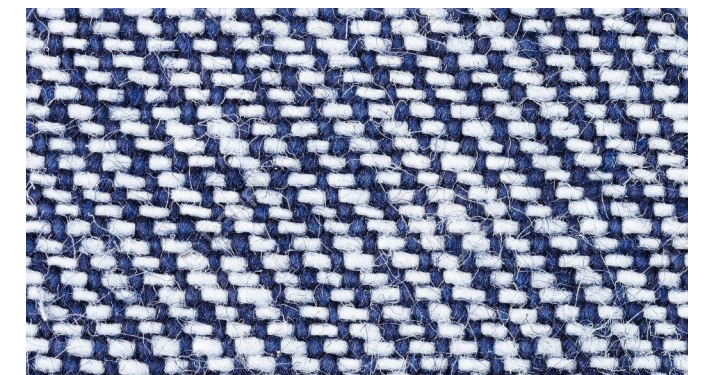


Figure 20. Denim: weave of blue warp and white weft.

Do you want to know more about the history of jeans? Read supporting chapter 2.1.

CHAPTER 2.2

THE LIFECYCLE OF A JEANS

To know how to solve the problem, it is important to know the current situation. Thorough research is executed with the goal to fully understand the system around the use of recycled cotton in jeans production. By executing 13 extensive interviews with actors from different parts of the value chain, knowledge is gained about the lifecycle of denim products. In this chapter the current situation is described by giving an overview of the full cycle. The overview shows the answer to the first research question: 1. What does the current landscape of collection of textiles in the Netherlands, recycling of cotton and the production and consumption of denim look like? This section closes off with the explanation of how the quality of denim is currently tested and what certifications exist for recycled textiles.

The lifecycle of jeans

The full cycle of jeans, visualised in figure 21, involves many steps and stakeholders. Every step of the cycle will be shortly explained. The information is based on desk research and interviews with different stakeholders. For a thorough explanation of the lifecycle, please read supporting chapter 2.2. In the short explanation of the lifecycle, bottlenecks and opportunities are indicated by:



Difficulties in producing and using recycled cotton



Possibilities for producing and using recycled cotton

A short introduction

As mentioned before, denim is made of cotton. Therefore the cycle starts at the **cotton farmer**. There, the cotton is grown and harvested and from there, it will be transported to a **denim mill**. In the denim mill traditional spinning, chemical dyeing and weaving takes place. The result: denim fabric. This is shipped to the **jeans manufacturer**. Here it gets cut into pieces and sewn into completed jeans, all in an assembly-line. Then, the jeans is ready for finishing: a combination of wet treatments and dry treatments is given for the right appearance. The finished jeans is transported to warehouses from where it is sent to **retailers** and wholesalers. They sell it to the **consumer**. The consumer is wearing the jeans, or gives it to someone who will wear it. When the user does not want the jeans anymore, he or she gives it to someone else for a second life, throws it in the **trash bin** or donates it to a collecting organisation. The **collector** sorts the textiles and gives it different destinations. A part will be used as second hand clothes, a part is incinerated and a part is shipped to a recycle facility. The **recycler** shreds the jeans. The recycled fibers are downcycled by using it in low-value applications or they are shipped to a denim mill that uses them to make new yarn. The (jeans) brand is involved in almost every step.

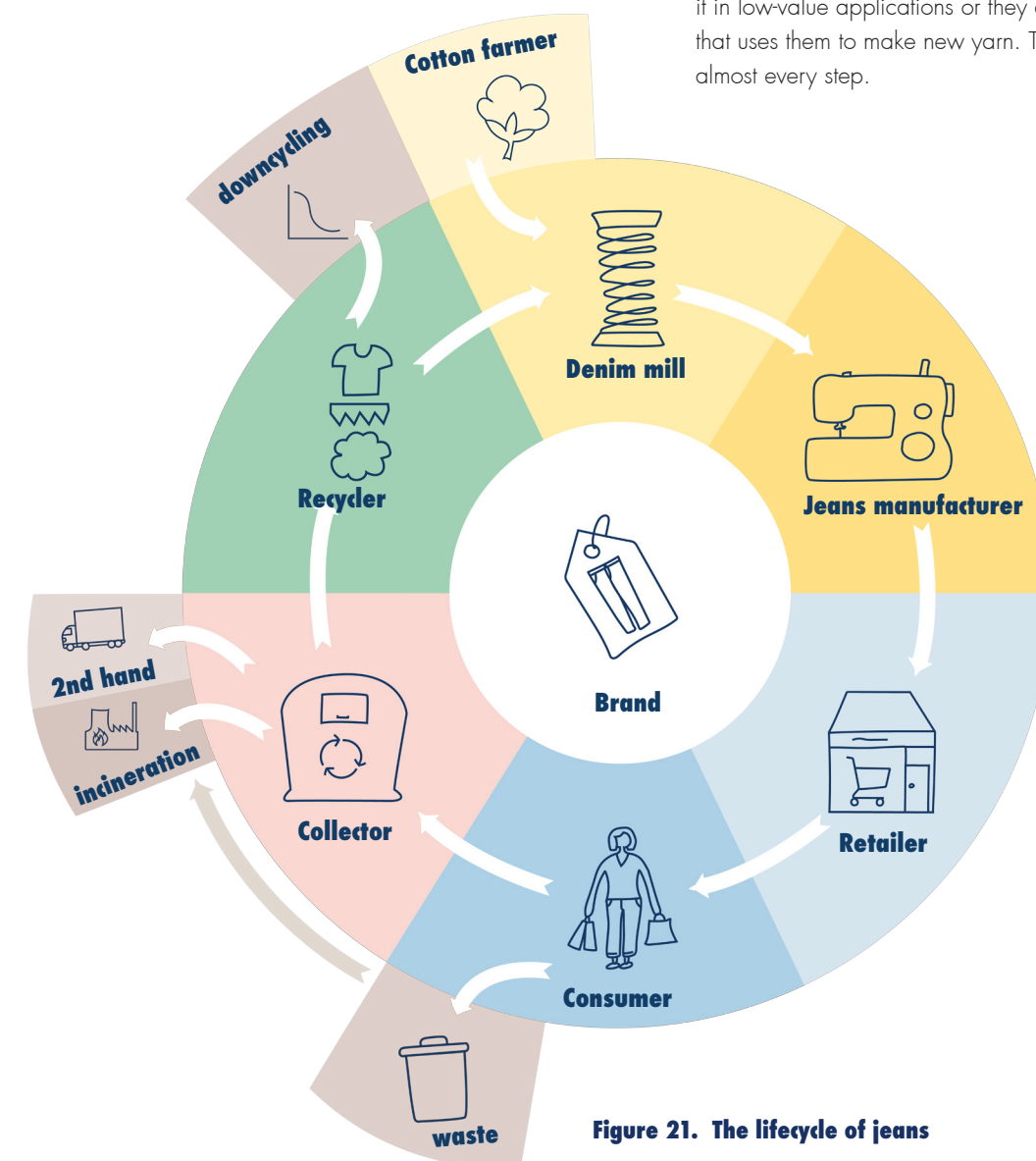
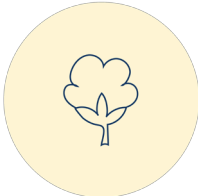


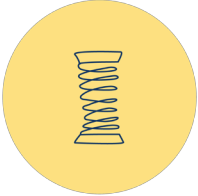
Figure 21. The lifecycle of jeans

A SHORT STEP BY STEP EXPLANATION OF THE CYCLE OF JEANS



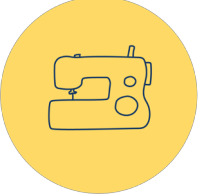
Cotton farmer

The main raw material of denim is cotton. Cotton is harvested and bundled into cotton bails, which are shipped to different fabric mills. Most of the cotton grows in India, China and USA. More than 29 million tons of cotton are produced yearly (The world counts, 2019).The cultivation of conventional cotton is linked to various environmental, social and economic issues (Oxfam Novib and others, 2009). Cotton cultivation leads to extreme consumption of water and chemicals: 8500 liter water is used to grow 1 kg conventional cotton, from which 2 pairs of jeans can be made (Oxfam Novib and others, 2009). Using this amount of water and chemicals leads to water and soil pollution, loss of biodiversity, a shortage in irrigation- and drinking water and soil erosion. In addition to this, there is still a lot of forced labour and child labour in cotton farming and the pesticides used in farming are highly toxic. Financially cotton farming is not a viable activity for farmers in developing countries. The demand for ‘better’ cotton has led to multiple initiatives and benchmarks. However, there is a lot of corruption and no transparency in the cotton chain.



Denim mill

In a denim mill, cotton fibers are turned into denim fabric. Worldwide, there are 513 denim mills (Fashion United, 2016). Most of them are located in China, Bangladesh, Italy, India, Japan, Pakistan, Spain and Turkey. In the denim mill, the cotton is cleaned and rigged and seeds are removed. The fibers are sort by length and blended into a perfect mix. With a spinning process, the fibers are formed into yarn. After spinning, a part of the yarns are wound onto a beam forming the ‘warp’. The warp is dyed by dipping it into several indigo baths. After dyeing, the yarn is rinsed with water and dried. The denim fabric is woven by inserting a white yarn into the blue threads. After weaving, the fabric undergoes a basic finishing process. The spinning and weaving processes are dry processes but use a lot of energy. The dyeing process is associated with (chemical) pollution and extreme water consumption.



Jeans manufacturer

At the jeans manufacturer denim products are created and finished. The pattern is cut out of the fabric and the pieces are sewn manually. Almost all jeans are ‘finished’ to make the denim look worn, rugged, broken and used. Several finishing techniques are used to obtain or avoid colour changes and create lighter areas. After finishing, accessories are attached, the pair of jeans is inspected and ready for transport to retail (CBI, 2016). Most of the jeans are manufactured in Bangladesh, Brazil, Cambodia, China, India, Mexico, Pakistan, Sri Lanka, Thailand, Turkey, Vietnam. The jeans production mostly leads to negative social impact. People have to work hard and long hours for low wages in bad working conditions. The finishing treatments are toxic. The old school finishings result in reducing the strength of the jeans: this decreases the technical life time of the jeans.



Retailer

The products are transported to warehouses. From there, they are distributed amongst the different sales channels: retail, wholesale and e-commerce. The transport throughout the whole process combined with the retail is responsible for 11% of the CO2 emissions of a pair of jeans (Levi Strauss & Co., 2015). The largest suppliers of jeans to the Netherlands are Bangladesh, Turkey, Tunisia and China (CBI, 2014). The yearly production of jeans counts 2 billion jeans worldwide (CBI, 2016). Only 1.25 billion jeans are sold annually (Goldman, 2017), so more than 35% is never sold. The overstock, yearly 750 million pairs of jeans that are never used, is incinerated or end ups as landfill, which has a huge environmental impact. In the Netherlands, 21 million jeans are sold yearly (Chung, 2016) for an average consumer price of 45 euro (CBI, 2014).



Consumer

Consuming

Fast-fashion has caused a rapid growth in consumption: in the last 15 years, we buy more than twice as much (Ellen MacArthur Foundation, 2017). In denim we have seen a growth of 20% in the last couple of years. By buying a non-sustainable denim product, a consumer contributes to all the negative social and environmental consequences of producing all parts of the product. Besides that, garments also have a negative impact during use (water consumption and CO2 emission) and it causes an enormous amount of waste. The majority of the consumers is not aware of the impact of buying non-sustainable fashion and not aware of the possibility to consume sustainably. The awareness is growing amongst consumers but only a small part is buying sustainable clothes: there is a gap between attitude and behaviour. The appreciation for sustainability is not high enough to act upon it.



On the one hand, there is no active demand for recycled denim from consumers and on the other hand, there is not enough supply for consumers to choose from. This influences each other negatively.



Figure 22. Jeans manufacturing



Figure 23. Denim prepared for shredding

Discarding jeans

Of all clothes that are not wanted anymore, still 2/3 ends up in the regular trash bin: 1.24 million kg of textiles in the Netherlands per year (Sympany, 2017). This waste is being incinerated. This does not only lead to wasting existing resources but also contributes to the greenhouse effect. The other 1/3 of the textiles is donated, in the Netherlands mostly to collecting bins placed in the municipalities. Compared to other countries, **the Dutch collection rate of 30% of all textiles is a relatively high collection rate.**



Collector

Collectors receive textiles in the collecting bins and sell the textiles to sorting centers whereby some collectors have their own sorting center. The most important Dutch players are Reshare (Leger des Heills) and Sympany. The business of collecting is at risk: the costs of collecting are rising because in every municipality different parties have to bid against one another to place a container. Also, more clothes are collected but the quality of the clothes is diminishing, and therefore the value for collectors also decreases.



Sorting center

In the sorting centers, textiles are sorted. The first group, containing half of the clothes, is re-wearable: this forms the main income of sorting centers. Most of these clothes get a second life abroad. However, this important outlet is endangered since fast fashion, thus lower priced clothes, is a big competitor to our second hand clothes in less developed countries. The second group contains dirty or wet textiles; 'waste' that has to be incinerated. This group is growing and incineration costs are rising. When textiles are not sellable anymore, they are sorted by colour and fibre type to be recycled. Almost all these clothes are downcycled, they are used as industrial wipes or shredded to use as insulation material. The markets for both downcycled products and second hand clothes abroad are endangered. Being able to sell more garments for recycling would ensure the business of collecting; therefore **sorting centers look for new business models and are highly motivated to participate in a circular flow.** At the moment, less than 0,1% of the collected textiles in the Netherlands are recycled into products with the same or higher value (upcycling).



Since denim is made out of cotton, it could be partly made of recycled cotton (white, grey, blue or black).



This has to be pure material (>95% cotton) since **it is not possible to mechanically recycle mixed materials.** However, **there is 'enough' pure cotton available in the Netherlands to set up an upcycling chain.**



The biggest bottleneck at this stage is to sort the pure cotton: **sorting is nowadays mostly done by hand but in this way, it is hard to see the material of textiles.** Luckily, automatic sorting systems are developing. Wieland has developed 'Fibersort': a machine that is able to sort the right recyclable materials efficiently.



Automatic sorting machines need to become widely available for all sorting centers in the Netherlands in order to provide the industry with high and consistent quality of recycled materials.



Recycler

Mechanical recycling

As mentioned before, there are currently two ways of recycling cotton: mechanical and chemical. The traditional and most common way is mechanical recycling. In this process garments are prepared by removing all non cotton parts: only 60 to 65% of the total weight of the jeans can go into the shredding machines, in which they are shredded back into fibers (small, thin threads). The recycled fibers are sold to denim mills. **Shredding creates fibers that are shorter than virgin fibers. Therefore the strength and quality of the yarn and the fabric will be less (Arzaga, D. of Royo Tejidos)** When we look at denim, most of the upcycling is done in small projects and focused on creating denim out of old denim. Since denim is tightly woven, PCR denim fibers are even shorter than other PCR cotton textiles. The PCR fibers need to be mixed with virgin fibers. From the blend, new yarn can be spun.



Recycled fibers are not only shorter but also more expensive, less consistent and less available than virgin cotton, which makes virgin cotton more popular than recycled cotton. There is hardly recycle capacity in the Netherlands, having one recycling facility in the country named Frankenhuis. Until now, most PCR projects so far are done in Spain and Turkey with denim mills that are in close collaboration with mechanical recycling facilities. **The close collaboration is needed because the mills need to have full control over the content of the fibers;** even a small piece of metal can cause destruction during the spinning process.

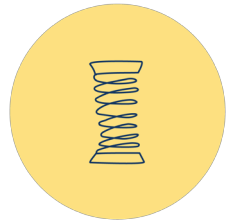


The way a jeans is designed and produced determines if it is recyclable or not. In order to work towards a fully circular economy, all fashion items need to be designed with recyclability in mind.

Chemical recycling

The other recycling technology for cotton is chemical recycling. Chemical recycling is chemically dissolving of textiles into its basic chemical building blocks. Through this high-value recycling route, mixed materials can be separated, new fibers with the same or higher quality can be created and 100% recycled textiles can be made. This technology is not yet available for commercial use and is more expensive than mechanical recycling but the Dutch chemical recycling center SaXcell expects it to be available on big scale in 4 or 5 years. **Investment is needed to scale up and make it widely available.**

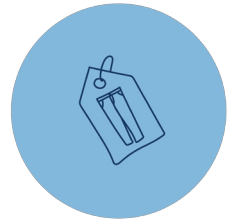




Denim mill 2.0



Denim mills that produce PCR denim buy the fibers from their recycling partner, blend it with virgin fibers and spin PCR yarn from it. The PCR yarn is often only used as ‘weft’ during weaving since this thread is exposed to less pressure than the warp thread. Not all denim mills work with PCR fibers: **because of their short length and inconsistency, PCR fibers are difficult to work with and it takes quite a technical expertise to make a strong cotton material out of it.** However, with good research & development, a strong yarn can be created: **the strength depends on the percentage of PCR used and by blending PCR fibers with organic cotton and a strong fiber such as hennep and or tencel, higher percentages of PCR cotton can be used.** Besides the strength, the **colour of recycled denim is slightly different** which can make recycled jeans less visual appealing. Because of the different fabric characteristics, the jeans manufacturer needs extra knowledge to wash and finish PCR jeans; it reacts different and can break faster. For brands, as well as mill and manufacturers, it is important to know the possibilities and limitations of the fabric.



Brand



Last but not least, the brand. The brand is the driver of the chain and has interactions with every actor of the cycle. When the brand decides to put new jeans on the market, it designs new jeans and chooses the fabric from samples of the denim mill they usually work with, or develops its own fabric in collaboration with the mill (Bruinsma, 2019). The brand tells the manufacturer what fabric they need to make the jeans from.

In order to make jeans out of PCR denim, brands can choose a PCR sample already produced by the mill (from locally collected textiles) or manage the collection of textiles themselves, getting these recycled and made into new denim. Choosing the pre-produced denim is not common, since there is not much to choose from and the marketing story is stronger when the recycled material is made from garments collected by the brand itself (“Jeans made out of our own jeans”) (Guzetti, 2019).

There is no material flow established from the Netherlands to denim mills abroad.



Therefore, the brand needs to establish a source of post consumer garments themselves (collecting in shop or collaborating with a sorting center), establish the network of a sorting center, recycling facility and denim mill and get the textiles shipped from one place to the other. **This logistical process is quite an expensive and time consuming operation for a brand:** an economic challenge. Because most brands want to deliver their own textiles to recycle, **mills wait for brands to raise the demand** and have only a small offer of PCR denim made of locally collected garments. Therefore, the brand needs to actively ask for recycled material. When a material flow is established, **a time consuming trial and error process starts to develop a good PCR fabric.** Because of the short and coloured fibers, it is more difficult to get to a fabric the brand likes. Since only a few brands have created jeans made of PCR denim, all the operations around recycling cotton are at small scale. In order to make using PCR denim economically feasible, the process needs to be industrialised and a volume of scale needs to be reached.

As mentioned before, PCR cotton is less strong. **In the industry, there is a disagreement amongst brands and mills about the quality of PCR denim:** up to what percentage of PCR fibers is the strength of the fabric good enough? The highest percentage so far (40% PCR content) is reached by Royo Teijidos in collaboration with the jeans brand Mudjeans (Engelen, 2019): a milestone for the industry but widely criticised by other brands. A percentage too high could lead to a jeans that does not last long enough, which is not sustainable after all. In general, brands perceive the PCR denim as an inferior version of conventional denim instead of a new material with its own possibilities. Brands expect the fabric to have the same characteristics as virgin cotton and by using old quality parameters, PCR denim is always compared to virgin cotton.

Since producing products of PCR denim is more expensive and difficult and the quality is lower, **brands are not motivated to do this.** Also, in the Netherlands, **there is no (fiscal) incentive from the government to use recycled material.** To make the use of PCR denim profitable, the communication towards consumers is important. However, to **enter the sustainable market with 1 or 2 items in the collection can be difficult.** Besides that, there are much easier ways to do something sustainable as a brand (which will bring a similar positive story to the consumer). Therefore, brands who start with sustainable practises will first try other sustainable innovations and **wait for consumers to raise the demand for recycled items.** Only intrinsic motivated brands use PCR denim. Furthermore, most of the brands **do not have enough knowledge about sustainable options, PCR denim and/or circularity,** so do not see the relevance of using recycled textiles.

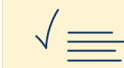
Figure 24. Mechanically recycled denim in different stages of the recycling process



Figure 25. Spinning PCR cotton thread



QUALITY AND CERTIFICATIONS



Quality Assurance

As explained on the previous page, the quality of PCR cotton is a tricky topic within the industry. The critical and slightly conservative minds disapprove the use of 30-40% PCR, since the jeans wouldn't last 10 years but only 2 or 3 years. However, no long-term research is done on what the significant relation is between the percentage of PCR material and the durability of the product. Besides that, it is arguable if a jeans needs to last for 10 years, looking at the current way of consuming. Also, it is debatable whether brands use material specifications that are outdated, since these have never changed since decades ago. Progressive minds have the opinion that brands follow such strict material specifications that PCR cotton cannot compete with virgin cotton. Yet it can still be sufficient to fulfil the requirements of middle quality jeans.

Tests

Currently, denim fabrics are tested on their quality multiple times throughout the value chain. When a denim mill is producing a new fabric, it tests physical properties like the tearing strength, tensile strength and resistance of color holding on to the fabric (rocking test). When a acceptable fabric is developed, production can start. Production happens in different batches because of a discontinuous dyeing process. Since indigo is unstable, every 'dye lot' is different. Besides checking the colour, batches are checked on weaving bugs (resulting in how much fabric cannot be used) and on shrinkage. The brands often test the fabric on possible washing and treatments. The strictness of the physical properties can be defined by a mill or brand. Often, certain ISO norms for textile specifications are followed. In the interviews, the limited knowledge of brands about the technical specifications of denim is mentioned a couple of times. Probably, more than 1 brand uses requirements for recycled material based on practises a long time ago.



Certifications for recycled content.

There are currently two certifications for recycled content in textiles: The Global Recycle Standard (GRS) and the Recycled Claim Standard (RCS), both managed by Textile Exchange. From these two, only the GRS is a well known standard in the industry. To receive a GRS certification the product should contains at least 20% Recycled Material. Suppliers mentioned the difficulty to attain this standard because of the strict requirements: the GRS standard is not only a content certification but has additional social, environmental and chemical processing requirements. Each stage of production is required to be certified, beginning at the recycling stage and ending at the last seller in the final business-to-business transaction. According to the organisation, the GRS is only aimed at eliminating the worst practices, but in practise, it is still difficult for many suppliers to attain. The 'post-consumer' label can only be given if there is proof that it is not mixed with pre-consumer textiles (e.g. overstock). Often mills do not know if this has happened in the sorting centers. Besides that it is difficult due to the additional requirements and the minimal percentage of PCR. The RCS standard is easier to attain since it is only a content claim (with a minimal of 5%) but this certification is not wide spread in the denim industry. Next to this, both standards do not address the quality of the fabric. Since GRS is highly challenging and RCS is not well-known, PCR fabrics are often not certified regarding the recycled content. This makes the fabric and the recycling practises untransparent. This uncertainty makes the fabric even less attractive for brands to work with.

SEE APPENDIX B
for a list of all the difficulties in producing and using
PCR cotton.

SEE SUPPORTING CHAPTER 2.2
for the full explanation of the lifecycle with all the difficulties,
opportunities and points of relevance per actor.

CHAPTER 2.3

THE RELEVANCE OF PCR

Why does the use of PCR cotton needs to be stimulated? In this section, a clear summary will be given of the relevance of recycling cotton and using recycled cotton in denim production.

WHY DOES THE USE OF PCR COTTON NEEDS TO BE STIMULATED?

By recycling cotton and using it in denim production, not only less virgin cotton is needed but also less existing resources are wasted: the knife cuts at both sides. This has both environmental as business advantages. All aspects are described in this section.

Cotton cultivation

Growing need for and pressure on virgin cotton

Because of the fast fashion development, the demand for cotton is still increasing: more and more cotton is needed to meet the growing need. Hans Bon of collecting center Wieland predicted that the cotton prices soon will go sky-high because of the demand on the one hand and the availability on the other hand: more and more farmers stop growing cotton and the draught has negative impacts. Also Franck Belochi, president of Calvin Klein, explained in the interview that there is not enough cotton, water, or 'anything' to continue producing like we are doing now. According to him, we are using the full capacity of the world to provide only 1/3 of the world to consume fashion (Europe and USA), while there is a 2/3 coming (Asia). The speculations of Belochi about the growing need are confirmed by the fashion report 'The State of Fashion 2018' of McKinsey & Company. In 2018, for the first time more than half of the apparel and footwear sales are originated outside of Europe and North America thanks to emerging markets in Asia-Pacific and Latin America.

As mentioned in the 'closing the Loop' report of Circle Economy, not investing in a circular resource industry will mean making your

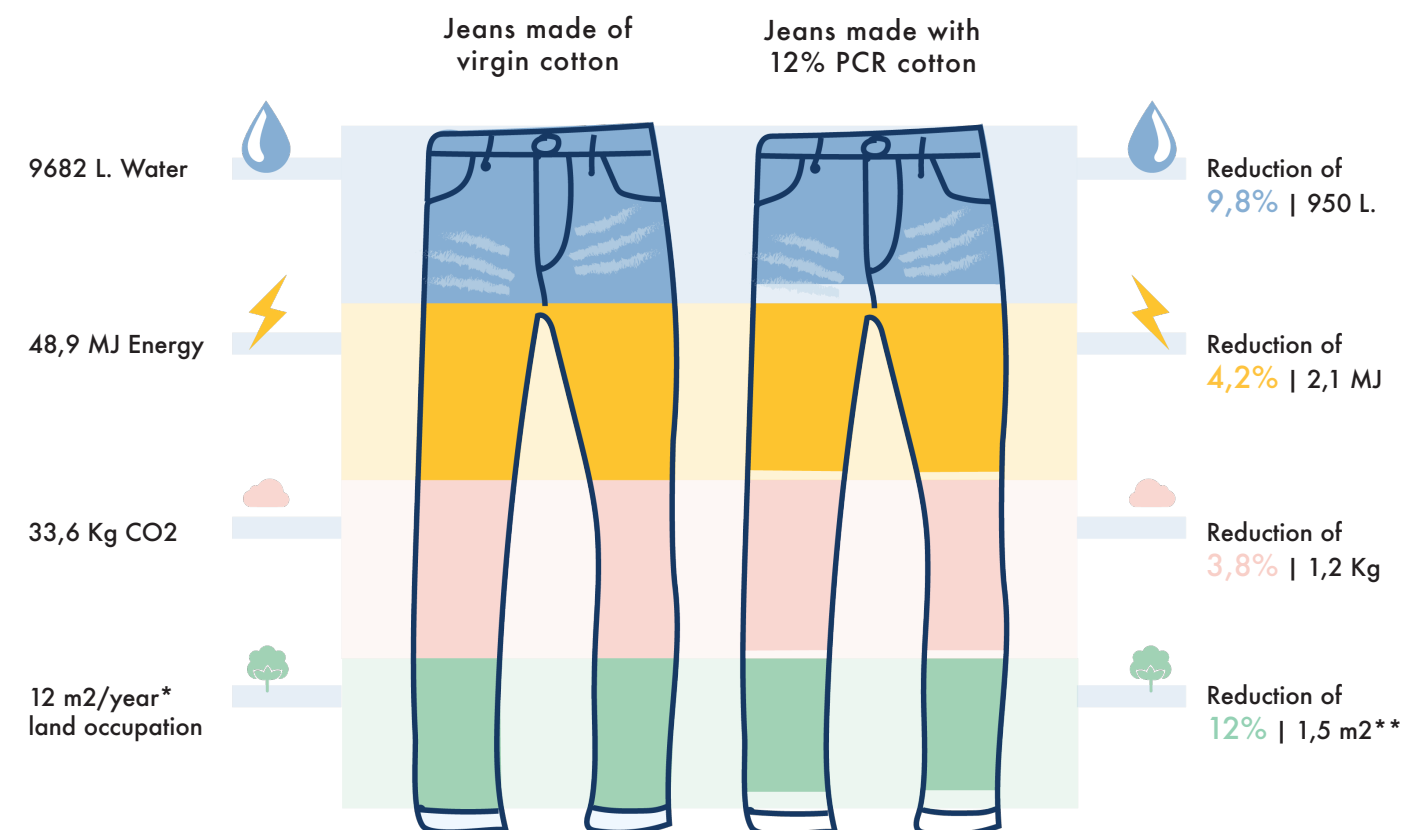
company particularly vulnerable to a sourcing crisis in the not too distant future, when virgin prices flare due to inevitable resource scarcity (Mathews, 2015). Also according to Cecilia Brännsten, sustainability business expert at H&M, the fashion industry is too dependent on natural resources and we must change how fashion is made (McGregor, 2015).

Environmental impact: saving water

In figure 26, four diagrams of environmental impact are shown: the consumption of water, energy, CO2 emissions and land occupation. The impact analysis shows that a recycled denim fabric with only 12% recycled content has a significant lower environmental impact than its virgin equivalent: water consumption can be reduced by 9,8%, energy consumption by 4,2% and CO2 emissions could be cut by 3,8%. Since spinning and weaving are the highest contributors to energy consumption and these impacts are not avoided with recycled yarns, the electricity savings are not outstanding. However, avoiding cotton cultivation by using PCR cotton leads to saving hundreds of liters water. Using less water will lower the water shortage, soil erosion, water depletion and the loss of biodiversity.

Environmental impact: use of chemicals

Cotton cultivation makes use of a lot of chemicals. This causes negative environmental (and social) impact. The use of chemicals causes (drinking) water and soil pollution, loss of biodiversity and soil erosion. Using recycled cotton will lead to the use of less chemicals.



Main source: Pilot project executed by G-star raw and Circle Economy (Circle Case study, 2016)

The exact numbers are calculated with the assumption that 2 pair of jeans are created out of 1 kg denim.

* Source: Life cycle of a jean, Levi Strauss & Co. (2015).

** Own assumption

Figure 26. A comparison of the environmental impact of jeans made of virgin cotton VS 12% PCR cotton

Discarded textiles

Waste of resources

Using discarded textiles for recycling reduces the amount of textiles incinerated. While incineration does produce useful energy, valuable materials are destroyed which could have been reused to make new higher value end products.

CO2 emissions

Incinerating textiles lead to CO2 emissions. Using discarded textiles for recycling prevents partly incineration, thus reduces the amount of CO2 emissions.

Land occupation.

Using recycled cotton reduces the need for space: on the one hand less textiles occupy landfill space (also counts when incinerated) and on the other hand, less land is needed for cotton cultivation. In the future land is needed for growing food, mentioned by Dr Kate Goldsworthy, University of the Arts London (Mathews, 2015): "Resources are becoming more scarce and we're running out of land for growing food. Agricultural land can't be used for fibres when it's needed for food. Keeping textiles and fibres endlessly circulating makes good business sense."

Business

The market for collected textiles is in danger.

Besides the environmental impact of incinerating textiles, recycling more textiles can stimulate the business of collecting positively. With the current developments, the sorting business is at risk. Sorting centers have to pay more and more money to be able to collect clothes. These clothes have lower value and therefore more often need to be incinerated, which also costs them money. The markets for both downcycled products and second hand clothes abroad are endangered. Being able to sell more garments for recycling would ensure the business of collecting. The denim industry can create a new flourishing market for the collecting and sorting industry which gives this business more financial stability.

Working towards a circular denim industry makes good business sense.

Not only for collectors, but also for brands and textile companies it makes good business sense to invest in a circular industry. A lot of companies know that adapting circular economy principles will outcompete their rivals in the long run, but are scared to invest money. If brands or textiles companies would invest in sustainable innovation contributing to a circular economy, it would give them a leading position worldwide.

A step towards a circular economy

As explained in chapter 1.4, recycling more post-consumer waste and using this in denim production is one of the steps needed to work towards a circular economy. To design out waste, it is important to increase the percentage of recycled content in new textiles.

As mentioned in the previous chapter, it is not yet possible to produce denim made from 100% mechanically recycled cotton because the mechanically recycled cotton fibers are not strong enough. It is possible to create a 100% recycled strong denim of a blend of recycled cotton with recycled polyester, but this fabric is not recyclable with the current mechanical technologies because it is a mixed material. With new technologies like chemical recycling, it is achievable to create fabric from 100% recycled fabric but this fabric has different characteristics than denim. A more rough material should be added for the look and feel of denim. With chemical recycling, it is possible to recycle mixed materials but this technology is not yet available at a bigger scale.

So, the ability to produce denim with a high percentage of recycled cotton is limited by a technological bottleneck. However, promising new technologies are about to be commercialised which promise to revolutionise the textile industry in the future. According to Gwen Cunningham and H  lene Smits of Circle Economy, we should not just sit back and wait for the technology. If we do that, we will ultimately be faced with a completely different bottleneck: a circular technology in a linear system (Mathews, 2015). We need to prepare the industry, the consumers and the government for the moment new technologies are improved and up-scaled.

Besides preparing for the new economy, we need to stimulate it by increasing the demand for recycled materials: this will accelerate the developments of the automatic sorting technology, improve the (chemical) recycling technology and expand the availability of these technologies. This will make it possible to make better use of the valuable source of discarded textiles that are not wearable and repairable anymore, and therefore make less use of virgin cotton.

'SIMILAR TO THE EXCITEMENT OF THE SPACE RACE OVER 60 YEARS AGO, FASHION & TEXTILE BRANDS ARE NOW ANXIOUSLY LOOKING LEFT AND RIGHT AT THE COMPETITION TO SEE 'WHO'S DOING WHAT' IN THE RECYCLING TECHNOLOGY RAT RACE.'

- Prof. Rebecca Earley, University of the Arts London



Figure 27. Discarded textile that are brought to developing countries are less wanted; eventually they end up as landfill.



Figure 30. Shredded denim in a rough stage.



Figure 31. Textiles sorted by colour in developing country



Figure 28. Bails full of discarded textiles



Figure 29. Massive cotton farming

DESIGN BRIEF

In this section, the research results are analysed and a design brief is formulated. It starts with presenting the problem network from which three key problems are derived (3.1). This is followed by the determination of the key actors and interactions (3.2). Based on this, the target group is defined. Then, a short reflection on the results so far is presented. The focus and results of the project are checked against the strategy of the Ellen MacArthur foundation in a side-by-side comparison. To have a clear starting point for the design phase, a design brief is written (3.3). The design brief is followed by an explanation of the ideation phase (3.4). As an introduction to the concept, the ten most important building blocks of the concept are introduced.

DESIGN BRIEF

3.1 PROBLEM NETWORK

By doing desk research, interviews with different stakeholders and visiting the denim fair Kingpins, several difficulties in producing and using PCR cotton are discovered. All these difficulties have led to the situation we see nowadays: *a situation in which multiple stakeholders are interested in the use of PCR denim but there is still barely any demand for it*. But why is there no demand? An interconnected circle diagram is created to find the most interrelated problems out of the list of difficulties. Based on the interconnected circle diagram plus synthesis from the Gigamap and feedback during the Kingpins week, the most important problems are defined. To be able to design for all these important problems, it is important to know how these problems relate to each other; how they cause, reinforce or reduce one and another. Therefore, the problem network is established. In order to communicate the problematics of the situation clearly to stakeholders, the problem network is analyzed and three key problems are identified

- 1. Brands have a negative perception of PCR denim. They perceive it as difficult, expensive and low quality fabric.
- 2. In order to work with PCR cotton, individual brands are given a complicated logistical challenge that results in a time consuming and expensive process.
- 3. The use of PCR fabric is not adopted as common practice due to the lacking supply and demand of the fabric. Therefore, recycled denim products are not conventional in the shops and consumers do not actively demand it

3.2 TARGET GROUP

The last research question that needs to be answered is: **What are the key actor(s) and interaction(s) within the cycle where interventions could change the current system?** To answer this question, firstly an actor map is created; to define all actors within the system and within one sector.

Out of the research, three conclusions are drawn that answer the research question.

Conclusion 1 | Focus on the brand to raise the demand
When we look at the three key-problems and the places of the problems in the system below, we can see that the brand is playing a key-roll in the demand for PCR denim. Since on the one hand, the consumers are influenced by the brands in their consumption behaviour and on the other hand mills wait for the demand of brands, the brands are the drivers in the fashion industry. The more brands demand for recycled material, the more widely available and affordable these fabrics will become.

Conclusion 2 | Collaboration is key
To start cotton recycling at scale, coordinated and collaborative action is needed. To establish a succesful material flow, the following interactions are important to focus on in a collaborative value chain: the interaction between brand - denim mill & the interaction between Denim mill - recycle facility - sorting center.

Conclusion 3 | Target group of the collaboration
Who needs to be involved in the collaboration? Wat players are needed to increase the use of PCR denim and who would potentially want to cooperate towards this goal? To initiate a change, it is desirable to implement the change in small steps. Therefore we should start with the focus on a compact group of players: the bigger Amsterdam denim brands, the innovative denim mills that are closest to the Netherlands, their recycling partners, the big collectors (and connected sorting centers) of the Netherlands and a transport company.

INTERIM REFLECTION

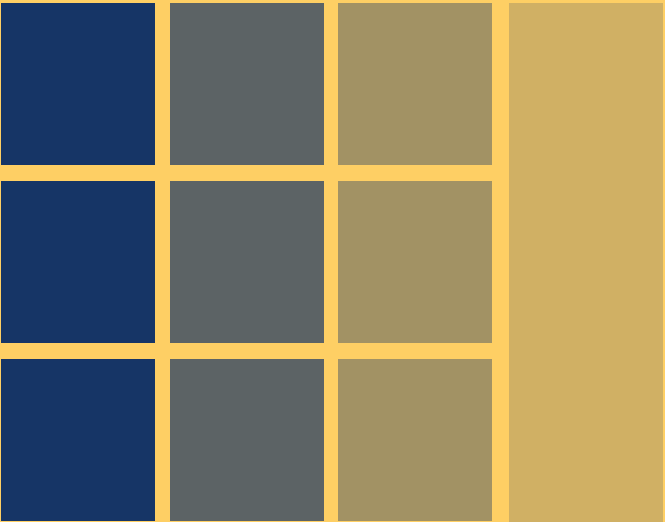
A short reflection on the results so far is executed. The focus and results of this project are checked against the strategy of the Ellen MacArthur foundation in a side-by-side comparison. This has shown that the right direction is chosen. The research results have shown that clothing design and clothing collection are bottlenecks for the long term future in the cotton- and denim industry in the Netherlands. Enough suitable textiles are collected to start setting up a material flow for recycling now. When low percentages of PCR are used, the technology is not the biggest bottleneck in the short term. Key is to stimulate brands to raise the demand.

3.3 DESIGN BRIEF

To have a clear starting point for the design phase, a design brief is written. It starts with the summarising the current rich system: a system driven by the pace of fast-fashion, which has negative environmental and social impact. The second step is a summary of the conclusions of the research. Because of scarce resources and a big amount of textiles incinerated, it is key to work towards a more circular fashion industry. Using PCR cotton in denim production would be one of the steps. Because PCR fibers are expensive and difficult to work with, it is not attractive for denim mills to develop recycled denim fabric without having the demand first. The higher price, the logistical difficulties and the quality perception make the barrier to high for brands. For the reason that recycled denim is not offered much to consumers, they are not aware of the possibilities and will not actively create a demand for it. This followed by a design vision: what is essential and important to happen? An efficient material flow needs to be initiated from collecting centers to denim mills in order to make it easier for brands to use PCR denim. Denim mills need to be motivated to experiment and develop a good PCR fabric. Brands need to be stimulated in an inspiring and educating way to create a demand for recycled fabrics, their negative perception about PCR denim needs to change. The last step is the direction for the intervention: to establish a network and collaboration between brands, denim mills, recycle centers, collecting centers and a transport company; and to focus on brands to raise the demand for PCR cotton.

3.4 IDEATION & BUILDING BLOCKS

The ideation phase started with idea generation by using different ideation strategies. The many ideas are categorised and evaluated to find the most promising solutions. Based on these solutions, a concept was formed. The concept is discussed with stakeholders and build upon the feedback of the stakeholders, iterations of the intervention took place which resulted in one final concept. To communicate the final concept, the 10 most important building blocks of the concept are introduced.



CHAPTER 3.1

PROBLEM NETWORK

In a traditional design process a problem statement would be defined to give direction for the design phase. Since this project is focused on a system change, several problems need to be tackled to move the industry. Instead of one problem statement, a problem network is defined. From this problem network, three key problems are identified. These problems answer the the second research question: What are the key problems in producing, using and selling recycled cotton in denim?

Interrelated problems

By doing desk research, interviews with different stakeholders and visiting the denim fair Kingpins, several difficulties in producing and using PCR cotton are discovered. All these difficulties have led to the situation we see nowadays: *a situation in which multiple stakeholders are interested in the use of PCR denim but there is still barely any demand for it.*

Why is there no demand? You can find the list of bottlenecks in appendix B. However, these difficulties are not isolated, they are related. When solving one problem, it can clear up another problem as well. Besides that, not all problems are equally important. To intervene in the system, a comprehensive solution needs to be found; a holistic and synergetic solution, that tackles the most important problems. But what are the most important problems and how do they relate?

Interconnected circle diagram

As explained in chapter 1.6, an interconnected circle diagram is created to find the most interrelated problems (see appendix C). All identified bottlenecks and challenges for producing and using PCR cotton are placed as individual parts on a circle. Relations are drawn if problems cause other problems. In this way, new relations are found and the most interrelated problems are defined, by determining what problems cause or reinforce most other problems.

The most important problems

Based on the interconnected circle diagram plus synthesis from the Gigamap and feedback during the Kingpins week, the most important problems are defined, which are shown in figure 33 (and appendix D). The lifecycle of denim is presented, and the problems are positioned at the places in the system where the problems work.

Problem network

To be able to design for all these important problems, it is important to know how these problems relate to each other; how they cause, reinforce or reduce one and another. Therefore, the problem network is established. A diagram was made to show what causes what (figure 34 and appendix E).

Three key problems

In order to communicate the problematics of the situation clearly to stakeholders, the problem network is analyzed and three key problems are identified. First, the key problems are shortly introduced. Then, each key problem is clarified by showing how this problem relates to the rest of the problem network.

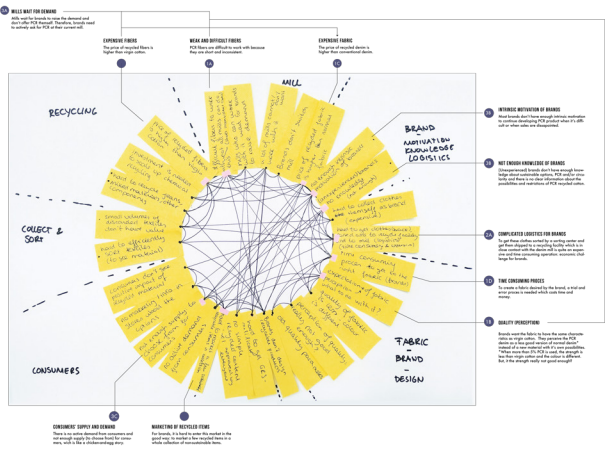


Figure 32 | Interconnected circle diagram

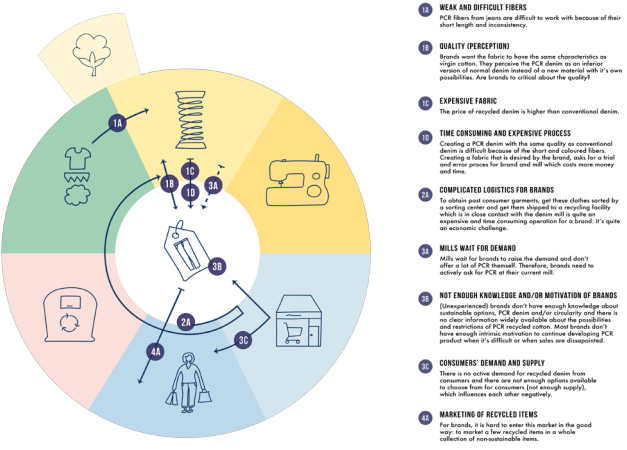


Figure 33 | Life cycle of denim with most important problems

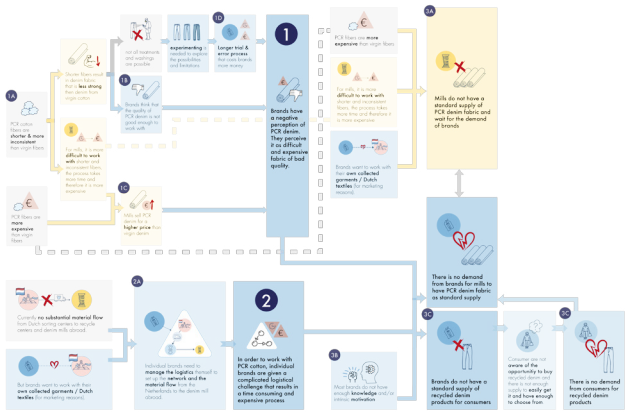


Figure 34 | Problem network

3 KEY PROBLEMS >

in producing and using PCR denim

1. Brands have a negative perception of PCR denim. They perceive it as difficult, expensive and low quality fabric.
2. In order to work with PCR cotton, individual brands are given a complicated logistical challenge that results in a time consuming and expensive process
3. The use of PCR fabric is not adopted as common practice due to the lacking supply and demand of the fabric. Therefore, recycled denim products are not conventional in the shops and consumers do not actively demand it.

KEY PROBLEM 1.

Brands have a negative perception of PCR denim. They perceive it as difficult, expensive and low quality fabric.

As explained, PCR cotton fibers are shorter and more inconsistent than virgin cotton fibers (problem 1A). This results in fabric that is less strong and often has a slightly different colour. Therefore brands perceive this fabric as an inferior version of denim made from virgin cotton. The two fabrics are always compared and old quality parameters are used. Because of that, brands think that the quality of the fabric is not good enough to work with (problem 1B). Because the fabric is less strong, not all harsh treatments and washings are possible, therefore more experimenting and a longer

trial and error process (which costs more money) is needed to come to a fabric and product beloved by the brand (problem 1D). For mills, it is more difficult to work with PCR fibers; the production process takes longer. This, together with the fact that the PCR fibers are more expensive than virgin fibers, makes the prices of the fabric higher than conventional denim (problem 1C). The quality difficulties, the higher price and the longer processes have given PCR fabric a negative image towards brands.

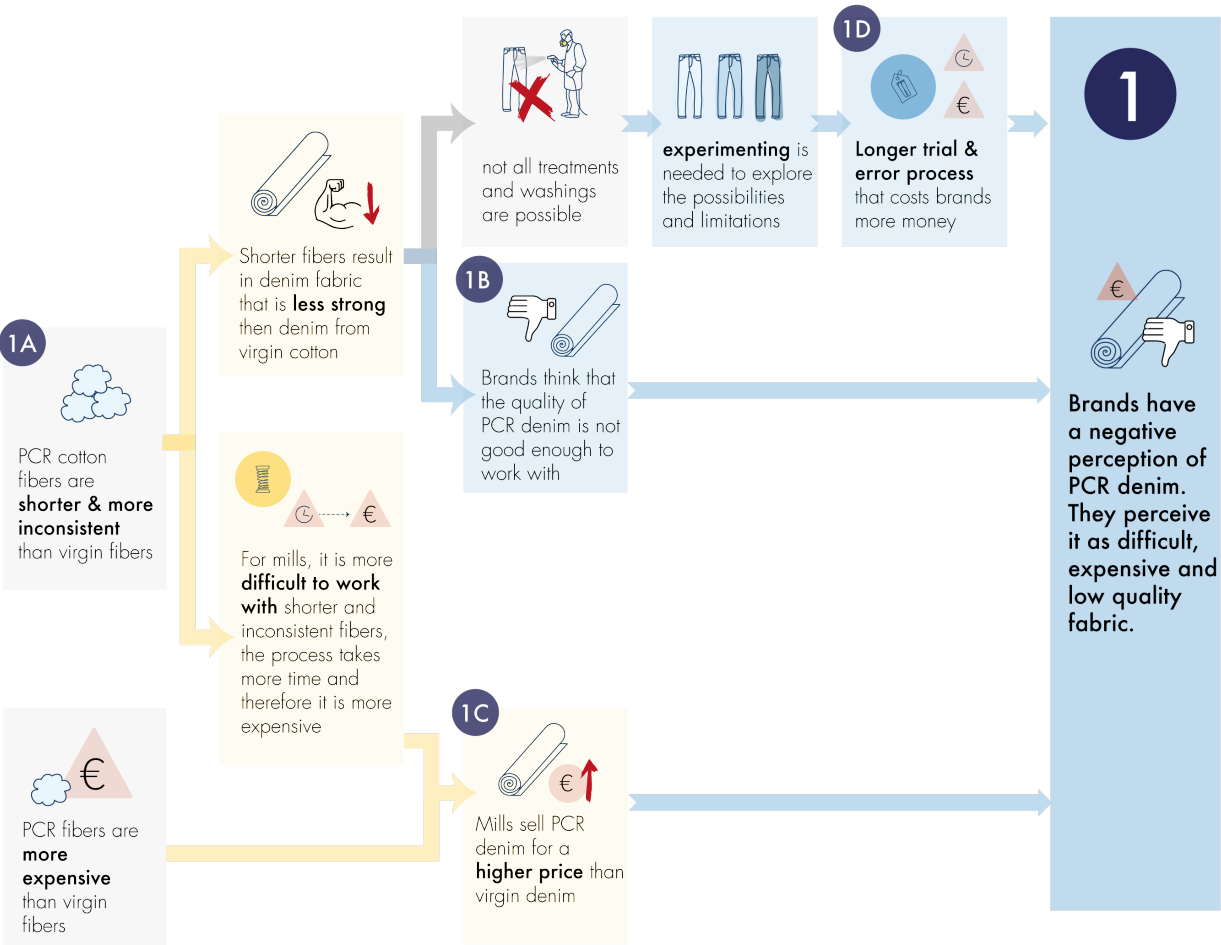


Figure 35. Part of the problem network that leads to key problem 1.

KEY PROBLEM 2.

In order to work with PCR cotton, individual brands are given a complicated logistical challenge that results in a time consuming and expensive process

In the current situation, there is no substantial material flow from Dutch sorting centers to recycle centers and denim mills abroad. Current projects are mostly done by brands that want to use their own collected textiles or textiles from the Netherlands to recycle and use in the production of their products. This leads to a good marketing story ('we made jeans out of our own jeans'). Therefore, mills do not offer a lot of PCR denim by themselves (e.g. made of

local collected textiles), they wait for the brands to demand it and 'bring' their own textiles. This results in a logistical challenge for individual brands of setting up the network of collector, recycler and denim mill and establishing the material flow between those actors (problem 2A). This results in a time consuming and expensive process.

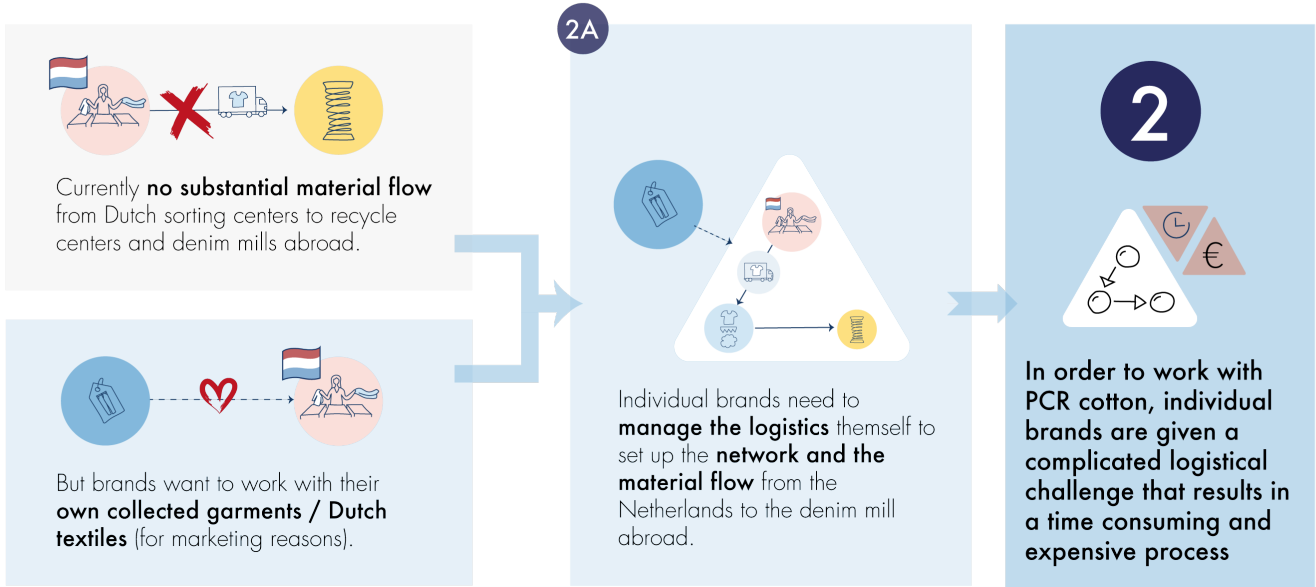


Figure 36. Part of the problem network that leads to key problem 2.

KEY PROBLEM 3.

The use of PCR fabric is not adopted as common practice due to the lacking supply and demand of the fabric. Therefore, recycled denim products are not conventional in the shops and consumers do not actively demand it .

Since PCR fibers are more expensive and more difficult to work with than virgin fibers, and brands often supply their own textiles to recycle, mills do not have standards supply of PCR denim fabric: they wait for the demand of brands (Problem 3A).

Since there is no standard supply, brands have to arrange the logistics themselves (Problem 2A). Besides that, they have a negative perception of PCR denim (Problem 1) and often not enough knowledge and/or motivation to work with PCR denim (Problem 3B). Therefore, the brands do not demand this fabric, which does not stimulate mills to offer a standard supply.

Because most brands do not use this fabric, there is no standard offer of recycled denim products to consumers. Therefore, consumers are not aware of the opportunity to buy recycled denim. Besides that, there is not enough supply for consumers to easily buy it and have enough options to choose from. This leads to a lacking demand from consumers, which does not stimulate brands to demand it in the first place (Problem 3C).

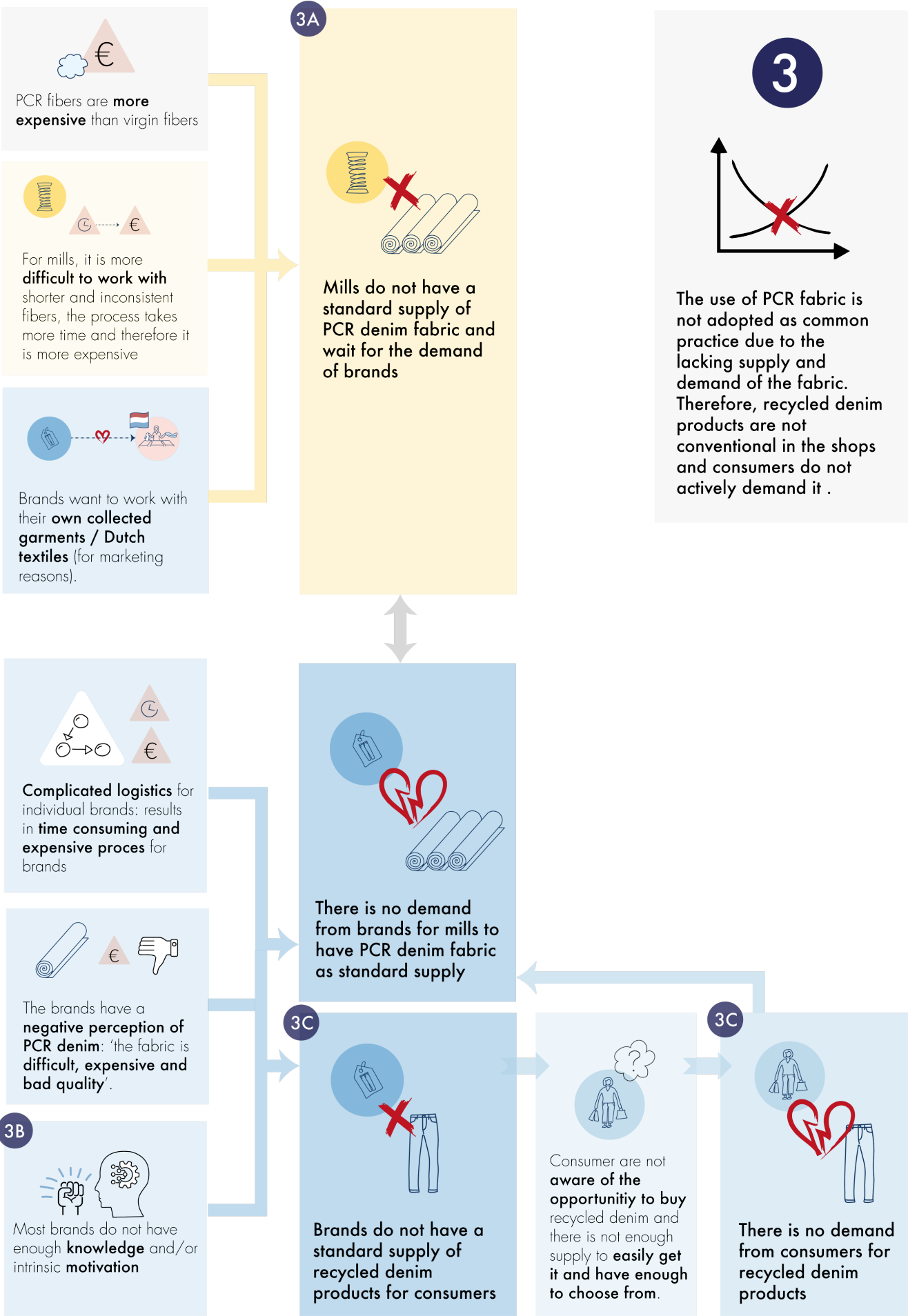


Figure 37. Part of the problem network that leads to key problem 3.

CHAPTER 3.2

TARGET GROUP

The last research question that needs to be answered is: What are the key actor(s) and interaction(s) within the cycle where interventions could change the current system? To answer this question, first, an actor map is created; to define all actors within the system and within one sector. After displaying the different actors, two main insights of the reserach are explained, which partly answers the research question. This is followed by a more specific description of the target group for the design intervention.

WHAT ARE THE ACTORS IN THE SYSTEM?

A short actor mapping is done to define the different players across the value chain but also within one sector. This is based upon the interviews and additional information from desk reserach. The actormapping is discussed with the client to validate the assumptions made and the defined categories.

The players are categorised by actor type and per player different charateristics are shown. The icon and name indicate the type

of player. The colour of the pastel dots defines the jeans segment that the actor contributes to. The red or green dot indicates if the player is a supporter or opponent of PCR denim. The colour of the square shows if the actor is a potential actor to focus on in an intervention.

An extended version of the actor map can be found in appendix F.

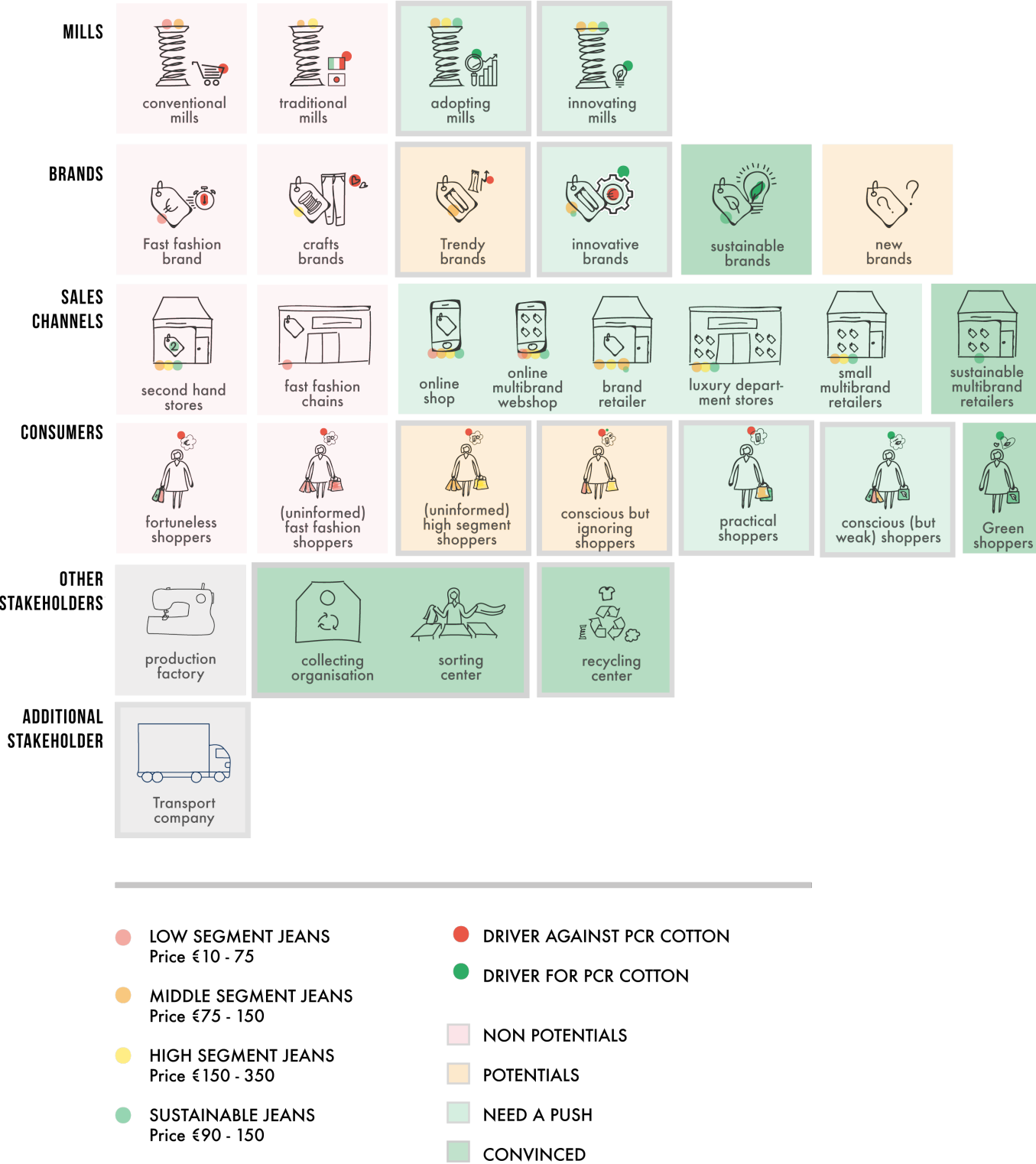


Figure 38. Actor mapping of all the actors within the current system

What are the key actor(s) and interaction(s) within the cycle where interventions could change the current system?

CONCLUSION 1: FOCUS ON THE BRAND TO RAISE THE DEMAND

When we look at the three key-problems and the places of the problems in the system, we can see that the brand is playing a key-roll in the demand for PCR denim. Almost all the important difficulties are placed in the interactions with the brand. Since on the one hand, the consumers are influenced by the brands in their consumption behaviour and on the other hand mills wait for the demand of brands, the brands are the drivers in the fashion industry.

Brands 'react' on the demand of the consumer, but in a certain way they also create the demand by offering certain products and doing marketing in a particular way. Since customers are not aware of the problematic issues in the industry and the opportunity of recycled cotton, they will not raise the demand in the nearby future actively themselves. The brands however are aware.

The denim mills react on the demand of the brands. There are complications in using PCR fibers for the denim mills but when the demand will increase, the industry will react and will deal with the difficulties. Just like the Ellen MacArthur foundation stated: Driving up demand for recycled materials would bring economies of scale and inspire innovation to improve their quality.

Resource security in the future seems like a challenge for the denim mills in the first place. The idea that the supply chain is responsible for this and are the only ones that should invest in the solutions is a wrong expectation. Closing the loop is an industry change and the brands are the actor that can support this change, scale up the demand and commercialise the fabric and the corresponding technologies.

To conclude, the brand is the key-actor who can raise the demand for PCR cotton. The more brands demand for recycled material, the more widely available and affordable these fabrics will become.

‘Brands can activey encourage a sourcing culture and buying standard that supports recycled content – slowly weaning off virgin while the industry shifts from a linear to a circular model.’

- Closing the Loop report | Mathews, 2015

CONCLUSION 2: COLLABORATION IS KEY

Not only in the Netherlands, but worldwide no clothing-to-clothing recycling operations exist at scale. There is no efficient material flow or collaboration in the denim value chain for PCR cotton. This is not only due to lacking demand of the brands. Brands are dependent on the denim mills. The denim mills and recycling facilities have the knowledge and expertise to innovate in this area and really make the change. Brands often choose fabrics that denim mills propose and do not have a lot of knowledge about other opportunities. The denim mills need a source of discarded textiles; a rich source are collecting and sorting centers. To meet the wishes of the (Dutch) brands and make use of the strength of the Netherlands, the high collection rate and innovating sorting technology, the source can be sorting centers in the Netherlands.

To conclude: To start cotton recycling at scale, coordinated and collaborative action is needed. To establish a succesful material flow, the following interactions are important to focus on in the collaborative value chain:

Interaction Brand - Denim mill
Brands need to be connected to denim mills that can produce denims from PCR fibers.

Interaction Denim mill - recycle facility - sorting center
Denim mills will need to cooperate with sorting centers in the Netherlands to obtain discarded textiles.
Denim mills should be linked to local recycling facilities to get these textiles recycled into PCR fibers.

‘Closing the loop requires ‘coopetition’; not only pioneering or risky efforts that pay off in increased competitiveness for the ‘winning team’ but also collaborative efforts to create the ecosystem that enables the circular textile revolution that will benefit us all.’

- Closing the Loop report | Mathews, 2015

CONCLUSION 3:

TARGET GROUP OF THE COLLABORATION

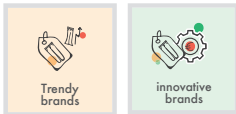
The design intervention should tackle the key problems, it should focus on the brands to raise the demand and it should incorporate collaboration. But who needs to be involved in this collaboration? Wat players are needed to increase the use of PCR denim and who would potentially want to cooperate towards this goal?

According to conclusion two, the actor types that should be involved in a collaboration are the brands, mills, recycling centers and collectors /sorting centers. In the actor map, we have seen different players within one actor type. In this section the choices for specific players are discussed: the target group(s) of the design intervention.

A compact group of players

To initiate a change, it is desirable to implement the change in small steps. Therefore we should start with the focus on a compact group of players to start collaborative action. After the succes of the concept, others can join.

BRANDS



To raise the demand significantly, a collaboration with the bigger Amsterdam denim brands is needed. The trendy and innovative brands are chosen to focus on.

Sustainable brands such as Mudjeans and Kuyichi can join but are too small to make a big impact on the industry. They are already demanding PCR from their mills and work in small volumes. The prices of fast fashion brands do not give much space for using recycled material. Crafts brands will not be willing to give up on the high quality and ‘traditionally crafty’ aspect of their jeans.

Trendy brands are the brands that focus on good looking trendy and unique jeans of middle quality. They have not started on sustainability at all but have a price range in which there is space for sustainable choice. Innovative brands offer middle to high quality jeans and are focused on innovating. They have tried sustainable innovations in short term projects, some of them already with PCR material.

The bigger trendy and innovative brands in Amsterdam are:

- G-star Raw
- Tommy Hilfiger
- Calvin Klein
- Pepe Jeans
- Scotch & Soda

Besides that the following brands can be involved:

- Levi Strauss & Co | important innovative brand | No headquarters in Amsterdam but co-founding partner of Denim City
- Kings of Indigo | Sustainable brand but bigger market share.

MILLS



In the collaboration, the adopting and innovative mills should be involved.

These mills are open to produce sustainable products, have adjusted their facilities to work with PCR fibers and want to think along to create the best product. Conventional mills do not have the facilities and/or knowledge to create PCR denim. Traditional mills stick to the traditional and ‘crafty’ way of spinning and weaving and only use the best virgin cotton. The adopting and innovative mills that are closest to the Netherlands are:

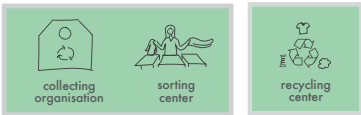
- Orta Anadolu | Turkey
- Bossa Denim | Turkey
- Royo Tejidos | Spain

The mills above are defined as the target group. These mills have a big share in the production in the current middle to high quality denim products sold in the Netherlands.

Other options are:

- Soorty | Pakistan | product development in Turkey | Very motivated to innovate sustainably
- Candiani | Italy | Traditional mill but also motivated to innovate sustainably

COLLECTING AND RECYCLING



The mills defined as the target group all have experience with PCR cotton. Therefore they have had earlier collaborations with local recycling centers. Since mills need to trust their recycling partners for control over the quality of the fibers, the current recycling partners will be involved in the network.

To have a high supply of suitable textiles to be recycled, the big collectors (and connected sorting centers) of the Netherlands will be involved:

- Reshare | Collecting organisation of Leger des Heils
- Sympany | Biggest collector in the Netherlands
- Wieland | Sorting center in close contact with House of Denim

TRANSPORT



In order to create an efficient material flow in this collaboration, a Dutch transport company should be involved. With one transport company (preferably sustainable transport), deals can be closed about efficient transport of textiles from the Dutch sorting centers to recycle centers in Spain and Turkey.



LET'S TAKE A SMALL BREAK.

SUMMARY

REFLECTION

The goal of this project is to increase the use of PCR cotton in denim production. Why? To reduce the environmental impact of the production of denim by using less virgin cotton and giving discarded textiles a second life. Besides that, it will give the collecting business a boost and stimulate the circular economy in the Netherlands. How? By focussing on the brands to raise the demand and starting a collaboration between the key actors in the value chain to realise the material flow. The target group of this collaboration, a compact group of actors, is defined.

TARGET GROUP OF COLLABORATION

- Adopting and innovative mills in Spain and Turkey
- Trendy and innovative Amsterdam based brands
- Current Spanish and Turkish recycling partners
- The big Dutch collectors (and connected sorting centers)
- A Dutch (sustainable) transport company.

To stimulate brands to raise the demand and to start a collaboration for an efficient material flow, the key problems need to be solved.

3 KEY PROBLEMS

1. Brands have a negative perception of PCR denim.
2. In order to work with PCR cotton, individual brands are given a complicated logistical challenge.
3. The use of PCR fabric is not adopted as common practice due to the lacking supply and demand of the fabric.

A short reflection on the results so far is executed. The focus and results of this project are checked against the strategy of the Ellen MacArthur foundation in a side-by-side comparison.

In chapter 1, the research question of this project is defined as:

How can the demand for recycled cotton in jeans production, started from within the Netherlands, be increased by triggering the key actor(s) or interaction(s) within the cycle?

The focus for increasing the demand was based upon the four approaches for improving recycling in the textiles industry, defined by the Ellen MacArthur foundation.

1. Align clothing design and recycling processes
2. Pursue technological innovation to improve the economics and quality of recycling
3. Stimulate demand for recycled materials
4. Implement clothing collection at scale.

Besides the four areas, to get clothing recycling really at scale, the Ellen MacArthur foundation has put emphasis on the following:

Cross-value chain action is required to introduce clothing recycling at scale

Area 1. Align clothing design and recycling processes

To increase the recycling of cotton, it is important that garments will be designed with recyclability in mind in the future. Reducing the complexity of mixed materials and non-cotton parts in the clothes will make recycling easier. Transparency on the materials flowing through the system will make it more simple to detect and sort material streams. Both brands and sorting centers, recycling centers and denim mills would take advantage of design guidelines for recyclability.

However, what can be concluded from the research is that clothing design is not the main problem for the nearby future. As confirmed by sorting center Wieland, there are enough 95-100% cotton textiles available at the sorting centers in the Netherlands to start setting up the circular material flow. When in long term more players are involved and there is more need for suitable textiles, clothing design will play a more important role.

Area 2. Pursue technological innovation to improve the economics and quality of recycling

This is definitely the case in the cotton recycling and denim production. By improving mechanical recycling and commercialising chemical recycling, the quality of recycling will develop. When the scale of recycling will increase, the technology and its product will become more affordable. However, in the short term, the technology does not have to be a big bottleneck when low percentages of PCR are used.

Area 3. Stimulate demand for recycled materials

The research was set up to discover how the demand can be stimulated by triggering the key actor(s) or interaction(s). What we have seen is that the brand is the key actor to increase the demand. To realise the material flow, a collaboration between brand, denim mill, recycle center and sorting center is needed.

Area 4. Implement clothing collection at scale

A low rate of collection is a bottleneck named in a lot of publications and roadmaps. Many people believe it is vital to improve collection rates in order to provide the feedstock for the potential new business model. However, in the Netherlands this rate is relatively high compared with other countries (between 30-35%) and currently the collectors do not know what to do with all the textiles that they collect. The Netherlands has a relatively good infrastructure for collecting and sorting but the re-use market is stagnating and downcycle market doesn't contribute to working towards a healthy circular economy. By stimulating the demand and collaborating throughout the value chain, the current infrastructure can be used to sort specific useful textiles which can be recycled for the denim industry.

Additional focus point. Cross-value chain action is required to introduce clothing recycling at scale

Since no single actor can achieve a system change alone, cross-value chain action is needed. As explained, this was also one of the conclusion of the research phase: collaboration is key.

CONCLUSION

We can conclude that the right direction is chosen. The research results have shown that clothing design and clothing collection are bottlenecks for the long term future in the cotton- and denim industry in the Netherlands. Enough suitable textiles are collected to start setting up a material flow for recycling now. When low percentages of PCR are used, the technology is not the biggest bottleneck in the short term. Key is to stimulate brands to raise the demand.



CHAPTER 3.3

DESIGN BRIEF

Design Brief

To have a clear starting point for the design phase, a design brief is written. This design brief is structured based upon the guidelines of Marc Tassoul (TU Delft). It consists of four steps: first the current rich system is summarised. This is not the lifecycle of jeans but the reality in which the lifecycle is working. The second step is a summary of the conclusions of the research. This is followed by a design vision: what is essential and important to happen? The last step is the direction for the intervention.

Future Perfect Story

As a source of inspiration for the design brief and the intervention itself, a Future Perfect Story is written. Marc Tassoul created this approach to achieve a sense and vision about issues of change. What does the future look like if the design intervention works out as it should and the industry changes according to the goals of the intervention? The story takes readers in an easy way to an imaginative future of the denim industry. You can find the Future Perfect Story in appendix G. In the Future Perfect Story, elements that are used as inspiration are highlighted.

DESIGN BRIEF

Step 1: Describe the current rich system

In the last decades, the consumption of clothes has changed drastically. Everyone is able to buy the latest fashion trends for less than 10 euros, just to wear once or twice. The fast-fashion movement has short fashion cycles, trends come and go, a new collection appears in the shop every week. In the last 15 years, clothing production has doubled.

To produce this massive amount of clothes, a lot of resources are needed. Europe and North-America used to be the biggest fashion markets but this has changed recently; Asia is emerging rapidly. If we continue consuming in this way, we would need 60% more production in the future to be able to produce enough clothes for the emerging markets. There are not enough resources in the world to do this.

If we look at today's practice, the money and time pressure has negative impact on the people at the start of the value chain, people working in production. The production of the denim and the products have negative impact on the environment. A pair of jeans is a highly polluting item. An enormous amount of water and a lot of chemicals are used to produce the cotton, to dye the cotton and to finish the jeans. Besides that, the quality of cheap clothes decreases.

Because of the reduced quality and the fast fashion trends, already within a few months, clothes are not wanted anymore. In the Netherlands 2/3 ends up in the trash bin (which makes re-using or recycling impossible), 1/3 is collected. From the collected garments, less than 0,1% is recycled into items with the same or a higher value. The rest is re-used, downcycled or gets incinerated, which leads to destroying valuable materials and the emission of CO₂.

Within the jeans industry, there is a lot of attention for producing more sustainably. Especially because the demand for conscious fashion is rising and sustainability is seen as a 'trend' where you can make money with. More brands make use of organic cotton and more sustainable ways of finishing the jeans are developed. Also, more and more mills, make sure their post-industrial cotton waste gets recycled.

However, the use of Post-consumer recycled material is not a common practice yet. There is no material flow from the collecting centers in the Netherlands to recycle centers and denim mills abroad.

Jeans are especially hard to recycle because of its tightly woven structure. Mechanical recycling results in short fibers and this makes it difficult to spin good quality yarn with. Because recycling textiles is no ordinary practice, the fibers are more expensive than virgin cotton, which results in more expensive fabric and more expensive clothes.

A group of conscious consumers is developing in the Netherlands, but only a small amount of consumers is willing to pay more. The offer of sustainable jeans in the Netherlands is not big and not easily available.

Step 2: Conclusions out of the research

Because of scarce resources and a big amount of textiles incinerated, it is key to work towards a more circular fashion industry. Using PCR cotton in denim production would be one of the steps needed to work towards a circular system, which would lower the environmental impact, would use discarded textiles in a high-value way and give the collecting business a boost. Because recycled fibers are expensive and difficult to work with, it is not attractive for denim mills to develop recycled denim fabric without having the demand first. The higher price, the logistical difficulties and the quality perception make the barrier to high for brands to buy and use this material. Because it is quite an undiscovered field, brands often do not have the knowledge about the possibilities and restrictions of the material. Since there is no substantial offer of recycled jeans to consumers, they are not aware of the possibilities and will not actively create a demand for it.

Step 3: Design vision: What is essential and important?

It is essential to redefine our ecosystem: to build new business models and work towards a circular fashion industry. Moving from a linear to a circular fashion industry will make less resources needed at the beginning of the cycle and less discarded textiles incinerated at the end of the cycle: this will result in less environmental impact of the denim industry on our earth. But it is not only important to reduce environmental impact today, going circular it also needed to be able to serve the growing world population and the emerging markets in the future. In this project, an intervention will be designed for the House of Denim foundation, in order to move the denim industry to a more circular way of working. The House of Denim foundation has the goal to stimulate the industry to use more Post-Consumer-Recycled cotton (PCR). In order to do this, House of Denim's network of brands and other industry players can be used. An efficient material flow needs to be initiated from collecting centers to denim mills in order to make it easier for brands to use PCR denim. Denim mills need to be motivated to experiment and develop a good PCR fabric. Brands need to be stimulated in an inspiring and educating way to create a demand for recycled fabrics, their negative perception about PCR denim needs to change.

Step 4: Direction

The direction which would fit to the organisation House of Denim and which could be effective to solve the case is: to establish a network and collaboration between brands, denim mills, recycle centers, collecting centers and a transport company; and to focus on brands to raise the demand for PCR cotton. In this way the most influential problems can be tackled.

CHAPTER 3.4

IDEATION & BUILDING BLOCKS

In this section, the ideation phase will be explained. It started with idea generation by using different ideation strategies. The many ideas are categorised and evaluated to find the most promising solutions. Based on these solutions, a concept was formed. The concept is discussed with stakeholders and build upon the feedback of the stakeholders, iterations of the intervention took place which resulted in one final concept. To communicate the final concept, firstly the 10 most important building blocks of the concept are introduced.

Idea generation

The idea generation phase started by exploring as many solutions as possible. Different strategies were used to form ideas.

Idea exploration

Firstly, all ideas that popped up during the research phase were captured. More ideas were formed by going through the Giga map, the transcripts of all the interviews and writing down all opportunities or ideas that were mentioned in the research phase. Also, ideas were formed in a more structured way by brainstorming about solutions for each part of the problem network.

SOD Toolkit

The intervention strategy tool of the SOD toolkit was used to explore the space of possibilities even more. Different questions were answered to come up with solutions; for example 'how can we empower the actors to change the system by themselves?' or 'How can we improve the current physical structures?'.

Brainstorm

Besides that, a creative but casual brainstorm with fellow design students was setup. The life cycle of jeans was introduced and 'How to' questions were prepared in order to have a new perspective on some specific topics and generate as many new ideas for these problems as possible. For example: 'How to stimulate brands to raise the demand?'.

Analogies & metaphors method

To prevent finding only obvious solutions, the Analogies & metaphors method (Delft Design Guide) was used. Key problems were picked out and suiting analogies were found. Analogies were analyzed to find components that could lead as inspiration for the design. To make this clear, one example is given: For the key problem 'Brands perceive PCR denim as an inferior version of normal denim', situations were searched in which a different version of product became a success although it first seemed like an inferior version. The analogies 'Heineken 0.0, oatmilk and 'fake fur' were used. The reasons for success of these products were analysed and inspirational components were defined. For example: branding the product in a different way, communicating the advantages of this product over the traditional product, creating a substantial and easy-to-get offer.

Idea selection

By structuring and analysing all ideas, the most promising ideas are selected to build a concept with.

After ideation, it became clear that the final concept was going to be a combination of different solutions, since not one solution was found that could tackle all the different problems. The chaotic cloud of ideas were structured into a list of categorised solutions. Similar ideas were merged, others were expanded.

Impact and threshold analysis

As explained in chapter 1.6, to define which ideas could have a positive impact on the current system, an Impact & Threshold analysis of the structured list of ideas is conducted. All ideas are analyzed and a score is given for:

- The short term and long term impact of the idea
- The organisational, economical and technological threshold
- The dependency of House of Denim on other players

By putting the scores of the different ideas in a graph, the most promising ideas are selected: ideas that have high impact but a low threshold.

Concept forming

The most promising ideas led to the first concept. Two iterations of the concept were made by evaluating the concept with stakeholders.

First concept

By taking the most promising ideas from the impact & threshold analysis as building blocks for the intervention, the first concept was formed: a platform to form the coalition 'the circular Denim Rebels'. This concept was discussed with the client of this project, James Veenhoff, House of Denim.

Iteration

Based on his feedback, the concept was adjusted. Ideas were taken out of the intervention, other ideas were added. The overall branding of the platform/coalition was changed. The new concept was further discussed in two different meetings; one with Mariette Houtink, co-founder of House of Denim and one with Maarten Wentholt, former product developer at G-star and currently lecturer at Denim City. Recommendations for further development of this concept are gained.

Final concept

Incorporating the recommendations led to the final concept.

Building blocks

To communicate the final concept, firstly the 10 most important building blocks of the concept are introduced. The building blocks are divided in three categories based on the key problems and main conclusions presented before. First, the categories of the building blocks are shortly introduced. On the next page, every building block is explained.

A. Improving the (perception of) quality

The first category is based upon the first key problem: Brands have a negative perception of PCR denim. The building blocks are mainly ways to improve the (perception of) quality.

B. Collaboration throughout the value chain

The second category is based upon the second key problem: In order to work with PCR cotton, individual brands are given a complicated logistical challenge. Combined with the conclusion that collaboration is key, three building blocks are defined to create a collaboration throughout the value chain in order to make the process easier for brands.

C. Stimulating brands to raise the demand

The last category is based upon the third key problem: The use of PCR fabric is not adopted as common practice due to the lacking supply and demand. Combined with the conclusion that brands are the key actor to raise the demand, four building blocks to stimulate brands to raise the demands are defined.

10 INTERVENTION BUILDING BLOCKS

A. Improving the (perception of) quality

1. 20% PCR cotton

Current initiatives and small sustainable brands are often focused on increasing the percentage of PCR cotton in denim which brings discussion about quality. To establish a systemic change, the use of a relatively low percentage PCR cotton is proposed, in order to focus on scaling up the volume. By working with 20% PCR cotton, no technological challenges and quality debates will be in the way.

2. Source textiles that result in longer fibers

The debate that the main obstacle of PCR is the short fiber length, is based upon projects done with jeans-to-jeans recycling. Jeans is woven tightly: shredding gives short fibers resulting in weaker yarn. Other cotton textiles can be used as a source: textiles (in the colour white, grey, blue and black) that result in longer fibers after shredding it, for example knitted cotton t-shirt and linnen. This will increase the strength of the yarn.

3. Quality assurance

Recyclers say that brands follow such strict material specifications that PCR cotton cannot compete with virgin cotton but yet it can still be sufficient to fulfil the requirements of middle quality jeans. In the collaboration, a way to create transparency of material properties needs to be incorporated. By assuring the specifications of the PCR denim, a certain quality can be ensured, making it easier for brands to commit to demanding these fabrics.

B. Collaboration throughout the value chain

4. Initiate a material flow

A material flow can be initiated independently from the brands by setting up a network of sorting centers, a transport company, recycle centers and denim mills. By creating the connections and establishing the material flow beforehand, the logistical challenge for brands is less complicated.

5. Stimulate an open dialogue

By connecting the key actors, an open dialogue can be created. Clear and open communication between sorting center, recycle facility and denim mill about specifications of textiles is needed to sort the best discarded textiles and with that, create a good quality fiber, yarn and fabric. A dialogue between all actors about the opportunities of PCR cotton and the relevance of using it will inspire and educate them, facilitate transparency, increase trust and support a long term relationship.

6. Create a standard supply

When a material flow is established, denim mills can be stimulated to experiment and create quality PCR fabrics made from recycled Dutch textiles. By introducing a new fabric category, denim mills can label these fabric and this will make it easier for brands to choose a PCR denim made from recycled Dutch textiles.

C. Stimulating brands to raise the demand

7. An image as global front runner

When Dutch brands would collaboratively commit to create a certain demand for PCR cotton, 'The Netherlands' will make a big step in the world of the circular fashion industry. To stimulate brands to raise the demand, the (worldwide) image of being a sustainable front runner can be promised as reward.

8. Educating & Inspiring

Brands need to have an understanding of recycling, production and consumption from a technological, environmental and economical perspective. Besides being educated, going circular needs to be a state of mind; brands should understand the relevance and be inspired to experiment, discover the possibilities of PCR denim and play an active role in making sure it happens in practise.

9. Communicating towards consumers

A part of the intervention will be focused on the end-consumer. When brands have produced a substantial offer of PCR denim items, a shared message of all collaborating and committed brands can be send towards consumers. By doing this, consumer can be made more aware of the environmental benefits of buying recycled jeans and the effort of the participating brands, which can work stimulating towards brands.

10. A governmental incentive

During this project, the initiative of the government to create a denim deal was kept in mind. The ambition of the government to cooperate towards a denim deal in which both the industry and government will take steps to solve the problems and make the way towards a circular economy easier, will play important role in the design.

By creating a group of committed actors and taking actual action, an effort from the government can be asked. In return for a joint effort of the industry, the government can stimulate the demand by incentivising the use of recycled cotton or disincentivising the use of virgin cotton. This would make using PCR cotton in jeans production much more affordable and a good stimulans for brands.

DUTCH DENIM PROGRAMME

This section introduces the intervention, designed to be executed by House of Denim: The Dutch Denim Programme (DDP). The section starts with an introduction of the concept in which the vision, the activities and responsibilities of the programme as well as the participants are described (4.1). This is followed by an explanation of the Bright Blue Loop label and material flow connected to the programme (4.2). Then, the communication towards consumers as well as the industry is presented (4.3). To implement this programme, an implementation roadmap is created, with all the steps that House of Denim needs to take, followed by a long term plan (4.4). It closes off with an explanation of the validation of the concept and recommendations to House of Denim.

THE DUTCH DENIM PROGRAMME

4.1 INTRODUCTION OF THE DUTCH DENIM PROGRAMME (DDP)

The Dutch Denim Programme is a collaborative and experimental programme initiated by House of Denim to work towards a Bright Blue loop: a circular denim industry in the Netherlands. As a first step, it will focus on increasing the use of PCR denim.

In order to work towards circularity, the Dutch Denim Programme (DDP) will start with triggering brands to create more products with PCR cotton. The programme helps brands by stimulating them and facilitating a collaboration in which PCR denim from Dutch textiles will be developed, by setting up the network and initiating the material flow. Besides that, the DDP will launch the Bright Blue Loop label: a label for PCR denim fabrics and products that contain 20% PCR cotton (made of Dutch garments). It will serve as a way for mills to offer an easy to recognise supply of PCR denims and a way to give brands quality assurance of the PCR fabrics.

The DDP will set up the network of brands, collecting organisations, recycling centers and denim mills. By showing a joint effort, the industry can push the government to contribute to the circular economy by fiscal incentivising the use of PCR cotton. Besides that, the participants and the denim industry in the Netherlands will be known as circular frontrunners, thanks to the publicity that will be created around the programme. Besides the industry focus, the programme will also communicate towards the consumer by doing a marketing campaign for all Bright Blue Loop labeled products, in order to make the consumer aware of the possibility to buy recycled jeans.



4.3 COMMUNICATION

The communication about the programme is an important aspect to motivate brands to participate.

A PR campaign towards the industry will be executed for the Dutch Denim Programme.

News releases, media interviews, speaking at conferences and promoting the DDP at industry events such as the Fashionweek and Kingpins. The strategy will mostly be defined by a marketing agency, the execution will mostly be done by House of Denim. The goal is to make the programme nationally and internationally known and give the participants the image of circular frontrunner.

Besides that, a marketing campaign towards the consumer will be established.

Via online and offline marketing channels, consumers will get to know the Bright Blue Loop label. When buying a jeans, they will recognise the label on the hangtag or the webshop. The target group is defined as hip urbanists who appreciate the sustainability trend. The tone of voice will need attract the young urban generation; funny and slightly provocative. With the marketing and the label, the Dutch Denim Programme will remind the consumer in funny way of the opportunity to buy sustainable.



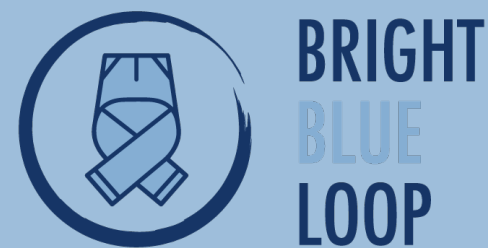
4.2 A BRIGHT BLUE LOOP (BBL)

The goal of the programme is to work towards a circular denim industry: a Bright Blue Loop. This goal has been translated in a material flow that can be realised in the short term and a Bright Blue Loop label for PCR denim fabrics and products.

The BBL label is a label for denim fabrics and products to verify a minimal amount of 20% PCR cotton (made from textiles worn and collected in the Netherlands) and certify a quality standard. The label stands for a category of denim fabrics that contribute to working towards a Bright Blue Loop: a circular material flow for the denim industry.

New PCR denim quality requirements need to be developed, adjusted to the current society. In the Dutch Denim programme, a panel will be formed that will develop these requirements. If the denim contains 20% Dutch PCR fibers and meet the quality requirements, it gets the BBL label. The label will make sure that brands do not have to doubt about if the fabric actually contains recycled material and if the quality is good enough.

The unique part of this label is that it will also be used towards the consumer. A marketing campaign but also a physical hangtag will remind consumers of the possibility to buy recycled jeans.



4.4 IMPLEMENTATION

To implement this programme, an implementation roadmap is created, with all the steps that House of Denim needs to take. This roadmap is divided in three sections.

It starts with a roadmap to create the minimal viable intervention. This is followed by steps to expand the programme: to tackle all problems from the problem network. Depending on the ambition, capacity and motivation of House of Denim, the organisation can start with the minimal viable intervention or with the full intervention. The initial intervention is a way to give the use of PCR cotton a boost. The ambition is that the use of PCR cotton becomes a new standard in the denim industry. In the short term, the focus is to scale up the volume. Later on, the programme can focus on recycling denim products instead of other cotton and/or to increase the percentage of PCR. Therefore, the programme needs to be connected to essential developments and important technological innovations: for example chemical recycling.

In the long term the programme is not only about the use of PCR cotton. The vision of the programme is to work towards a circular denim industry. Other circular flows are important in developing a circular economy as well. House of Denim needs to be aware of this vision and adjust the programme according to the possibilities and developments happening during the years.

4.5 VALIDATION & RECOMMENDATIONS

To validate the intervention, three interviews were conducted. In the interviews, the programme is presented and feedback on different aspects of the programme was gathered. In the interviews the feasibility, desirability and viability of the programme is discussed, with a slight focus on the feasibility. A strategy for the financial flow and rough estimation of the costs are made in collaboration with House of Denim. Based on the validation interviews, recommendations for further development were written.

CHAPTER 4.1

INTRODUCTION OF THE DDP

The Dutch Denim Programme is a collaborative and experimental programme initiated by House of Denim to work towards a Bright Blue loop: a circular denim industry in the Netherlands. As a first step, the programme will focus on increasing the use of PCR denim. This chapter will introduce the programme.

THE DUTCH DENIM PROGRAMME

The Dutch Denim Programme (DDP) is a collaborative and action-oriented programme initiated by House of Denim to work towards a Bright Blue loop: a circular denim industry in the Netherlands.

In order to work towards circularity, the Dutch Denim Programme will start with triggering brands to create more products with PCR cotton. The programme helps brands by stimulating them and facilitating a collaboration in which quality PCR denim from Dutch textiles will be developed. The programme will give brands quality assurance of PCR denim by launching the Bright Blue Loop label.

Brands, as well as collecting organisations, recycling centers and denim mills will be involved. By showing a joint effort, the industry can push the government to contribute to the circular economy by fiscal incentivising the use of PCR cotton. Besides that, the participants and the denim industry in the Netherlands will be known as circular frontrunners.



Figure 39. Logo of the Dutch Denim Programme



Figure 40. Logo of the Bright Blue Loop label

BRIGHT BLUE LOOP LABEL

The Dutch Denim Programme will launch the Bright Blue Loop label: a label for denim fabrics and products to verify a minimal amount of 20% PCR cotton (made from textiles worn and collected in the Netherlands) and certify a quality standard.

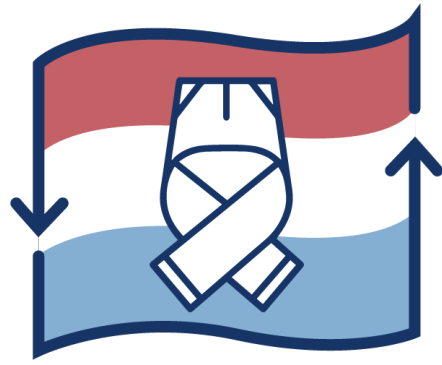
Overall objectives of the programme

The aim of the initial programme is to increase the use of Dutch post-consumer-recycled (PCR) cotton in the denim production.

1. Achieving this aim will lower the amount of resources needed and therefore reduce the environmental impact.
2. It will give discarded material a second life
3. It will give the collecting business a boost.
4. A joint commitment to work towards a circular economy will put the Netherlands on the map as circular frontrunner.

How?

By initiating The Dutch Denim programme, House of Denim will both 'facilitate' and 'stimulate'. Both aspects are further explained on the next page.



THE DUTCH DENIM PROGRAMME WILL...

facilitate a collaboration in which quality PCR denim from Dutch textiles will be developed, by setting up..

the network | House of Denim will connect the important industry actors: collecting/sorting centers in the Netherlands with the denim mills and their recycling partners in Spain and Turkey.

the material flow | By demanding PCR denim samples, HoD will initiate a material flow from the sorting centers in the Netherlands to the recycling facilities abroad. The programme will partner up with a logistical party, such as a transport company. The sorting centers will sort specific textiles that results in long fibers after shredding. These textiles will be shipped by the transport company to the recycling centers.

the samples | With the recycled fibers, involved denim mills will experiment, make 20% PCR denim samples and will send these samples back to HoD. The quality of the samples will be tested in a laboratory in the Netherlands. Students of the Jean School will create a sample collection with these fabrics to assess and show different washings and treatments possible with the fabrics.

the BBL label | Criteria for minimal quality requirements will be defined. When the samples meet the quality requirements and contain 20% PCR cotton, they will be labeled with the Bright Blue loop label. When brands develop and launch products made from Bright Blue Loop labeled denim, the products automatically also receive the label, which will be attached to the products in retail.

an open dialogue | By bringing the actors together, an open dialogue can be triggered: on the one hand to discuss practical issues about textile specifications and on the other hand to brainstorm about the opportunities and restrictions of the material, to share case practises and stay up-to-date of current developments.

What does it achieve?

Making the choice for PCR easy

the network & material flow | Creating the network and establishing the material flow beforehand will make the logistical challenge for brand less complicated. When more than 1 brand commits to use PCR denim from a denim mill, textiles from the Netherlands can be shipped at once, having a more efficient material flow than current practises.

the samples & label | Brands can choose from the BBL labeled samples to buy and make a collection with. The BBL label will certify the specifications of the PCR denim and will give quality assurance to brands. The sample collections of the students show what can be done (and not be done) with the fabrics. Having supply to choose from and knowing the characteristics of the denim fabrics will make it easier for brands to commit to using and demanding a larger volume of these fabrics.

an open dialogue | Clear and open communication between sorting center, recycle facility and denim mill about specifications of textiles is needed to sort the best discarded textiles and with that, create a good quality fiber, yarn and fabric. An open dialogue between all participants, together with the educational part, will change the mindset of the brands. Conversations will facilitate transparency throughout the value chain, support relationships and therefore increase trust.

stimulate brands to demand PCR denim by..

publicity | A communication campaign for the Dutch Denim Programme will be established. By news releases, media interviews, speaking at conferences and promoting the DDP at events, the involved brands will be put on the map as circular front runners. With a good PR strategy the denim industry in the Netherlands will be internationally known as a pioneer in the circular economy.

a common goal | By participating, brands commit to launch at least 2 PCR denim products in the first year. The group of committed participants will collaboratively define a goal to work towards a more circular denim industry, for example 1 million PCR products sold by 2022. The goal will be used in publicity.

marketing | Besides publicity around the programme, a marketing campaign for all the Bright Blue Loop labeled products will be set up in collaboration with a marketing agency. Especially social media will be used. Ambassadors will be asked to promote the products and communicate the message to the public.

Denim Deal | The Denim Deal initiated by the Ministry of I&VW is an essential opportunity for this programme. When implementing this programme, the joint effort will be used as a lobby towards the ministry of I&VW. A deal can be made: when a certain goal is reached (e.g. X amount of PCR jeans sold), the government can help stimulating these practises further by fiscally incentivising the use of Post-consumer recycled cotton.

education | HoD will help brands that lack knowledge about PCR. By means of a summit with keynote speakers, workshops and lectures, an understanding of production, consumption and recycling will be given, from a technological, environmental, social and economical perspective.

What does this achieve?

Making the choice for PCR attractive

publicity | Publicity around the programme will be one of the main reasons for brands to join. To be known as a circular frontrunner will give them a positive image towards industry and consumer.

a common goal | A common goal will be used in publicity to create momentum around the programme, which will work positively on the external motivation of the participants. By giving the participants the chance to create the goal themselves, they will be more intrinsically motivated (see theory of goal setting and task performance - Edwin Locke and Dr. Gary Latham) and the goal will be realistic.

marketing | BBL Marketing towards consumers helps brands to give the product the right place in the market, within their collection of non-recycled (often non-sustainable) jeans. It draws the attention of the consumer to recycled products.

Denim Deal | A deal with the government will change the industry drastically. Fiscal incentivising would lower the price of using the material, which will make it more attractive for brands.

education | By educating, HoD ensures the learning of brands on the importance of the circular economy, and the steps to be taken to reach it.

What are the roles of all involved actors?

Activities and responsibilities

HOUSE OF DENIM



House of Denim is the organiser of the programme.

Network

- It will involve all different actors in the programme.
- It will create the connections between the parties that are not connected yet (especially the Dutch sorting centers and recycling facilities abroad).
- It will manage and outsource tasks to different parties, such as a marketing agency, a logistical company and a research institute. It will be in close contact with these partners.

Goal and promotion

- It will facilitate all participants to create a common goal together.
- It will keep track of the progress towards the goal defined and arrange the communication about the goal to the outside world.
- It will make sure milestone are celebrated and communicated.
- It will organise summits for participants with keynote speakers, workshops and lectures to create an understanding of production, consumption and recycling.
- It will be the face of the programme towards the media.
- House of Denim will promote the programme on all industry events.

Materials

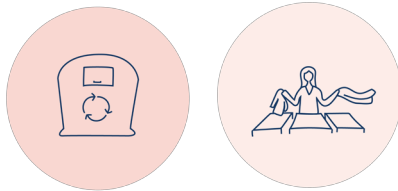
- It will demand PCR denim samples for involved mills
- It will make sure that sorted textiles from sorting centers will be shipped to recycling facilities abroad.
- It will form a panel to create quality specifications.
- It will make sure that the samples it receives will be tested by a research institute and will get the BBL label.
- It will make sure there is a physical BBL label that brands can attach to their products.



DENIM CITY

- Denim city will bring the participants physically together. It is a place for collaboration and education. Workers from Denim City will organise summit, workshops and lectures.
- Denim city can hosts events, organised by HoD, to celebrate milestones and create momentum around the programme: for example when all brands have launched their first products.
- Denim city will sell all BBL labeled products in their store.

COLLECTORS/RECYCLING CENTER



Multiple organisations will be involved in the program, to have enough sorting capacity and materials available for recycling into PCR denim. If brands and/or mills have experience with Dutch collectors, they probably want to work with the same one. Therefore, all big parties should be involved.

- Their role is to sort suitable textiles: white, blue, black and grey (>95%) cotton textiles, preferable knitted instead of woven.
- They will make the textiles ready for sending; the volume needs to be as small as possible, for example with a textile baler.
- They will make financial agreements with recycling centers and transport company beforehand.

LOGISTICAL/TRANSPORT COMPANY



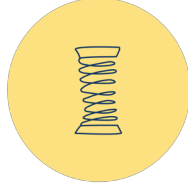
This partner will transport the textiles from sorting centers in the Netherlands to recycling centers abroad, for the sample batch as well as for the whole production coming. This company will do this as efficient as possible, combining batches from different sorting centers in the Netherlands, taken into account to geographical positions of the recycling centers abroad.

RECYCLING FACILITIES



- Recycling facilities mechanically shred textiles into recycled fibers. They will experiment with different shredding methods and different kind of textiles. They will do this by order of the denim mills.

MILLS



- Mills will purchase the textiles that can be recycled from the sorting centers and delegates recycle partners to recycle this for them.
- They will create denim samples from the recycled fibers. Samples are often 50-100m of fabric made on a sample machine. Every mill will use their strength and make a sample that suits the mill: they can create raw denim (20% PCR cotton, 80% cotton) or conventional denim (20% PCR, 78% cotton, 2% Elastane).
- They will send the samples to House of Denim with clear information about costs of these fabrics for brands.
- When they receive orders from brands, they will request more textiles from the collectors they worked with.

JEAN SCHOOL



- Students from the Jean School will make sample collections of the PCR fabrics to show the possibilities to brands.
- The Jean School will educate students, the future industry, about the circular denim industry and PCR denim.

BRANDS



- Brands will collaboratively define a common goal.
- By participating in the programme, brands commit to use PCR cotton: by saying yes to the programme, brands are supposed to launch at least 2 denim product made from PCR in the first year.
- Brands can choose one or multiple fabric sample(s) of the denim mills they are already working with (or start working with a different mill, but this is highly unlikely)
- Brands will design and launch products with these fabrics.
- Brands will make sure the products are sold in their normal online and offline sales channels.
- After the first 2 products, they will continue working towards the common goal.

MARKETING AGENCY

The marketing agency will both manage the direct marketing for the BBL labeled products towards consumers as well as the publicity around the programme. It will put participants on the map as circular front runners. A marketing agency HoD has worked with before is Keplar.

THE GOVERNMENT

First of all, the government can help by financially supporting this programme. In the long term, it can support the circular denim economy by applying fiscal incentives: instruments such as tax reduction, grants and subsidies. Incentivising the use of PCR cotton or dis-incentivising the use of virgin cotton will stimulate the demand for PCR. It is recommended to positively reward the good practises. This can be done by, for example, reducing customs duties on products that contain PCR denim: products that have got the Bright Blue Loop label.

CHAPTER 4.2

A BRIGHT BLUE LOOP

The goal of the programme is to work towards a circular denim industry: a Bright Blue Loop. This goal has been translated in 1. a material flow that can be realised in the short term and 2. a Bright Blue Loop label for PCR denim fabrics and products. The material flow as well as the label are explained in this chapter.

A Bright Blue loop: a circular denim industry

The Dutch Denim Programme will launch the Bright Blue Loop label: a label for denim fabrics and products to verify a minimal amount of 20% PCR cotton (made from textiles worn and collected in the Netherlands) and certify a quality standard. The label stands for a category of denim fabrics that contribute to a Bright Blue Loop: a circular material flow for the denim industry. The first step is to recycle Dutch cotton textiles and use these in new denim fabrics.

A material flow that can be realised in the short term is visualised and shown at the right. More advanced options for the longer term are shown at the bottom of the graph. Ideally, the textiles are prepared in the Netherlands (cutting out labels and non-recyclable parts), so that material that cannot be used would not be shipped to recycle facilities abroad. House of Denim will need to talk to current sorting centers about this since they often manage or collaborate with sheltered workshops in order to prepare textiles.

MATERIAL FLOW

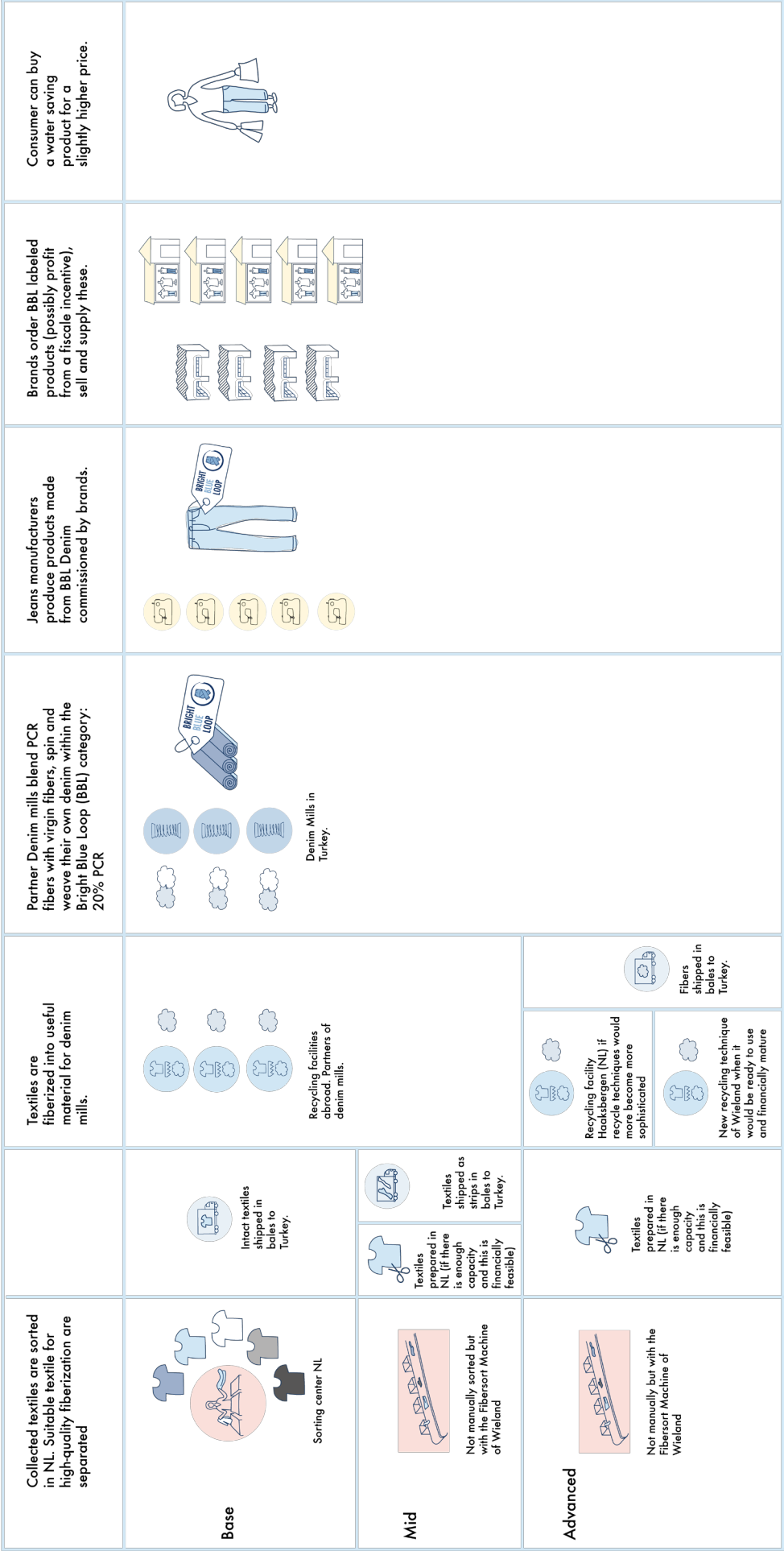


Figure 41. The material flow connected to the Dutch Denim Programme

THE BRIGHT BLUE LOOP LABEL:

20% PCR content claim & Quality assurance.

Current labels

As explained on page 55, there are currently two certifications for recycled content in textiles: The Global Recycle Standard (GRS) and the Recycled Claim Standard (RCS), both executed by Textile Exchange. Since GRS is highly challenging and RCS is not well-known, PCR fabrics are often not certified regarding the recycled content. This makes the fabric and the recycling practises intransparent and makes using this material even less appealing. The denim industry needs a simple well-known label for recycled content claim in denim.

Quality

Besides that, the denim industry needs quality assurance of PCR denim. The quality of PCR cotton is a tricky topic within the industry. Nowadays, old and strict quality parameters are used which makes it hard to get PCR denim through the tests. Progressive minds say that brands follow such strict material specifications that PCR cotton cannot compete with virgin cotton, but yet it can still be sufficient to fulfil the requirements of middle quality jeans.

20% PCR cotton

Since middle quality brands are the target group of the Dutch Denim Programme, we believe that these brands are able to work with PCR material in their products and do not have to lower the quality of their products. To ensure the quality it is decided to strive for a percentage of only 20% PCR cotton. This will make it easy for denim mills and trustworthy for denim brands. By not focussing on increasing the percentage of PCR in the short term future, but to focus on scaling up the volume, a significant positive impact can be realised. No technological challenges will be a threshold. The other 80% can be conventional cotton in the beginning of the programme, and it can include 2% elastane for a slightly stretchy feeling. A higher percentage of elastane or another material (such as polyester) is not allowed, since this makes the fabric unrecyclable.

Bright Blue Loop label as content claim

House of Denim will launch the Bright Blue Loop label. This is a label especially for the denim industry, claiming a minimal content of 20% PCR cotton. The label will comply with the RCS certification to make the label trustworthy.

New quality requirements

New PCR denim quality requirements need to be developed, adjusted to the current way of consuming. In the Dutch Denim programme, a panel will be formed that will develop these requirements. It is important to involve people from different areas to make it trustworthy towards the industry. A research institute in the Netherlands that is able to test textiles in laboratoria needs to be involved. This can be a private party or TNO / TU Delft. Besides the research institute, someone from Textile Exchange (from the RCS standard), a technical expert from Denim City, a denim mill and a brand should be involved.

Bright Blue Loop label as quality assurance

When denim mills have created samples of PCR denim, the samples will be sent to House of Denim. House of Denim will make sure that these fabrics will be tested by the research institute according to the new quality requirements. When the fabric has the 20% RCS certification and meets the quality requirements, it receives the Bright Blue Loop label.

Bright Blue Loop label for brands

The label will make sure that brands do not have to doubt if the fabric actually contains recycled material and if the quality is good enough.

Washings and treatments

Besides the quality, other constraints of denim with PCR are the limited possibilities of washing and treatments, due to the short fibers. Highly chemical treatments reduce the persistence of the fabric drastically. The uncertainty about the characteristics of PCR denim is what makes it even more a challenge for brands to work with it: testing and experimenting is needed to discover how the fabric acts undergoing the treatments.

Sample collection by students

Therefore it is proposed that students from the Jean school experiment with the samples and create a sample collection. As part of their courses, they can try different washing and treatments. This will help brands to see the possibilities of the fabric beforehand. Failed efforts will be documented to not only see the opportunities but also the restrictions. The sample collection, launched in an event, will also give brands the opportunity to discover upcoming talent and to get inspiration for new collections.

Bright Blue Loop label for consumers

There are two differences between a normal CRS certification and the Bright Blue loop Label.

1. The BBL label involves quality requirements besides the content claim. The confirmed checklist of technical specifications especially for PCR denim makes the fabric more trustworthy to work with.
2. The BBL label will be used in marketing towards consumers: not only a marketing campaign but also a physical hangtag will be put on the denim products. Towards consumers, the label will communicate a message: by buying this jeans you contribute to a circular economy. This message alone will probably not convince people to buy a certain jeans, since price, look and fit are still more important to consumers. But by means of marketing not focused on a specific brand or collection but on a shared label, consumers can still go for their favourite brand or compare different jeans from different brands. Since all involved brands will make a part of their product collection with PCR and will make it recognisable by the hangtag, buying such a jeans will be easier accessible and there will more choice. The collaboration between brands enables awareness of the BBL label on a wide scale, which stimulates the interest of consumers and the attention for the label in the industry.

Bright Blue Loop label evolving over time

Participation in the programme should be an easy step, for both brands as mills. The goal is to stimulate the use of PCR cotton, to work eventually towards a circular denim industry. To create an easy start, the BBL label only involves a content claim and minimal quality requirement. The idea is that the label evolves over time. When the industry is adapted to the use of a small percentage of PCR, the requirements can be made more challenging. When technology is ready, the percentage of 20% can be raised to 30, 40, 50 or even more: depending on the quality of the fabrics. Besides that, the additional social, environmental and chemical processing requirements that are now included in the 'difficult' GRS certification can be included, to make the production process of the jeans more sustainable after all. The other 80% cotton can be conventional cotton in the beginning, but this will change to organic cotton when the time has come. In the long term, the Bright Blue Loop label can evolve towards the cradle-to-cradle label: to not only include recycled material in the jeans, but also to be fully recyclable.



BRIGHT BLUE LOOP

CHAPTER 4.3

COMMUNICATION

The programme is focused on the industry: making the use of PCR denim easier by establishing a collaboration between different industry players. However, communication about the initiative is an important aspect to motivate brands to participate. Therefore, this chapter elaborates on the communication towards both consumers and the rest of the industry.

Communication towards consumers and industry

How is the message of the Dutch Denim Programme and the BBL label communicated to the outside world? To the consumers, the industry and the media?

For the Bright Blue Loop label and its products, a marketing campaign towards the consumer will be established. Besides that, a PR campaign towards the industry will be executed for the Dutch Denim Programme.

A simple webpage for the Dutch Denim Programme and the Bright Blue Loop label will be developed. The webpage will have two landing pages, one for the industry (www.dutchdenimprogramme.com) and one for the consumer (www.thebrightblueloop.com). It will be easy to switch between the two sections on the webpages.

COMMUNICATION TO CONSUMERS

Communication flow

Consumers will be targeted by a marketing campaign. Via online and offline marketing channels, consumers will get to know the Bright Blue Loop label. When buying a jeans, they will recognise the label on the hangtag or the webshop. On the label, a short explanation will be displayed. When consumers want to know more, they can go to the webpage which is referred to on the hangtag.

Target group

At page 75, different psychographic types of consumers are defined. Chosen is to focus on two types of consumers:

1. Conscious but ignoring

These consumers have heard about the dark side of (fast) fashion; they know the social and environmental impact but the step to act upon it is still too big. They lose good intentions when entering a shop and would not know where to start when wanting to buy sustainable clothes. They are impulsive shoppers, sensitive for trends and often attracted by sale and promotional offers.

2. Conscious but weak

This group is conscious about the social and environmental impact and put effort into buying 'good' products. However, they have difficulty realising this because of low availability of sustainable clothes and they can have weak moments in which non-sustainable products are bought.

Demographically, these target groups consist of consumers between 20-35 years old, living in the city, relatively wealthy with a high education level: hip urbanists who appreciate the sustainability trend. This is based upon the increasing interest in sustainability of the younger generations, and this group is wealthy enough to buy middle to high quality jeans (90-150 euro).

Marketing campaign

A marketing campaign for all the Bright Blue Loop labeled products focused on the targetgroup described above will be set up in collaboration with a marketing agency in close collaboration with House of Denim, for example Keplar in Amsterdam. Especially social media and advertisement in city environments will be used. One famous ambassador and several (instagram) influencers could be asked to promote the products and communicate the message to the public.

Tone of voice

The tone of voice is inspired by the marketing strategy of Oatly, the Swedish oat drink brand. All adds are in english, make jokes and are slightly provocative. This tone of voice will attract the young urban generation, see the next page for some possible examples.



Figure 42. Offline campaign of Swedish oat drink brand Oatly

Digital hangtag

Products that are Bright Blue Loop labeled and are sold online can display the logo of the label on the webshop.

Physical hangtag

Products will get a physical hangtag, preferable in the form of a pocket flasher in order to not be lost in all the labels hanging on a jeans. See next page for an example.

Message

The marketing campaign together with the label will remind the consumer in funny way of the opportunity to buy sustainable. The targeted consumers are already aware, but need a reminder of their good intentions. The goal is not to educate the consumer; it is to draw attention and help consumers that are already willing to make the right choices.

Webpage

The digital and physical hangtag will refer to the page www.thebrightblueloop.com, made for the highly interested consumers. The main goal of the relatively simple webpage is to inform the consumer about the meaning of the label: what is the positive impact of 20% recycled content, what are we striving towards and who is participating? The page will also show all products with the Bright Blue Loop label with links to the webshops of the brands.

COMMUNICATION TOWARDS CONSUMERS

playful, informal, honest



Figure 43. Impression of a possible add for the Bright Blue Loop label



Figure 44. A pocketflasher that displays the Bright Blue Loop label



HEY THERE, LOOK CLOSE!
WASTE ISN'T WASTE UNTIL WE WASTE IT.

20% RECYCLED CONTENT.



TURNING SOMETHING OLD INTO SOMETHING NEW..
IT'S MAGIC! BUT WE DID IT!

20% RECYCLED CONTENT.



ONE DAY.. OR TODAY?
SHOW YOU CARE FOR THE PLANET.

20% RECYCLED CONTENT.



LET'S NOT WASTE THE FUTURE.
IT'S IN YOUR HANDS RIGHT NOW.

20% RECYCLED CONTENT.

Figure 45. A playful, informal and honest tone of voice.

COMMUNICATION TO INDUSTRY

Communication flow

The process to involve participants, is described in the roadmap in the next chapter. This small section focuses on the communication towards participants during the project, communication towards the not-yet-involved actors and communication towards the media.

Public relations campaign

A PR strategy for the Dutch Denim Programme will be established: news releases, media interviews, speaking at conferences and promoting the DDP at industry events such as the Fashionweek and Kingpins. The strategy will mostly be defined by the marketing agency, the execution will mostly be done by House of Denim. Since House of Denim is normally present at these events and already active in promoting the message of sustainable denim worldwide, this is within their reach. The goal is to make the programme nationally and internationally known in order to:

- Make the denim industry in the Netherlands known as a pioneer in the circular economy.
- Make the participating brands and mills known as circular frontrunners.
- Stimulate industry actors to participate in the programme
- When participating is out of reach: to inspire other parties to also start working with PCR on their own.

Target group campaign

- (International) brands, mills and other industry actors that are not yet involved
- Government(s)
- Other industries

Digital platform

Besides a PR campaign, there will be a webpage about the programme, mainly targeted to the industry and the media: www.dutchdenimprogramme.com

Non-participants and the media can visit the public part of the webpage to stay up-to-date of the current developments, to see who is participating and read more details of the programme. Industry actors that are interested to join can see how they can participate. The landing page of this website will show immediately how far the programme is from reaching the goal. The home page will show what the programme is about and who participate. The first glance of the page is easily understandable, in case consumers and media visit the page. A second layer (e.g. by scrolling down) will give more specific and technical information about the details of the program, about PCR and circularity in the denim industry.

For participants, a third layer of the platform could be created. By logging in, participants can enter their personal page to see their current activities but also the agenda of the programme and the educational part of the website with e.g. web lectures. Via the private part of the platform, House of Denim can communicate with the participants.

COMMUNICATION TOWARDS THE INDUSTRY

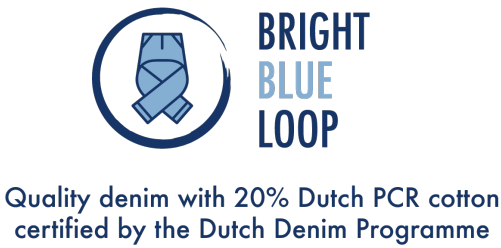


Figure 46. Impression of the communication towards the industry

CHAPTER 4.4

IMPLEMENTATION

To implement this programme, an implementation roadmap is created, with all the steps that House of Denim needs to take. This roadmap is divided into three sections. It starts with a roadmap to create the minimal viable intervention. This is followed by steps to expand the programme later. Last, imaginable plans for the long term are proposed.

To help House of Denim implementing the programme, an implementation roadmap is created. The Systemic Design Toolkit introduces a way to plan the implementation of an intervention in a way that change in a system will occur: 'the roadmap for transition tool'. According to the toolkit, three versions of the intervention model need to be designed, a minimal viable intervention model, an intermediate version and full version: the intervention will grow towards the desired goal; being adopted in the current system. Inspired by this idea (but slightly adjusted to this project), an implementation roadmap for the Dutch Denim Programme is developed: a Minimal Viable intervention, a full intervention and a long term roadmap are developed.

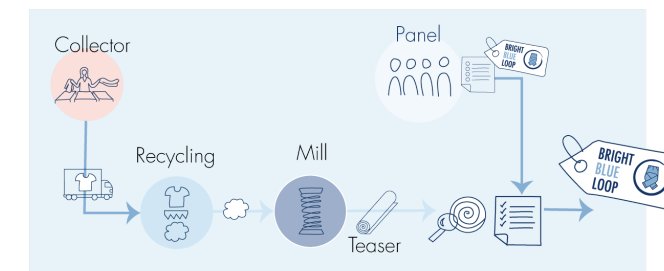
Version 1. Minimal Viable Intervention

House of Denim is advised to start with the most simplified version of the Dutch Denim Programme. This programme tackles the following problems of the problem network (presented earlier on page 70):

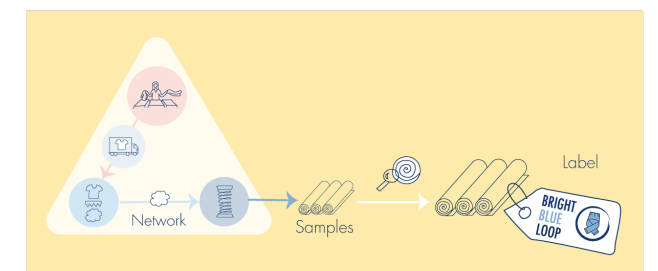
- 1A. PCR cotton fibers are shorter & more inconsistent than virgin fibers.
- 1B. Brands think that the quality of PCR denim is not good enough to work with.
- 2A. Individual brands need to manage the logistics all by themselves to set up the network and establish the material flow, that results in a time consuming and expensive process.
- 3A. Mills do not have a standard supply of PCR denim fabric and wait for the demand of brands.

Hereby a summary of the minimal viable intervention. An extended version is presented on the next page.

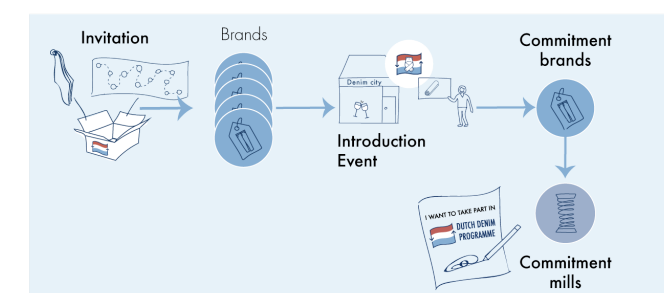
A. ESTABLISH BBL LABEL AND DEVELOP A TEASER TO GET ACTORS INVOLVED



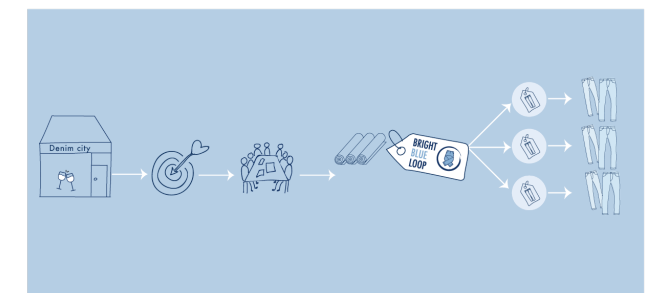
D. KEEP TRACK OF PARTICIPANTS DOING WHAT THEY COMMIT TO



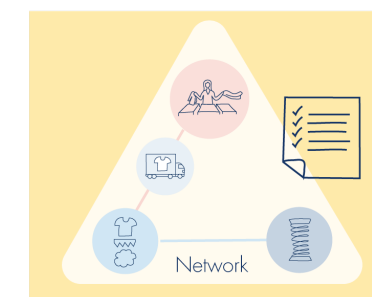
B. INVOLVE BRANDS AND MILLS TO PARTICIPATE IN THE PROGRAMME



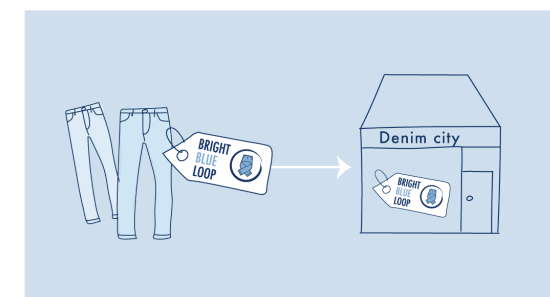
E. ORGANISE DDP SUMMIT TO HELP BRANDS



C. ESTABLISH NETWORK AND GUIDE LOGISTICAL CHALLENGES



F. BRANDS DESIGN AND LAUNCH PRODUCTS WITH THE DENIM FABRICS



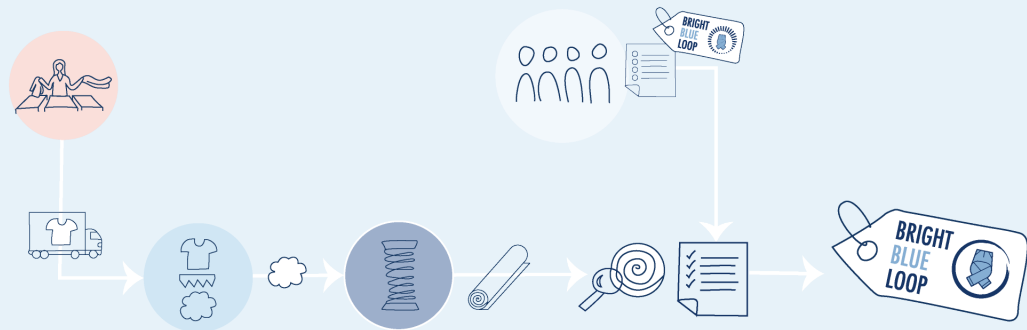
F. PROMOTE THE DUTCH DENIM PROGRAMME



ROADMAP FOR THE DUTCH DENIM PROGRAMME

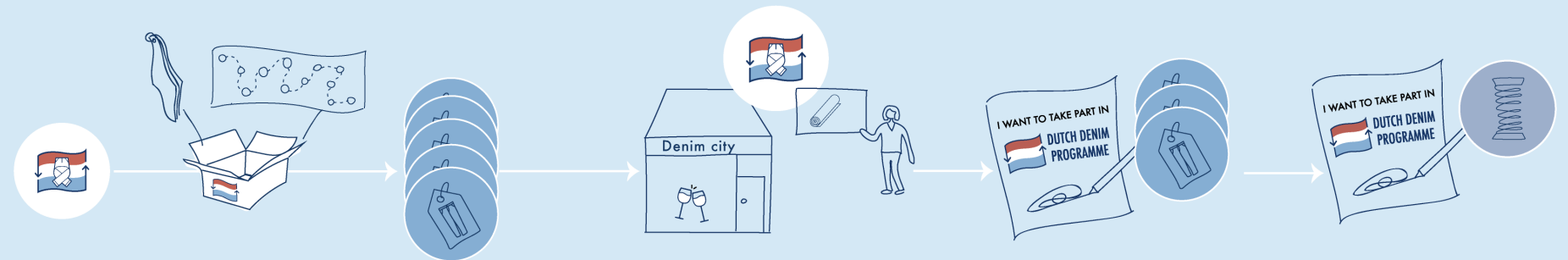
Version 1. Minimal viable intervention

A. ESTABLISH BBL LABEL AND DEVELOP A TEASER TO GET ACTORS INVOLVED | SEPT-NOV 2019



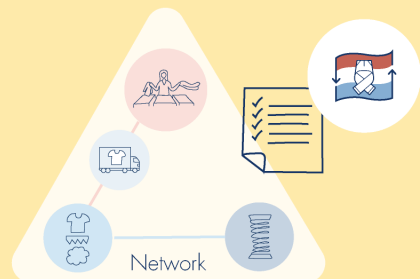
1. HoD involves one Dutch collector (Wieland). Collector sorts long fibered textiles and send these to mill.
2. HoD involves one Denim mill (Bossa/Orta) + Recycling partner. Mill creates one 20% PCR denim sample (teaser) and send this to HoD.
3. HoD involves Textile Exchange and forms the rest of the panel. Panel defines quality criteria for Bright Blue loop label.
4. HoD makes sure teaser is tested upon the quality criteria and receives the BBL label if it meets the criteria.

B. INVOLVE BRANDS AND MILLS TO PARTICIPATE IN THE PROGRAMME | DEC 2019



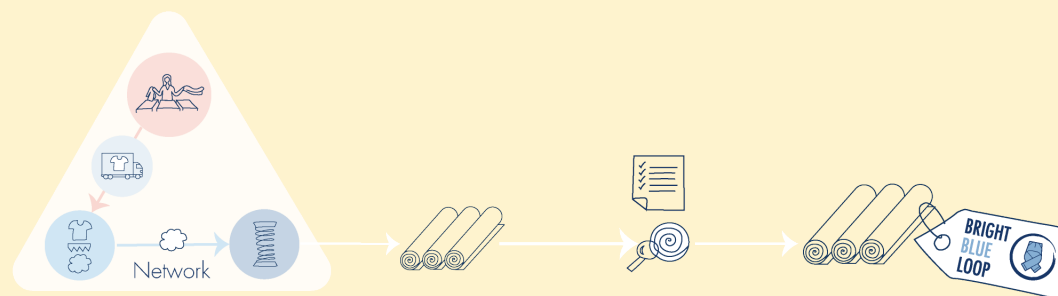
5. HoD invites all targeted brands to come to the DDP introduction Event. The invitation will be like a 'present': with little samples of the teaser fabric and a big map of the denim cycle. By giving a 'present', giving the brands something of value, they will be more likely to feel an impulsive to do something back: to come to the event (inspired by 'Reciprocity': one of Dr. Robert Cialdini's principles of persuasion).
6. At the DDP introduction events, HoD explains the DDP and the BBL label and will show the teaser.
7. HoD makes sure at least 3 brands commit. By committing, they say yes to launching 2 BBL labeled products in the first year and pay a certain start amount. Because the motivation of the brands in general is quite low, the task should be easy (Fogg's Behavior Model).
8. HoD makes sure at least 1 extra mill participates. HoD will contact Bossa/Orta, Royo, Candiani. By having 3 brands that commit, it is easier to involve extra mills;

C. ESTABLISH NETWORK AND GUIDE LOGISTICAL CHALLENGES | JAN 2020



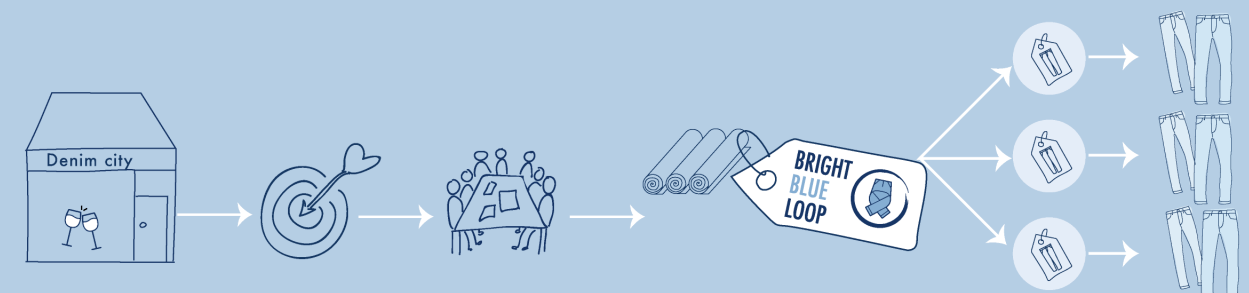
9. HoD connects participating collector, transport company, recyclers and mills.
10. HoD guides making financial and logistical agreements for the samples and for further collaboration.

D. KEEP TRACK OF PARTICIPANTS DOING WHAT THEY COMMIT TO | JAN-MARCH 2020



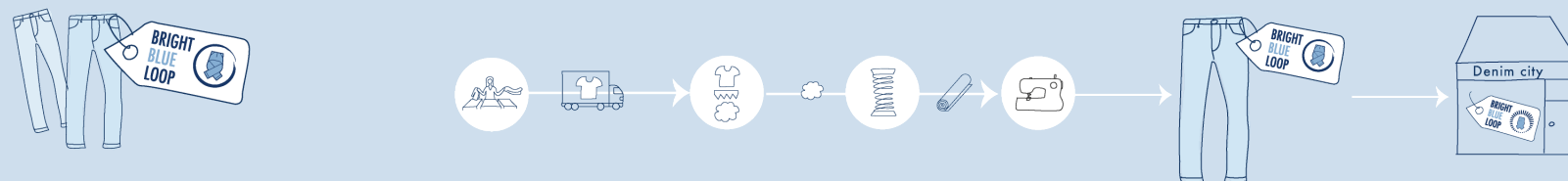
11. HoD makes sure collector sends textiles to involved recycling facilities.
12. HoD makes sure recycling facilities recycle textiles and send fibers to mills.
13. HoD makes sure mills make at least 3 denim samples and send these to HoD.
14. HoD makes sure samples are tested in a laboratory and receive BBL label if they meet criteria.

E. ORGANISE DDP SUMMIT TO HELP BRANDS | MARCH 2020



15. HoD organises a DDP summit for all participating brands.
- 15a. Brands will define a common goal.
- 15b. Recommendations for the government about legislation and incentives will be co-created.
- 15c. HoD will show all samples to brands
16. Brands can choose samples and negotiate with the mills that created them to buy bigger volumes.

F. BRANDS DESIGN AND LAUNCH PRODUCTS WITH THE DENIM FABRICS | MAY 2020



17. Brands develop at least 2 BBL labeled denim products in the first half a year (this is what they agreed to when signing up). Brands design a product (jeans or other denim product) which the chosen PCR denim.
18. When mills get an order, they will request PCR fibers from the connected recycle and sorting center. They will follow the agreements made earlier (step 3). Textiles (to be recycled) can be shipped for several brands all at once. Furthermore, brands, mills and manufacturers develop the product as normal.
19. Denim Cit will sell all BBL labeled products and brands can sell their products via their own sales channels.

G. PROMOTE THE DUTCH DENIM PROGRAMME | STARTING DEC 2019



20. HoD creates publicity around the programme and participating brands. During important industry events HoD will bring the DDP and the BBL label to the attention of the visitors.

Version 2. Full intervention

To tackle all problems from the problem network, a full intervention is created. This incorporates everything from version 1 but has additional aspects. These aspects tackle the following problems of the problem network:

- 1D.** Longer trial and error proces for brands to experiment with the PCR denim fabrics
- 3B.** Brand's do not have enough knowledge about PCR denim
- 3C.** Consumers are not aware of the opportunity to buy recycled denim

The visual at the next page shows the additional aspects. Besides that, the full version of the intervention advises to strive for involving all players from the target group defined in chapter 3.2, while the minimal viable intervention advised to involve one sorting center, two mills and three brands.

Long term

The use of PCR as a new standard in the denim industry

The initial intervention is a way to give the use of PCR cotton a boost. The ambition is that the use of PCR cotton becomes a new standard in the denim industry. In the short term, the focus is to scale up the volume. A low percentage of PCR fibers will be used, and these fibers will be made of the most suitable cotton textiles.

Recycling denim & increasing percentage

In the long term, the recycle loop can focus on recycling denim products instead of other cotton, to work towards a closed loop within the denim industry. To improve the length of recycled denim fibers, the recycling techniques need to develop further. This can improve simultaneously with increasing the percentage of PCR fibers (that are made from other cotton textiles). Depending on the availability, demand and the technology, a choice can be made to go further with denim, other cotton or both.

Technological innovations

To scale up the percentage and to improve circular practises in general, the programme needs to be connected to essential developments. It should stay up to of important technological innovations. Since the role of the Dutch Denim Programme is to facilitate and stimulate, the Dutch Denim programme can be the programme to connect the denim industry with innovations when the innovation is ready to be used on a bigger scale. Therefore, House of Denim can optimally use its strength of being a connector between different actors and it can educate the rest of the industry about the innovations.

Chemical recycling

One of the first important innovations is chemical recycling. In a few years, chemical recycling will be possible on a big scale (Saxcell expected to be commercialised in 4 / 5 years). The programme should be connected to one of the chemical recycling companies and connect them to the industry when the time has come, to experiment with the production of denim samples from the new chemically recycled fiber. This will make it possible to increase the percentage PCR content rapidly.

Start with version 1 or 2?

Depending on the ambition, capacity and motivation of House of Denim, the organisation can start with the minimal viable intervention or with the full intervention. The minimal viable intervention should have impact on the three key problems. The additional aspects of version 2 are ways to tackle all problems from the problem network and create even more impact on the current system. Based on previous experience, valuable connections or motivation, House of Denim can select and implement elements of version 2 when they think it is needed and feasible.

Other circular strategies

However, in the long term the programme is not only about the use of PCR cotton. The vision of the programme is to work towards a circular denim industry. There are different roads that the programme can take towards this goal. Other circular flows are important in developing a circular economy, as explained in chapter 1.4. House of Denim should be aware of this vision and adjust the programme according to the possibilities and developments happening during the years.

The Dutch Denim Programme can play an educational role. It can organise summits and/or workshops to gain and spread the knowledge the industry needs. It can play a facilitating role by connecting the right actors to make innovation happen. It can play a stimulating role by adjusting the requirements for the Bright Blue Loop label over time: increasing the percentage of PCR, requiring the use of organic cotton instead of conventional cotton, adding social, environmental and chemical processing requirements to make the products more clean and fair (working conditions, fair wages, use of chemicals, use of renewable energy in production etc), and requiring a certain percentage of the product that is recyclable.

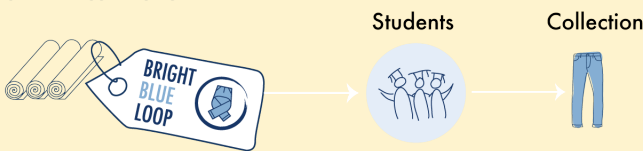
But the programme can go even further to stimulate a circular system:

- Teaching brands how to design recyclable products (or how to increase the percentage of a products that is recyclable)
- Helping companies create new business models such as repair- or renting services.
- Focus on the durability to create long lasting products
- Stimulating the development of - and investment in biodegradable denim, denim that decomposes naturally.

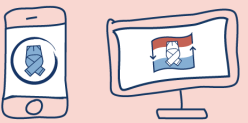
On the next page, a timeline is created in which you can see how the Dutch Denim Programme and the Bright Blue Loop label will evolve over time. Most of the steps of the roadmaps are included in the timeline.

Additional aspects of the full intervention (version 2)

SAMPLE COLLECTION | FEB 2020



DIGITAL PLATFORM | MARCH 2020

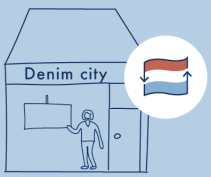


In the full intervention, the digital platform will be developed and launched at the start of the programme. A simple webpage for the Dutch Denim Programme and the Bright Blue Loop label.

MARKETING | MAY 2020

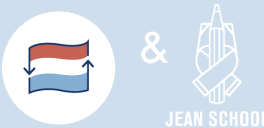


EDUCATION | MARCH 2020

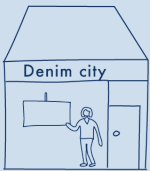


Educational and inspiring event(s) for participating brands, in which unexperienced brands learn everything about PCR and experienced brands and mills will collectively brainstorm about/discuss the opportunities of PCR.

EDUCATION | MARCH 2021



Start a course at the jeans school about circular denim: to educate the future denim world



Organise workshops at Denim City for interested actors that donot want to commit but want to learn the basic knowledge.

CELEBRATION | MARCH 2022



When the goal defined by the brands is reached, it needs to be celebrated big by an event and creating publicity.

How will the intervention develop in the long term?

EXPANDING | MARCH 2022



When the first goal is reached: open invitation to the industry to take part, brands, mills and sorting centers



When a goal is reached, a new collective goal should be defined by all participating brands.

ADOPT TO CHEMICAL RECYCLING | JAN 2023



Involve chemical recycling companies in the programme. Connect them industry. Start experimenting with producing denim-like fabrics.

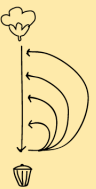
EDUCATION CIRCULAR DESIGN | MARCH 2023

Stimulate and educate brands how to design recycable products. Organise Circular Denim Design summit in which participating brands learn how to design recycable products.



OTHER CIRCULAR FLOWS | MARCH 2025

Role of the Dutch Denim programme can change: if the use of PCR is more and more common, the programme can focus on other circular flows. It can help companies invest in new business models such as repair services, renting services etc.



DEVELOPMENT OF BBL LABEL | OVER THE YEARS



% of PCR material in fabrics increases over time

at some point, a required use of organic cotton is added

% of product that is recycable increases over time

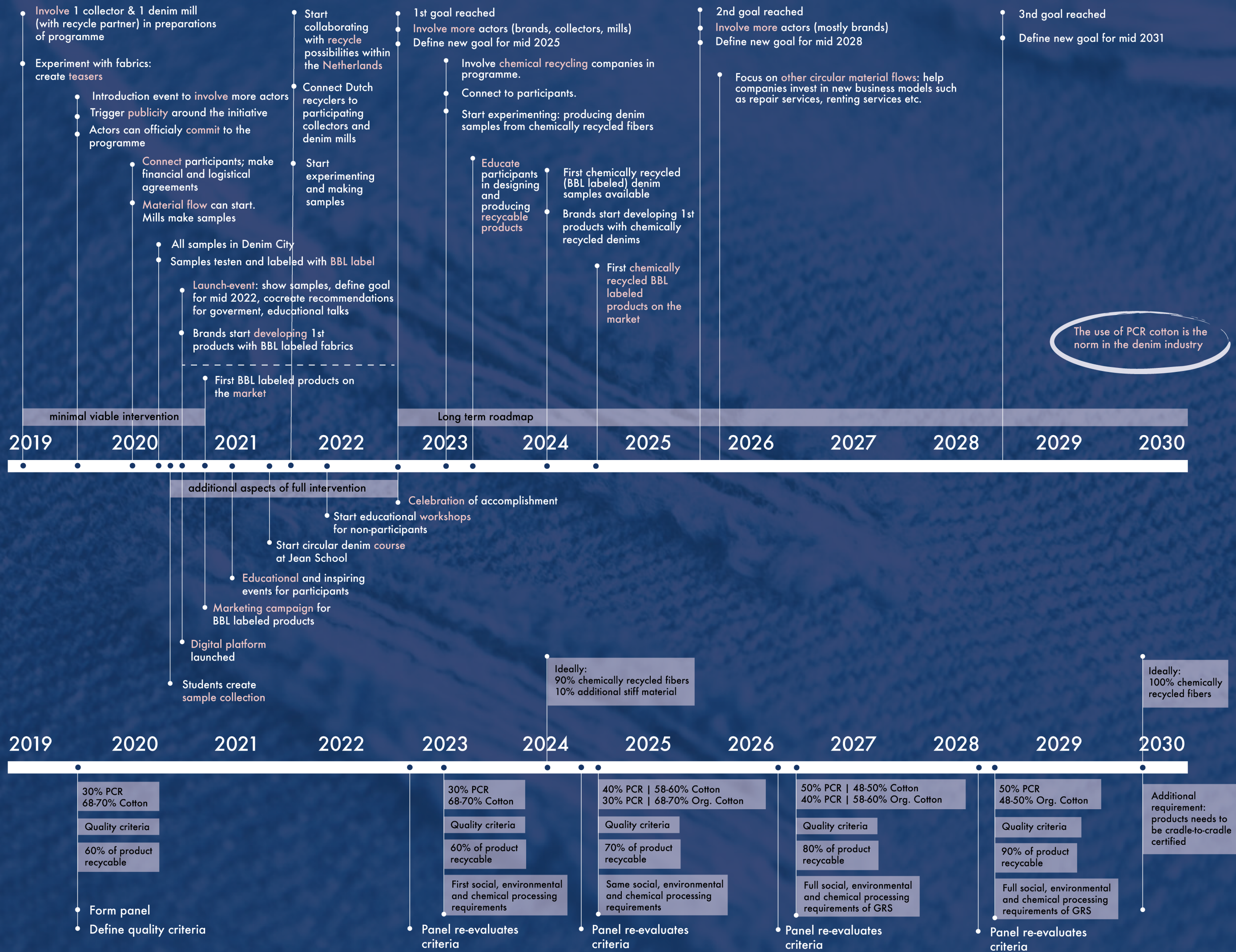
social, environmental and chemical processing requirements are added, and got more and more demanding over time

eventually developed to being fully cradle-to-cradle





DUTCH DENIM PROGRAMME



UNIQUE SELLING POINTS

What makes this programme different from other initiatives?

In the last couple of years, several initiatives are carried out. What makes this programme different from other initiatives? The different types of initiatives are described and compared with the Dutch Denim Programme.

Initiatives from brands

There are two types of initiatives of brands using PCR cotton in denim production.

1. Individual sustainable brands that set up a continuous material flow themselves, produce their own fabrics and market their own products. Two examples of successful initiatives are the brands Mudjeans and Kuyichi, they develop their own fabrics in collaboration with mills within Europe and have a constant offer of recycled products to consumers. These brands were initially started out of sustainability reasons and are known for their sustainable products. The brands are mostly focused on the conscious consumer that is willing to pay a little more. Because of the intrinsic motivation of the brand and their position in the market, they have an internal drive to continue the development of PCR fabrics and do not compare it with non-recycled denim. Therefore they have established a continuous material flow (however on small scale) and long term relationship with their partners.

2. One time projects of brands in which a temporary collaboration is started. Several projects are executed by (bigger) brands; in these projects a one-time material flow is initiated as a trial. Only a few styles are made with the produced fabric. These brands are not build on having the logistical challenge and longer product development process within their daily operations. Also, it is more difficult to market these few recycled products within a collection of non-recycled (or even non-sustainable) projects. The main target group of these brands is often not (only) the conscious consumer. The project often stagnates, when the sales of the recycled products are not directly a success. Because of the extra operations, extra costs and the small scale of the project, these projects are rarely profitable.

Comparison The Dutch Denim Programme (DDP) and initiatives from brands

- The DDP will reduce the extra operations to delight brands that are not build upon the extra recycle operations. The Dutch Denim Programme will set up the network, initiate the material flow and demand samples made from Dutch textiles. In this way, brands that are not build to incorporate a lot of extra operations can chose for PCR cotton easier.

- The DDP will realise bigger volumes and a more stable material flow within the value chain. When multiple brands commit to the programme, a more stable, collective material flow with bigger volumes will be established, in order to become profitable.

- The DDP will position the Bright Blue labeled products in the market collectively. By teaming up, communicating this to the world and executing collective marketing, the products get a place in the market that attracts conscious consumers as well as the current target group of brands.

- The DDP will give brands a drive to continue with PCR cotton when sales are not directly successful. By collectively committing to the goal of the programme, that hey set themselves, brands will have a drive to continue. By creating publicity around the programme and the participants, external motivation is generated. Besides that, the long term vision of the programme, to work towards a circular denim industry, will make the Dutch Denim Programme a long term continuous initiative instead of a one time recycling project.

Initiatives from organisations

Other organisations have developed programmes to work towards a circular textiles economy. A few examples: the transition agenda ‘Consumption good’ of the governmental programme “Nederland Circulair in 2050” and the platform ‘Circular Textiles’ that created a roadmap to work towards a circular textiles industry (both mentioned in chapter 1). Often those kind of initiatives are focused on educating, inspiring by sharing a strategy or good case practises and stimulating innovations. Advocating good initiatives and promoting best practises are good ways to stimulate and accelerate innovation, for example for the development of automatic textile sorting and advanced ways of recycling. Education and inspiration is useful to make the industry aware of the possibilities.

Comparison The Dutch Denim Programme (DDP) and initiatives from organisations

- The unique element of the Dutch Denim programme that is focused on taking action. By facilitating the network, initiating the material flow and creating a new fabric category (Bright Blue Loop labeled fabrics), it tries to solve practical issues. By taking the lead in stimulating the development of 20% PCR denims, it gives the industry a focus on increasing the volume instead of the percentage. This tries to prevent individual brands from all going through the same process of solving issues to increase the percentage and dropping out because of the difficulties. Education will be given to make it possible to start working with PCR cotton, not (only) to be aware.

- The Dutch Denim programme is a programme specifically for the denim industry. Most of the current organisational initiatives are focused on working towards a circular textile or fashion industry. Since this programme is focused on the denim industry, it makes it easier to work towards action: to actively involve the actors, establish the network and make a change happening. House of Denim has the unique position to already be in contact with most of the important players

SUCCESS INDICATORS

When is this programme a success?

Success to communicate

As explained, the participants of the programme will define a collective goal. This should goal should be realistic, ambitious and measurable. Therefore a time span should be chosen.

In the development of the Denim Deal with the government, the following ambition is expressed: to produce 1 million jeans with 10-20% PCR in 2022. Advised is to evaluate this goal with the participants to see if it is attainable. If the participants could define their own goal, they are probably more motivated to strive for it. Besides that, it is advised to set a goal of X amount of jeans sold instead of produced, since only producing it is not having any positive impact either.

The success of the programme can be communicated to the participants and the industry by keeping track of the progress towards the goal.

Internal success indicator

The overall objective of setting up the Dutch Denim Programme is to increase the use of Post Consumer Recycled cotton in denim production. Since denim production is growing in general, an absolute growth does not indicate any success. Therefore we should look at a growth in the percentage of denim products produced with PCR cotton: success is defined by a growth in the market share of PCR. To able to measure this, an estimation should be made of the current production of PCR denim compared to other denims: data of denim mill need be requested.

An assessment of the relative growth of PCR of the last ten years needs to be made, since the same linear growth of PCR that we have seen the last year would not indicate succes of the programme either.

By having numbers of the market share of PCR and the growth the last years, it will be possible to measure the succes of the programme: the relative growth in market share. Every year, new data should be requested from the participating denim mills in order to evaluate and compare the numbers. Not only the production of the Bright Blue Loop labeled fabrics should be included into this calculation, but the production of all PCR denims (PCR denims made from foreign textiles), since the programme can have ripple effects in the current system with the result of stimulating others to work with PCR as well.

Based on the current numbers and ambition of the participants, House of Denim will need to define a goal: for example a relative growth of 5 or 10% per year. This can be used as internal success indicator.



CHAPTER 4.5

VALIDATION & RECOMMENDATIONS

To validate the intervention, interviews were conducted. In the interviews, the programme is presented and feedback on different aspects of the programme was gathered. Based on the validation interviews, recommendations for further development were written and are presented in this chapter.

To evaluate and validate the concept, interviews are conducted. Ideally, validation with actors from all parts of the value chain would have taken place. Due to time constraint and other reasons, this was unfortunately not possible. Three extensive interviews are carried out: with branche organisation Modint, collecting organisation Sympany and the governmental workwear department of the Ministry of Defence. The Ministry of Defence was involved because House of Denim saw a possible collaboration with this party, since this actor has a constant material flow of all the workwear of the government and it concerns itself a lot with recycling projects. Besides these three parties, specific information is gathered from a textile specialist and the concept is evaluated with House of Denim representatives.

Focus of the interviews

In the interviews the feasibility, desirability and viability of the programme is discussed, with a slight focus on the feasibility. These three factors assess if the programme can be realised in practice, if it addresses the values and needs of House of Denim and of the denim industry, and if it will survive over time. Based on these three topics feedback was gathered and gaps were filled in.

The feedback and extra information gathered by the interviews is analysed. Some extra desk research is done. All of this is summarised in recommendations for House of Denim for developing both the Bright Blue Loop label as the Dutch Denim Programme.

Recommendations for the BBL label

In general all interviewees were positive about the label. They believed that the desirability of a label for PCR denim fabrics is high, since this would make operations for both the mills and the brands easier. Besides the ease it can offer the industry, the step towards the consumers is mentioned as a valuable unique point. However, Nienke Steen from Modint mentioned a current initiative called REMO (Recycle Movement), which also makes this step to the consumer by creating hangtags for textile products that show recycled content and the environmental impact of the recycled content. To prevent duplication of effort, House of Denim is advised to look into this initiative to see if collaboration could be desirable and feasible. In the interviews, the viability of the label is discussed. The development of the label overtime (slowly tightening up the requirements of the label) is mentioned as a positive aspect. In this way, the label gives a long term vision.

Make the BBL labeled fabrics available for everyone

Advised is to make the BBL labeled fabrics available for everyone; not only for the participants of the program. In this way, it can be used by other (non Dutch) brands that normally work with the participating mills and it can become a recognisable fabric category. Also other mills can be stimulated to participate in the collaboration and produce BBL labeled denims (still made from recycled cotton from the Netherlands), which would make the label more viable.

Test fabrics locally instead of in the Netherlands.

This advice goes hand in hand with the advice to test the fabric locally instead of in the Netherlands. Testing the fabrics to see if they meet the BBL quality requirements in research institutes in the Netherlands gives more transparency and trust. However, this is financially and logistically less desirable, especially in the longer term. Advised is to communicate the quality requirements to the denim mills, that already test their own fabrics. Spot checks can be done to check upon the quality.

Three topics are discussed in the interviews to asses the feasibility of the label.

1. How to define the quality requirements for the BBL label?

The advise to House of Denim was to form a trustworthy panel to create more up-to-date quality requirements for the BBL labeled fabrics. Often highly strict requirements are used by brands, while these are not adjusted to the current way of consuming. In the panel a research institute, a representative from Textile Exchange (from the CRS standard), a technical expert from Denim City, a denim mill and a brand should be involved. However, Nienke Steen from Modint told about a rapport created by experts from Modint together with Dutch and German textile experts in which quality requirements and test methods for all kind of fabrics are defined: the IQTL standards (former ECLA standards). This rapport is recently updated and involves recycled materials. Therefore House of Denim is recommended to look into these standards to see if these could be used. When up-to-date requirements for PCR denim are already defined, they can be acknowledged as BBL quality requirements or they can be used as a base to be assessed by a panel.

2. How to certify that there is 20% PCR fibers in the BBL labeled denims?

A topic that appeared in the interviews was how to proof the recycled content in the fabric. In the creation of the concept, a mass balance system is proposed: a volume tracking system. In this way, invoices and administrative files verify the purchase of recycled fibers. This does not prove a specific percentage of fibers in certain products. It only ensures that the quantity of denim sold with a PCR claim cannot exceed the quantity of PCR fibers purchased.

Rob v. Arnhem - Ministry of Defence, told in the interview about a project that will start after the summer to develop an objective measure system to prove recycled content, together with Saxion and Dutch SMEs. In the project different current methods are researched. One of the methods is to use identifier fibers that can be detected by infrared to track-and-trace recycled fibers. The project of the ministry will develop the most feasible method further and make it available for everyone. In this way, assurance of the recycled content can be created.

Since the Dutch Denim Programme will start in a close collaboration with 1 to 3 denim mills, in the short term the mass balance model can be implemented. The mills will buy recycled fibers based on the order commitments of brands (which can be organisationally and financially checked) and will commit to using this for producing 20% BBL labeled fabrics. Using a higher percentage is not desirably for the mill itself; a higher percentage is more difficult and more expensive for the mill itself. Using a lower percentage would result in a financial loss (if the fibers are not used after all), or they would be used in other fabrics that cannot be sold with the BBL label (since only a certain quantity can be sold with the PCR claim, according to the amount of purchased fibers).

Recommended to House of Denim is to stay up to date and connected to current developments of fiber tracking innovations. When the Dutch Denim Programme grows and these systems are available, it can make the switch to use a tracking system to create an even more transparent value chain.

3. Is 20% a realistic percentage?

The opinions about the choice of 20% PCR fibers were inconsistent. The Ministry of Defence believed that the percentage was highly ambitious since in most of the workwear of the Ministry 10% is used. Others considered 20% as a save choice since currently 40% PCR jeans are on the market (Mudjeans). This feedback represents the industry, since in the research phase the percentage also appeared to be a matter of debate. Therefore it is advised to start with 20% and see if the fabric can meet the new quality requirement by using the new textile category (knitted cotton textiles).

Recommendations for the Dutch Denim Programme

Similar to the Bright Blue Loop label, the overall opinion about the Dutch Denim Programme was very positive. One of the biggest limitations of the programme is that it only would work if enough actors would participate: collecting centers, mills and brands. Therefore, this topic is discussed in the validation interviews.

Would mills and collectors participate?

In the research phase as well as the validation interviews, the interest of mills and collectors to innovate and work towards a circular flow is confirmed. Collectors are looking for new destinations of their textiles. The targeted mills have already innovated in this area and looking for ways to scale up.

Would brands participate?

A critical mind would immediately question if competing brands would collaborate with one another. Sharing experiences and knowledge might look like revealing your company secrets. However, in sustainable innovation, sharing experience and knowledge could lead to benefits for everyone. Technology will develop faster, the demand will be higher and therefore, the technology and its products will be more accessible and affordable in the long run (Wentholt, M). However, to make this clear to the industry and motivating actors to be involved in the programme because of this is highly challenging. Therefore it is advised to focus on other aspects to get actors involved.

Nienke Steen (Modint) and Maarten Wentholt (H.o.D) both confirmed the interest of brands to be part of the newest innovations. Brands are dependent on what other are brands doing and within the industry there is a lot of focus on sustainable innovations. Missing the network and knowledge that the programme brings, will mean lagging behind on others that do participate. Besides that, a lot of momentum and publicity will be created for the programme and the participants. Mariette Hoitink advised to focus, when involving brands, mainly on the publicity and the brand image that committed brands will get: they will be put on the map as circular frontrunners. By this programme, the Dutch fashion industry will make a big step towards circularity and could become internationally known for this. As brand, you do not want to miss out on this, right?

Another very important driver could be to unite in order to make the government create fiscal incentives. When more brands participate, they are stronger together and therefore able to bring a coordinated message from the industry to the government. It is advised to use this message when getting brands involved and committed.

Communication of the programme

Mariette Hoitink, co-founder of House of Denim, advised to not position the programme as the start of a new coalition all over again but to use the position and network that House of Denim already has. The industry will get tired of just another coalition that only ‘talks’. Therefore, House of Denim is advised it should be to communicate the programme as a programme of House of Denim, that is action oriented.

Organisational feasibility

Since House of Denim is mostly ran voluntary, the organisational capacity is limited. Therefore, this topic is discussed with Mariette Hoitink and Maarten Wentholt. Both saw this not as a bottleneck and found the programme realistic, since the organisation has experience with a lot of different elements of the programme: networking, organising events, creating collections by students etc.

However, in the validation period of this project, a new initiative revealed itself. An initiative that House of Denim could potentially collaborate with, in order to make involvement and commitment even more attractive for all actors and it would ensure organisational and economical feasibility: The Dutch Circular Textile Valley (DCTV). An initiative from branche organisation Modint in collaboration with Fashion for Good, Circle Economy, ABN-Amro, MVO-Nederland and Het Groene Brein. This is a collective textile initiative within the transition agenda ‘consumption goods’ of the governmental programme called “Nederland Circulair in 2050’ in which the organisations want to take concrete steps. The DCTV will define different tracks within the programme and is planning on creating a denim track. Nienke Steen from Modint was not responsible for this project herself but stimulated the idea to see if the Dutch Denim Programme could be the denim track of this programme. House of Denim is recommended to focus on this collaboration. Being part of this programme would ensure interest of different actors, would create a lot of publicity and would, as mentioned above, make the programme financially and organisational feasible.

Besides the commitment of actors and organisational feasibility, technical feasibility aspects are discussed and recommendations are formed.

Is the use of knitted cotton textiles for recycling realistic?

Based on speculations, the recommendations was developed to create PCR denims made from recycled textiles that result in longer fibers than denim. The idea is to sort >95% cotton textiles that are knitted instead of woven, in the colours blue, white, grey, black.

Some background information

As explained, denim is a cross twill weave fabric with (blue) coloured warp yarn and white weft yarn. Woven fabrics are not elastic, especially denim is a tightly woven and sturdy material. Shredding this results in short fibers. Tricots, knitted fabrics, are more elastic and are made from a single yarn. There are different cotton tricots. One of them is the jersey knit. Often t-shirt, tops, polo shirts, sweatshirt, leggings, dresses, baby wear and linnen are made from cotton jersey.

Validation

So far, this idea was still a hypothesis. In the validation interviews, the hypothesis that jersey knitted cotton textiles can result in longer fibers after shredding is checked with a textile expert from the Ministry of Defence and the collecting organisation Sympany. Both parties confirmed this hypotheses in theory. However, probably the shredding method needs to be adjusted according to the fine and delicate material to really make sure the fibers are longer. Ideally the material would not be chopped, but brushed in a way, to get back to the thread the material is knitted from.

Is there enough supply of discarded jersey knitted cotton textiles?

The textile expert from the Ministry of Defence warned that the supply of those material could be much smaller than denim products. However, Sympany was very positive and saw potential in this idea. Already earlier in the process the availability of enough supply of >95% cotton textiles (white, blue, grey, black) was confirmed. To see how much knitted material is available per year and how much this would cost, an estimation is requested (Sympany is working on the assessment at the moment). If a small batch could be sorted, experiments with different ways of recycling could start.

Innovation

In the validation period, House of Denim also spoke to innovative sorting center Wieland. Wieland revealed that their automatic sorting system (mentioned earlier in chapter 2.1), is ready to enter the market. It is further developed and at the moment it is possible to automatic sort materials by content and colour. This can be used to sort the right material.

Should recycling happen in the Netherlands or abroad?

Recommended is to prepare textiles at sheltered workshops in the Netherlands and to recycle the textiles at the current recycling partners of the denim mills abroad. During the interviews, this idea is validated since the only Dutch recycling facility (in Haaksbergen) is specialised in shredding textiles to use for down-cycling purposes. This is a very rough way of shredding. Especially when experiments with knitted textiles need to take place, it is advised to work with highly specialised facilities that have expertise in shredding for upcycling projects; a delicate way of recycling.

However, Wieland also revealed a new innovation it is developing at the moment. It is an innovative way of recycling, still a bit mysterious, that can unravel textiles with the use of tension that promises a result with longer fibers. Recommended to House of Denim is to stay in touch with Wieland and this new way of recycling: if it would be possible to create long recycled fibers within the Netherlands on a big scale, this would be a very valuable opportunity. At one hand, more value creation would take place in the Netherlands if textiles are recycled locally and on the other hand, shipping usable recycled fibers is more efficient (and would have less environmental impact) than shipping textiles. However, if the technology of Wieland would be available in the short term, the participating denim mills need to work in close collaboration with Wieland since the mills need to trust the content of the material (some metal within the fibers can damage machines). House of Denim will need to consider this and could look into the development of a new ISO norm for PCR fibers, so that denim mills can trust the material.

The last important topic that was discussed in the validation interviews was the focus on the consumer. Presented was the hangtag and the possible marketing campaign which was not part of the minimal viable intervention but only of the full intervention.

However, both Mariette Hoitink as Rob van Arnhem mentioned that the link to the consumer is a very important aspect of the programme. Raising the demand from the consumer could have a lot of impact on the brands. Van Arnhem brought up the strange perception consumers have of recycled clothes. He mentioned the surprised reaction of people when he shows recycled clothes; ‘Oh it does not smell weird, and the colour is the same!’. With a strong marketing campaign the perception of recycled clothes and the awareness of the impact of fashion could change. Hoitink put emphases on the fact that brands are especially willing to participate if consumers would care about the label; about the fact that it is recycled. Simultaneously to this project, a consumer facing design project by another graduate from the TU Delft has taken place. In this project, a rating system is designed that shows the consumer how sustainable jeans are. House of Denim is advised to link the Bright Blue Loop label to this rating system. If the label would give products a high score, which will be communicated to the consumer, brands would be more willing to have this label on their products.

Financial feasibility

To evaluate if the programme is financially feasible, a strategy for the financial flow and rough estimation of the costs are made in collaboration with House of Denim. In creating this strategy, the recommendations described on the previous pages are taken into account; therefore it is presented at the end of the validation chapter.

Market flow

The idea is that the working of the new material flow is financially covered by the industry. The costs for the first samples will need to be paid by the actors involved. Sorting centers and mills will be asked to experiment and create new samples, and pay their own part in this first process. Since they will see a chance that the programme succeeds and a new market will open up, they will probably take the risk and charge the costs of the samples in the price of the fabrics later on (just as current practises).

When brands commit to the programme and demand bigger volumes of the BBL labeled fabrics, the actual material and financial flow can start. The average virgin cotton price at the moment is 1,60 euro per kg (Statista, 2019). By means of a rough approximation, we estimated that the internal extra costs for the mills to work with these fibers are 0,10 euro per kg. To be able to sell the fabric for the same price as normal denim, the price for the recycled fibers should cost not more than 1,50 euro per kg.

The average value of collected textiles is 0,80 euro per kg. Normally around 0,40 euro per kg is paid to the municipality (Gemeente.nu, 2015), 0,20 euro per kg are normal sorting costs, roughly speaking, which leaves approximately 0,20 euro per kg for charity (Veenstra, 2013). Based on these numbers, we could say that 1,00 euro per kg needs to be paid to the sorting centers. This leaves room for 0,20 per kg for transport costs and 0,20 per kg for the preparation of the textiles. These numbers need to be validated.

When the mill will need to pay 1 euro per kg for the textiles, there is 0,50 euro per kg left. A part needs to be paid to the recycle center in order to shred to material (rough estimation; 0,20 per kg). The rest can be paid to the Dutch Denim Programme, as a license for using the Bright Blue Loop label (0,30 per kg). In this way, the denim mill does not have any extra costs for using PCR fibers and can sell the denim for a normal price to the brands. The brands do not have extra costs, except from the physical hangtag (which will be around 0,20 - 0,40 euro per product).

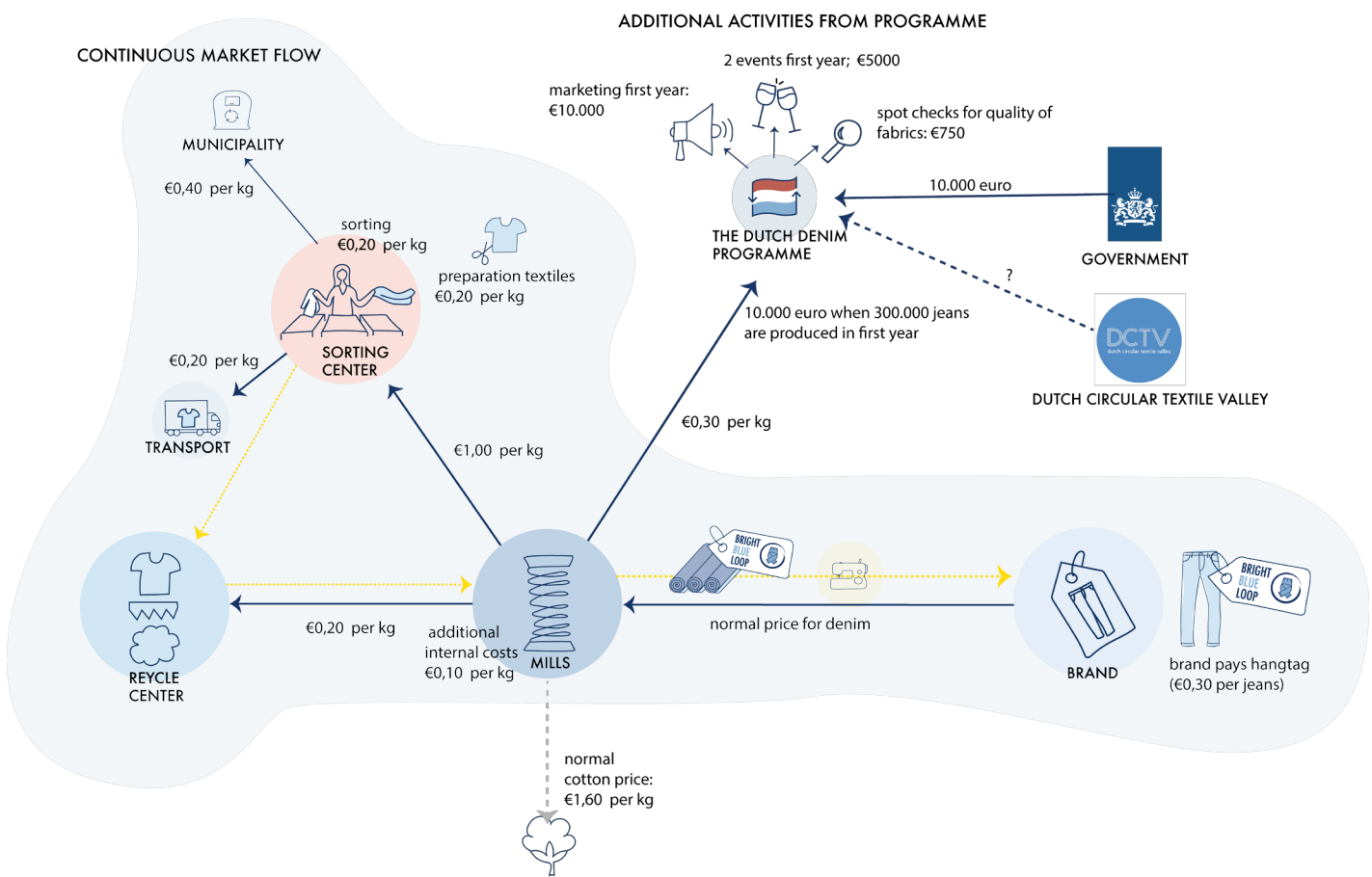
Validation of the following costs are essential to see if this market flow can work: costs for preparing the textiles, recycling costs, additional internal costs for mills and transport costs.

Finances of the Dutch Denim Programme

The Dutch Denim Programme will be responsible to involve the actors, bring the network together, stimulate action and communicate. All of this costs rarely anything, especially since the network is already established, there is a physical location to bring people together (Denim City) and a lot of the publicity activities will be sponsored because of the relations of House of Denim, for example a stand on the Denim event Kingpins. Also the feasibility of a sample collection made by Jean School students is validated and does not bring any costs. The highest costs will be the marketing costs; the communication towards the consumer in order to make the consumer aware of the possibility to buy BBL labeled products. Besides that, expenses for events and the spot check to see if the fabrics meet the quality requirements needs to be made. The production of BBL labeled products will bring in money. An additional grant from the government can be asked, as a part of the Denim Deal. Becoming part of the Dutch Circular Textile Valley would also bring financial benefits. Together, these commissions should be able to cover the organisational and marketing costs of the programme.

However, this is a rough estimation. House of Denim is advised to re-evaluate this and involve different actors from the value chain in creating a proper estimation. This can be presented to the government as well as the DCTV to see how they could financially help in the best way.

Figure 47. The financial flow of the Dutch Denim Programme



EVALUATION

In this section, the project and its outcome will be evaluated. The research questions are answered in an overall conclusion of the project (5.1). The possible effect of the programme on the three key problems is discussed. In addition, points of discussion and limitations of the project are named (5.2). The chapter will close off with a reflection of the contribution to the design field and a personal reflection (5.3).

EVALUATION

5.1 CONCLUSION

In the conclusion, the main question of this project is answered.

Main question

How can the demand for recycled cotton in jeans production, started from within the Netherlands, be increased by triggering the key actor(s) or interaction(s) within the cycle?

Main conclusion

The demand can be increased by solving the key problems through collaborative action of the value chain and by stimulating brands to raise the demand.

How does the Dutch Denim Programme solve the three key problems through collaborative action of the value chain and stimulating brands to raise the demand? The DDP is evaluated according to the key problems.

1. Brands have a negative perception of PCR denim. They perceive it as difficult, expensive and low quality fabric.

Focussing on a low percentage of PCR fibers (20%) and sourcing cotton textiles that result in longer fibers after shredding, will ensure a good quality of the PCR denim fabrics. The Bright Blue Loop label will create trust and transparency about the quality. Cost could decrease by stimulating a larger demand, shipping larger batches and possibly a fiscal incentive. The Bright Blue Loop label & sample collection will shorten the trial-and-error process for brands.

2. In order to work with PCR cotton, individual brands are given a complicated logistical challenge that results in a time consuming and expensive process

The Dutch Denim Programme makes the use of PCR more accessible by making the logistics easier for brands: brands do not have to establish the network and material flow themselves.

3. The use of PCR fabric is not adopted as common practice due to the lacking supply and demand of the fabric. Recycled denim products are not conventional in the shops and consumers do not actively demand it.

Publicity and collectively lobbying the government could motivate brands to commit and raise the demand. The brands will be prepared by educational activities and sharing experiences. Because brands that participate in the program commit to demanding a certain quality, mills do not have to wait and can start making samples. More supply, the recognisable BBL hangtag and marketing could stimulate the demand of consumers.

Does the dutch denim programme increase the use of pcr cotton in denim production?

The Dutch Denim Programma has a lot of potential to increase the use of PCR cotton in denim production. However, this depends mainly on the participation and commitment of the actors that need to be involved and the financial structure regarding the material flow and programme.

5.2 DISCUSSION AND LIMITATIONS

Should overstock be included in the programme?

In the research phase it appeared that 30% of all produced clothes are never sold; the overstock. These enormous amounts of clothes are often incinerated but this is a gigantic resource that could be upcycled as well. However, giving these garments value for the brand will not stimulate to estimate better stocks and prevent causing this overstocking problem. Also, other partners should be involved in the programme which are currently not in House of Denims network.

Should we use Dutch textiles while there are also textiles available nearby the denim mills?

The denim mills also have a lot of collected textiles locally which would result in less shipping costs and CO2 emissions; why is it needed to use Dutch textiles? It is advised to start working with Dutch textiles, since this makes the programme more likely to succeed. In the long term, it could be interesting to investigate if locally collected textiles could be used, since at the end of the day, House of Denims vision is to make the denim industry more sustainable.

What should happen with all the collected denim products that are not suitable for upcycling yet?

Since the Dutch Denim Programma would use other cotton textiles than denim, this still leave a very big supply of collected denim products that are not repairable anymore. House of Denim's ambition is to make the denim industry more sustainable: also the end-of-life of denim products is the responsibility of the denim industry. The Dutch Denim Programme could look into the high value recycle possibilities of denim products that do not have the tough quality requirements, for example in a scarf or mat.

Limitations

In the research phase, all the people that are interviewed are close connections of House of Denim. This could have biased their expressed opinions. The main limitation of the design stage is the restricted validation process. Therefore, House of Denim is advised to continue validation with different stakeholders to hear the perspective of the denim mills and brands.

5.3 REFLECTION

How does this project contribute to the field of design?

This project is executed with a Systems Oriented Design (SOD) approach, a relatively new field of design. This project could serve as an example project to introduce SOD to the TU Delft.

A world with a growing need for sustainability, a continuous globalisation and ongoing innovation gives highly complex problems which gives designers the perfect challenge to use their skills to have a positive impact. To solve complex problems, designers should be able to cope with different perspectives and combine different values. Systems Oriented Design is a field of design that has emerged in the last 10 years and that has developed a way of designing for complex problems based on designing for and with systems: a multi-centric approach to design. I think that a systemic ways of designing will become more and more relevant. This project could be used as an example when implementing systemic design education.

The personal reflection can be read on page 136.

CHAPTER 5.1

CONCLUSION

In this subchapter the conclusion of the project will be presented. Firstly, the research questions are answered. This is followed by an evaluation of the Dutch Denim Programme to assess if the intervention tackles the three key problems. An overall conclusion is drawn.

ANSWERS ON THE RESEARCH QUESTIONS

To conclude this project, first of all the research questions are answered.

Main question of research phase |

How can the demand for recycled cotton in jeans production, started from within the Netherlands, be increased by triggering the key actor(s) or interaction(s) within the cycle?

Main conclusion of research phase |

THE DEMAND CAN BE INCREASED BY SOLVING THE KEY PROBLEMS THROUGH COLLABORATIVE ACTION OF THE VALUE CHAIN AND BY STIMULATING BRANDS TO RAISE THE DEMAND.

The answer on the main question, the main conclusion, is based upon three sub questions, which are answered below.

1. What does the current landscape of collection of textiles in the Netherlands, recycling of cotton and the production and consumption of denim look like?

The current landscape is a rich system in which different actors behave according to the environmental, technological and social changes in the world, but also according to their relations and dependencies between them. Fast-fashion and mass production has changed the consumption culture and industry practises drastically which has extremely negative environmental and social consequences. In the new consumption culture clothes have lower value and are used less long, resulting in an overload of discarded textiles, that are nowhere wanted, seen as waste. Collectors are looking for new market opportunities to make the 'waste' used as resource and ensure their business. The pressure on brands to produce as cheap as possible in a limited time, gives no room for innovating and experimenting with recycled textiles. Therefore, no constant material flow from collectors to denim mills is established yet. A group of conscious consumers is developing in the Netherlands, but only a limited amount of consumers is willing to pay more (consumers are used to fast fashion prices), resulting in no substantial supply and demand for recycled denim products. To have an overview of the rich system we are talking about, a systems map is created called 'The cycle of a pair of jeans' in which all actors, activities, problems are visualised. A small version can be found in appendix A.

2. What are the key problems in producing, using and selling recycled cotton in denim?

Based on the analysis of the research results, three key problems are defined, which are all part of the problem network.

1. Brands have a negative perception of PCR denim. They perceive it as difficult, expensive and low quality fabric.
2. In order to work with PCR cotton, individual brands are given a complicated logistical challenge that results in a time consuming and expensive process
3. The use of PCR fabric is not adopted as common practice due to the lacking supply and demand of the fabric. Recycled denim products are not conventional in the shops and consumers do not actively demand it.

3. What are the key actor(s) and interaction(s) within the chain where interventions could change the current system?

By means of an answer on this question, three conclusions are formed.

1. The brand is the key-actor who can raise the demand for PCR cotton. The more brands demand for recycled material, the more widely available and affordable these fabrics will become.
2. To start cotton recycling at scale, coordinated and collaborative action is needed. To establish a successful material flow, the following interactions are important to focus on in the collaborative value chain: brands need to be connected to denim mills that produce recycled denims. Denim mills will need to cooperate with

sorting centers in the Netherlands to obtain discarded textiles. Denim mills should be linked to local recycling facilities to get these textiles recycled into PCR fibers.

3. Conclusion three focusses on who needs to be involved specifically to increase the use of PCR denim and cooperate towards this goal. To raise the demand significantly, a collaboration with the bigger Amsterdam denim brands is needed. In the collaboration, the adopting and innovative mills of Turkey and Spain (and their current recycling partners), the big Dutch collectors (and connected sorting centers) and a Dutch (preferable sustainable) transport company should be involved.

x EVALUATION OF THE DUTCH DENIM PROGRAMME

The main conclusion of the performed research was that the demand for PCR denim can be increased by solving the key problems through collaborative action of the value chain and by stimulating brands to raise the demand. In response to this, an intervention is designed: the Dutch Denim Programme. Does the Dutch Denim Programme solve the three key problems through collaborative action of the value chain and stimulating brands to raise the demand? The DDP is evaluated according to the key problems.

1. Brands have a negative perception of PCR denim. They perceive it as difficult, expensive and low quality fabric.

Focussing on a low percentage of PCR fibers (20%) and sourcing cotton textiles that result in longer fibers after shredding, will ensure a good quality of the PCR denim fabrics.

Because shredding denim results in shorter fibers than shredding other cotton textiles, it is highly plausible that using other cotton textiles for recycling results in stronger yarn and denim fabric. Although confirmed in theory, this hypothesis should be tested by sorting the right textiles, experimenting with the recycling of knitted cotton textiles and experimenting with spinning and weaving with these fibers. Besides that, we aim for a low percentage of PCR fibers. Using only 20% makes sure there are limited technical challenges and/or room for discussion about quality.

The Bright Blue Loop label will create trust and transparency about quality.

The intervention proposes to define quality criteria for the BBL label or acknowledge the IQTL criteria from Modint. Making sure the fabric meets the criteria could give brands certainty about the quality of the material. If doing samples (spot checks) would be enough to ensure the quality and create trust should be validated.

Cost could decrease by stimulating a larger demand, shipping larger batches and possibly a fiscal incentive.

PCR could become more affordable by establishing a larger demand for PCR fabric and creating larger batches of textiles to be shipped and recycled which reduce the costs per entity. This will only happen if enough actors will take part in the collaborative programme. The Denim Deal could lead to a fiscal incentive which would lower the costs of using PCR drastically. It is hard to predict the probability of this happening in the short term.

The Bright Blue Loop label & sample collection will shorten the trial-and-error process for brands

Developing a PCR fabric that is desired by the brand asks for a trial and error process. In this intervention, mills will create different samples. Students from the Jean School will create a sample collection that shows the possibilities and restrictions of the fabrics regarding washings and treatments. Thanks to the samples and the sample collections, the time-consuming process to get to a fabric brands desire will be shortened because they can immediately see different options and the opportunities and limitations of each option. If this would work out in practice as well, will need to be validated with brands.

These four aspects can contribute to a more positive perception of PCR denim.

2. In order to work with PCR cotton, individual brands are given a complicated logistical challenge that results in a time consuming and expensive process

The Dutch Denim Programme makes the use of PCR more accessible by making the logistics easier for brands.

Brands do not have to establish the network and material flow themselves. This could save time and money. They can choose a sample (produced by their 'own' denim mill) and the connections and agreements to produce more of this fabric would be already provided. This idea should be put into action to really assess how much easier this would be in practice.

3. The use of PCR fabric is not adopted as common practice due to the lacking supply and demand of the fabric. Recycled denim products are not conventional in the shops and consumers do not actively demand it.

Publicity and collectively lobbying the government could motivate brands to commit and raise the demand.

The programme will try to motivate brands to participate by promising publicity and with that, getting the image as circular frontrunner, nationally and internationally. Because of the financial uncertainty at the moment, it is hard to estimate if it is really possible to give them this image, since this would bring marketing and publicity costs. It would be more feasible if a governmental financial contribution is assured or if the programme would be part of the Dutch Circular Textile Valley, since important industry players take part in this initiative.

Another motivating aspect would be collectively lobbying the government to create fiscal incentives for the use of PCR textiles, since this would be a real game-changer.

Prepare brands by educational activities and sharing experiences

The Dutch Denim Programme will educate the brands during a DDP summit about the use of PCR denim and current technological developments. Sharing knowledge and brainstorming could inspire and help other brands.

The Dutch Denim Programme stimulates denim mills to start experimenting and make samples.

Because brands that participate in the program commit to demanding a certain quality, mills do not have to wait and can start making samples. Only the first denim mill that will be asked to create a teaser sample for the preparations of the programme, in order to persuade brands to commit, will need to invest beforehand. Since previous projects are executed like, this will probably not be a barrier. Besides the direct operations of the programme, creating more attention for recycled denim within the whole industry, will also stimulate other mills (and brands) to start working with it.

More supply, the recognisable BBL hangtag and marketing could stimulate the demand of consumers

When enough brands participate in the programme, there will be more recycled jeans to choose from for consumers. A rapid growth of the supply for consumers. Marketing towards the consumers will remind consumers of the possibility to buy recycled denim. The hangtag makes the jeans easy to recognise, offline and online. Together, this could stimulate the demand of consumers. However, this strategy would only work out if enough brands participate (in order to have a bigger supply) and if the marketing campaign will be big (and smart) enough to reach the right target group. This highly depends on the financial capacity of the programme.

Overall design goal |

DOES THE DUTCH DENIM PROGRAMME
INCREASE THE USE OF PCR COTTON IN DENIM
PRODUCTION?

The Dutch Denim Programme has a lot of potential to increase the use of PCR cotton in denim production. However, this depends mainly on the participation and commitment of the actors that need to be involved and the financial structure regarding the material flow and programme.

CHAPTER 5.2

DISCUSSION AND LIMITATIONS

In this section, the scope and directions taken in this project are discussed. A few limitations of the research and design phase of this project are presented.

POINTS OF DISCUSSION

This subchapter sheds a critical light on the scope and directions taken in this project.

Should overstock be included in the programme?

In the beginning of the project, the scope is defined as Post-Consumer Recycled cotton. Therefore, during the research phase the student has mainly looked into the collecting and recycling of garments worn by consumers. However, during exploration it appeared that 30% of all produced clothes are never sold; the overstock. These enormous amounts of clothes are often incinerated to prevent that the brand image would be damaged (otherwise these clothes could get on the market for very low prices). It is a gigantic resource that could be upcycled as well. Especially since these are often bigger batches of the same garments, which makes it easier to sort and prepare for recycling. However, giving these garments value for the brand will not stimulate to estimate better stocks and prevent causing this overstocking problem. Also, other partners should be involved in the programme which are currently not in House of Denims network. For both these reasons, it is a good step to focus on Post-Consumer recycled products. However, it is an interesting topic to think about in the future.

Should we use Dutch textiles while there are also textiles available nearby the denim mills?

The choice is made to focus on collected textiles in the Netherlands. This is a logical choice, since the Denim Deal is a step to work towards a circular economy in the Netherlands. The denim mills closest to the Netherlands are in Spain and Turkey. These countries also have a lot of collected textiles which would result in less shipping costs and CO2 emissions; why is it needed to use Dutch textiles? This is an interesting topic to think about. When the programme would be financially supported by the Dutch government or would be part of the Circular Dutch Textile Valley, it is essential to use Dutch textiles since the programme should create value for the Netherlands. Besides that, the Netherlands has a relatively high collection rate and innovating sorting technology, which makes using the collected textiles more feasible. Also House of Denim has Dutch collectors in its network. However, working locally as much as possible would have environmental benefits and will stimulate the local economy. It is advised to start working with Dutch textiles, since this makes the programme more likely to succeed. In the long term, it could be interesting to investigate if locally collected textiles could be used, since at the end of the day, House of Denims vision is to make the denim industry more sustainable.

What should happen with all the collected denim products that are not suitable for upcycling yet?

In the beginning of the project, the technological challenge to recycle denim is examined. As explained, recycling denim and using this in the production of new denim is a big point of discussion because of the quality of the new denim fabric. Therefore, the decision is made to experiment with other cotton textiles as part of the intervention. However, this would still leave a very big supply of collected denim products that are not repairable anymore. As just mentioned, House of Denims ambition is to make the denim industry more sustainable. According to the case-solver of this project, also the end-of-life of denim products is the responsibility of the denim industry. Until technologies have developed and denim-to-denim recycling would technologically and financially be more feasible, the Dutch Denim Programme could look into the high value recycle possibilities of denim products and how to stimulate this: for example in a scarf, chair or mat.

LIMITATIONS

Finally, a few project limitations need to be considered.

In the research phase, most of the knowledge is gained by doing interviews. This qualitative way of researching always goes hand in hand with biases. The actors look at the situation from their own perspective, however; this is also the reality which needed to be taken into account in creating the intervention. All the people that are interviewed are close connections of House of Denim. They have had previous experiences with the organisation and a certain personal bond with the people from House of Denim. This could have influenced what they have communicated in the interviews and what not. Certain information that could have been held back, can influence the success of the intervention.

The main limitation of the design stage is the restricted validation process. Because a strategic organisational intervention has been developed, it was not possible to test it; verification needed to happen in the form of validation interviews or sessions. House of Denim is planning on executing (parts of) the Dutch Denim programme in a short term. Therefore, the interviewees needed to be picked strategically. Interviews could influence how the actors think about the programme and about participating. Eventually, this and time constraints has resulted in evaluating the intervention with only three actors, while ideally, validation with actors from all parts of the value chain would have taken place. Therefore, House of Denim is advised to continue validation with different stakeholders to also hear the perspective of the denim mills and brands.

CHAPTER 5.3

REFLECTION

Finally, two reflections are written: a speculation of how this project could contribute to the field of design followed by a personal reflection on the project.

How does this project contribute to the field of design?

This project is executed with a Systems Oriented Design (SOD) approach, a relatively new field of design. This project could serve as an example project to introduce SOD to the TU Delft.

The role of design

The role of design is developing over the years. Traditionally, the design process is focused on improving or creating new physical objects. This got also most of the attention in the educational programme of my bachelor Industrial Design Engineering at the TU Delft (started in 2012). However, new developments have shifted the focus from the object to experiences, interactions and developments. Service design is playing a bigger role in design practise. Luckily the educational programme is changing. I say luckily, because I think this is needed to train designers in forming the future. Every new or improved 'design' will have impact on the current society in some way and therefore contributes to the development of the future world. Traditional product designers are still needed and valuable, however, design practise is more than that nowadays. Where design projects mostly derived from commercial interest, more and more design students want to work on real-world problems and want their design to have positive social or environmental impact. A world with a growing need for sustainability, a continuous globalisation and ongoing innovation gives highly complex problems which I think, gives designers the perfect challenge to use their skills to have a positive impact.

To be able to design for complex problems, designers need to be trained. To solve complex problems, designers should be able to cope with different perspectives and combine different values: the economical, environmental, cultural, ethical, technological and social perspective on a problem, being user-oriented but also taking of non-human values into account.

Designing for complex problems

Systems Oriented Design is a field of design that has emerged in the last 10 years and that has developed a way of designing for complex problems based on designing for and with systems: a multi-centric approach to design. This field of design is not yet incorporated in the educational programme of Industrial Design Engineering or one of design masters at the TU Delft. However, I think that systemic ways of designing will become more and more relevant.

Example project

This project can show the TU Delft how systemic design methods and a systemic way of thinking can contribute to designing for a complex issue. Many students and many people in general do see working with systems as something difficult and do not see how systems can be combined with creative design. It is important

to train designers in the mindset that everything around you is a system and that everything you design has systemic impact. In SOD, you are more aware of the system and try to take the whole system into account when designing. The project can be used as an example to implement systemic design education. However, this field is currently developing and methods are not fully defined: every designer should evaluate themselves what is needed to design for that specific system.

In what way is this project a Systems Oriented Design project?

SOD guidelines

SOD practitioners have created guideline to assess a project represents a SOD project (SOD, 2016). This project corresponds to the following guidelines:

- Practicing a Designerly way of understanding and creating systems
- Applying central SOD techniques, amongst them Gigamapping
- Addressing complex problems using multiple perspectives.
- Emphasising relations and interconnections
- Applying different views: Telescope - Microscope
- Working with problem-fields, problem-networks and situations rather than singular problems.
- Facilitating participatory processes with stakeholders, experts and all relevant organizations and individuals.

In the research phase I tried to grasp the complexity of the situation: by interviewing a lot of stakeholders from different parts of the value chain, I saw the situation from different viewpoints. I tried to understand every actor's role but also how the actors relate and depend on each other. By means of Gigamapping, I did an attempt to not 'tame' the complexity of the situation, but to visualise and show the complexity. Stakeholders that are normally only focused on their own part of the system, could see the bigger picture in one glance. This gave them totally different perspective.

During the gathering of knowledge, I tried to zoom in on important players of the value chain, on how they relate and on all problems in producing and using PCR cotton. When synthesising this information, I tried to draw conclusions while not losing the rich problem analysis. Where it is normally key to define one problem definition to design for, in a SOD project all important problems need to be taken into account. Leaving out a few aspects to simply the process could lead to an intervention that would never work out in practise. Therefore I created a problem network, in which I looked at cause-and-effect; which problems cause other problems? During this project, I learned that it is wise to define a few key problems to be able to communicate the problematique to stakeholders; but only if you keep the connecting problem network in mind. In designing for the problem network and evaluating the intervention ideas, I tried to think about the short term systemic impact of the ideas and the long term effects and ripple effects on the system. In order to solve different problems from the problem network and taking into account multiple perspectives on the situation, several intervention ideas are combined: a strategy for House of Denim is created in a designerly way in order to change the current system.

A PERSONAL REFLECTION

Looking back at the last five months, I can say that I truly enjoyed the project. I must say as well that the level of complexity of this project was much higher than all other project I did before. It was one big challenge: not only the extensive amount of information I needed to process in the research phase but also to tell a clear story, once I thought I figured it out in my head.

Half a year ago, I decided I wanted to do a Systems Oriented Design graduation project. Just returned from Norway where I had explored this approach, I was very enthusiastic about designing for complex real-world problems. I believed that this approach could help me with becoming a designer that can make a positive impact on social and environmental problems. Combined with my interest for (sustainable) fashion, I started looking for possible projects. In a talk with James Veenhoff from House of Denim I triggered some curiosity with explaining SOD and I am grateful that James connected this way of working to a challenge that he just got into: the Denim Deal. Working towards a circular economy is an ultimate topic for a systemic approach. One of my learning goals was to develop a holistic way of working with complex problems. Reflecting on the result, I think I can say that I succeed in using this approach to come up with a solution that can impact the current system.

The topic and this way of working has resulted in a strategic programme focused on the industry. This differs completely from previous projects I did during the masters Design for Interaction: earlier projects have always been mainly user-oriented. Although I like the user-oriented side of design too, for me the positive impact that the design can have, is an important aspect. To combine both worlds would be ideally: doing systemic design projects that can create a positive impact and have enough time to elaborate on the actual design with a user-oriented perspective.

Another personal ambition was to involve a lot of people early in the process, because I always tend to postpone involving people and continue desk research too long. During the project I have got exclusive opportunities, which I am grateful for. Interviewing more than 20 experts, among which quite influential people, was demanding but also gave me energy and motivation to deliver a valuable result that could benefit all of them. Presenting my research to the 'leaders' of the global denim industry was a very valuable experience. To notice that they all take me and my input seriously, is stimulating for both the rest of the project and my further career. Their feedback and enthusiasm gave me the confidence that I can deliver valuable insights to experts after only two months work. Their keen interest in the Giga-map confirmed the power of visualisation and the systemic way of working.

My enthusiasm for (sustainable) fashion has helped me to not lose my interest for the topic of my graduation. On the contrary: getting to know more about the workings of the fashion industry, about the impact of the consumption culture we are living in and the sustainable options we have, has triggered me even more to make sustainable consumption choices and advocate this to others.

Finally, I enjoyed the process together with my supervisors and representatives from House of Denim, which led to a fruitful collaboration. I hope I have sparked the curiosity of others to explore the field of Systems Oriented Design and I am looking forward to use the skills and knowledge I gained during this project in more, hopefully impactful, design projects.



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Alberto di Conti | Rudolf Group
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Advisory Board meeting

Andrew Olah | Kingpins
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Adriana Galijasevic | G-star Raw
Lucel van den Hoeven | Modefabriek
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Margot Span | Kosten Advokaten
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Menno van Meurs | Tenue de Nimes
Alberto di Conti | Rudolf Group
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Short informative talks at Kingpins

Ebru Debbag | Soorty Denim
Tricia Carey | Lenzing
Philip Chung | ZDHC foundation
Nienke Steen | Modint

Validation interviews

Nienke Steen | Modint
Ellen Sillekens | Sympany
Rob v. Arnhem | Ministry of Defence
Aletta Westra | Ministry of Defence

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SUPPORTING CHAPTERS

To go deeper into two topics that could be interesting and relevant for different interested parties, supporting chapters are written. The first supporting chapter explains the design approach Systems Oriented Design in more detail (1.1) and presents a typical SOD process (1.2). In the second supporting chapter is elaborated on the history of jeans (2.1) and the lifecycle of a pair of jeans is discussed in more detail by elaborating on every step of the value chain (2.2).

SUPPORTING CHAPTER 1.1

ELABORATING ON SYSTEMS ORIENTED DESIGN

This chapter will elaborate on Systems Oriented Design. How did it evolve and develop?
And why is Systemic Design a applicable way to design for a Circular Economy?

SYSTEMS ORIENTED DESIGN

'SYSTEMS THINKING TAILORED FOR DESIGNERS'

Systems Oriented Design (SOD)

A traditional design process is focused on the object. New developments, like service design, have shifted the focus from the object to experiences, interactions and developments over time. This multi-layered design process has system thinking elements. However, often these projects are derived from commercial interest. Systems Oriented Design is an approach for designers to deal with complex real-world problems in the modern, rapidly changing society (Sevaldson, 2009). A world with a need for sustainability, a continuous globalisation and ongoing innovation gives highly complex problems, also known as problem networks or Wicked problems (Hors Rittel). The SOD techniques are based on the belief that the complexity does not derive from one actors or object in the system but from the interconnectedness of things. To know how to design for a complex problem, it is important to grasp and understand this interconnectedness. In this way, it is possible to combine ethical issues with sustainability, economy, new technology, social and cultural and commercial considerations (Sevaldson, 2013).

The base of SOD: System thinking

Systems Oriented Design uses the **General Systems Theory** as a base: The science of interconnectedness, first mentioned in the 1920s by biologist Ludwig von Bertalanffy. He used Systems Theory to explain the interrelatedness of organisms in ecosystems and he felt the need for a theory to guide research in several disciplines.

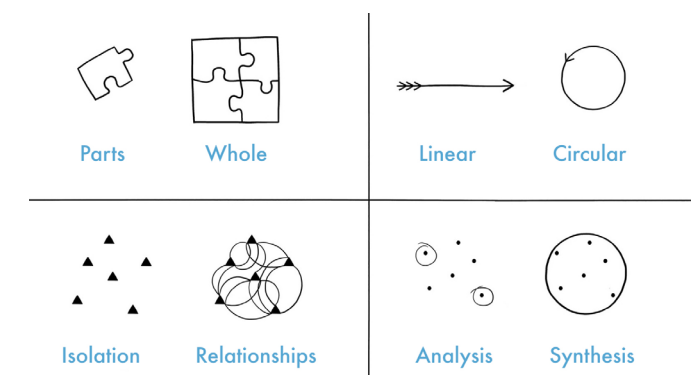
Traditional analysis breaks down the studied topic in different elements to understand the system. This has proven highly successful, for example to understand atoms and DNA. But for many of the systems people are interested in, this way of working does not find the right information. Many systems have a high level of interconnectivity, systems that are defined by the relations. Not only ecosystems, but also social- and computer systems. Von Bertalanffy argued that **properties of the parts can only be understood through the dynamics of the whole**. The process of reasoning that the combination of elements form a connected whole is also called 'synthesis', the foundation of system thinking. System thinking focusses on how the parts interact. Instead of isolating and studying smaller parts of the system, system thinking expands it's view (Aronson, 1996).

The theory has grown in diverse areas, by among others Fritjof Capra. He published 'The Tao of Physics' in 1976, in which he explored how modern physics was changing our world perspective from mechanistic to holistic thinking. In the nineties, environmental based theories are developed such as Industrial Ecology (Frosh and Gallopoulos, 1989) and Industrial Symbiosis (Chertow, 2000). Natural techniques could be used to make production part of the ecosystem, according to Gunter Pauli (1994). He started a research institute in which he focused on redesigning production and consumption inspired by natural systems.

The theory is also applied on artificial systems. Perceiving an organisation as a complex system in which the relation between parts are more important to manage than the parts itself, led to new management models that gained economical, social and environmental benefits (Pisek and Wilson, 2001).

Nowadays, systems thinking is used in different academic but also practical fields like psychology, biology, engineering, economy and political science. The broad field of systems thinking and systems practise is called Systemics. This interdisciplinary field sees the world in terms of connections and interactions.

Figure 48. Characteristics of system thinking
(Adapted image from Emma Segal)



Design thinking

But how did SOD derive from System thinking? This started with design thinking, now known as an umbrella term for multi-disciplinary, human-centered projects that involve research and rapid ideation.

Design thinking as an approach has been slowly evolving since the 1960's. It started with the development of creativity techniques in the 1950s and design methods in the 1960s. These days, Hors Rittel, known for coining the term "Wicked Problems", has driven the idea of design as an approach to creatively solving problems. Nobel Prize winner Herbert A. Simon was the first to mention design as way of thinking in 1969.

Systemic Design

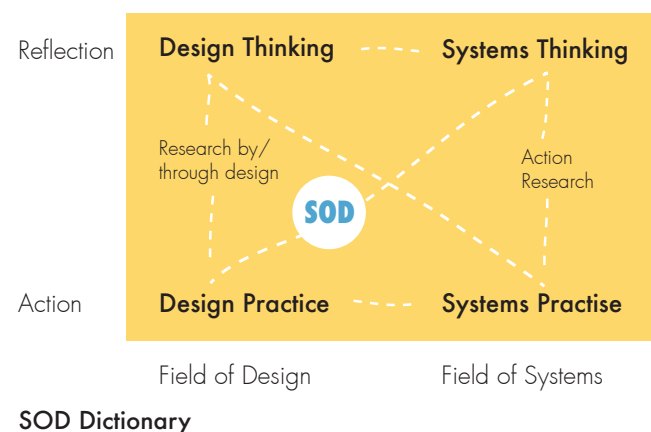
More than 20 years later, in 1992, Buchanan, wrote an article about Wicked Problems in Design Thinking. He argued that Design thinking is a way to integrate different knowledge fields in the design process, to jointly face a problem from a holistic perspective. He explained that different disciplines which you encounter in a design process, such as urban planning, public policy, business management and environmental sciences (Chertow et al., 2004) created a need for interdisciplinarity in the design phase. He was the first to mention the need for a holistic approach and a systemic integration.

The combination of Design and Systemics opened up a field of possibilities, 'Systemic Design': Designing to understand and create solutions for complex problems, also human-centred systems-oriented design practice (Bistagnino, 2011; Sevaldson, 2011; Nelson and Stolterman, 2012; Jones, 2014;Toso at al., 2012). The current developments in the Systemic Design field, are driven by the yearly Relating Systems Thinking and Design symposium (RSD) on the initiative of Birger Sevaldson at the Oslo School of Architecture and Design in 2012.

Systems Oriented Design

Nowadays, Systemics is fully integrated in the academic field of Design. However, in design *practice* this way of thinking is relatively new. In the field of Systemic design, different approaches are developed. SOD is the most design-oriented approach: it is most close to Design practice and therefore most easy to apply to existing design practices.

Figure 49. SOD in the Systemic Design field
(Adapted image of Birger Sevaldson)



SOD Dictionary

Leyla Acaroglu, award winning designer, describes terms concerning systemic design that are important to understand. A few are described below.

Interconnectedness | When one says 'everything is interconnected' from a systems thinking perspective, a fundamental principle of life is defined. As mentioned before, this comes from biological science: everything is reliant upon something else for survival. This causes a shift in how designers can see thing: from a linear way, to an interconnected way, to work with the complexity of life.

Synthesis | As also mentioned before, synthesis is seeing the interconnectedness: understanding the whole, the parts and the connections at the same time.

Feedback loops | Between parts of the system, there are feedback loops. To be able to intervene in a system, we need to understand the different types of feedback loops. The most important are balancing and reinforcing loops. A balancing loop is elements balance things out, what nature basically does. In reinforcing loops, which is most often a negative thing, one element reinforce itself, often taking over the system.

Systems mapping | This is one of the most important methods of Systems design. Fundamental is to identify and map the elements of the system and how they act and relate. Insights can be used to develop interventions that change the system in the most effective way. There are many different ways of mapping. The methods used in this project will be explained in chapter 2.3.

System boundaries | A system boundary is needed to be able to apply systems thinking to real-world problems. Without a system boundary, one could go one for ever, so it's important to define what you're looking at and what not.

DESIGN FOR A CIRCULAR ECONOMY.

Why is Systemic Design a applicable way to design for a Circular Economy? The current lineair system is a 'broken' system; a reinforcing loop, that creates waste and loses value. Objects, buildings, cities, factories: all human-created system that have not been designed to operate within other systems. They are created to work isolated and linear. People have designed things with a simplified perspective of the world, only focused on the end-user, without the systemic point of view to consider everyone who extracts, builds, uses, and disposes of things (Ellen MacArthur Foundation + IDEO, 2017).

A circular economy is a good working system with a balancing feedback loop. To be able to design for a balancing feedback loop, a circular economy, it is important to understand the complexity of - and relations within - the system. It is key to look how the natural, industrial, economical and social systems work at the moment, to discover how to shift to more circular one.

Keep zooming in and out

Also the Ellen MacArthur Foundation stimulates to design for a circular economy with systemic design principles. Together with IDEO, they created the Circular Design Guide, because they believe that designing for a circular economy means re-thinking traditional approaches and re-training in circular principles. In the guide, they encourage a mindset in which you keep zooming in and out. "Keep looking at the bigger picture, what are you trying

to change systemically, and go right into how you can leverage the connections that you have or maybe can create" (Karoline K, IDEO). In the Circular Design Guide a few thing are named that are important regarding systems design.

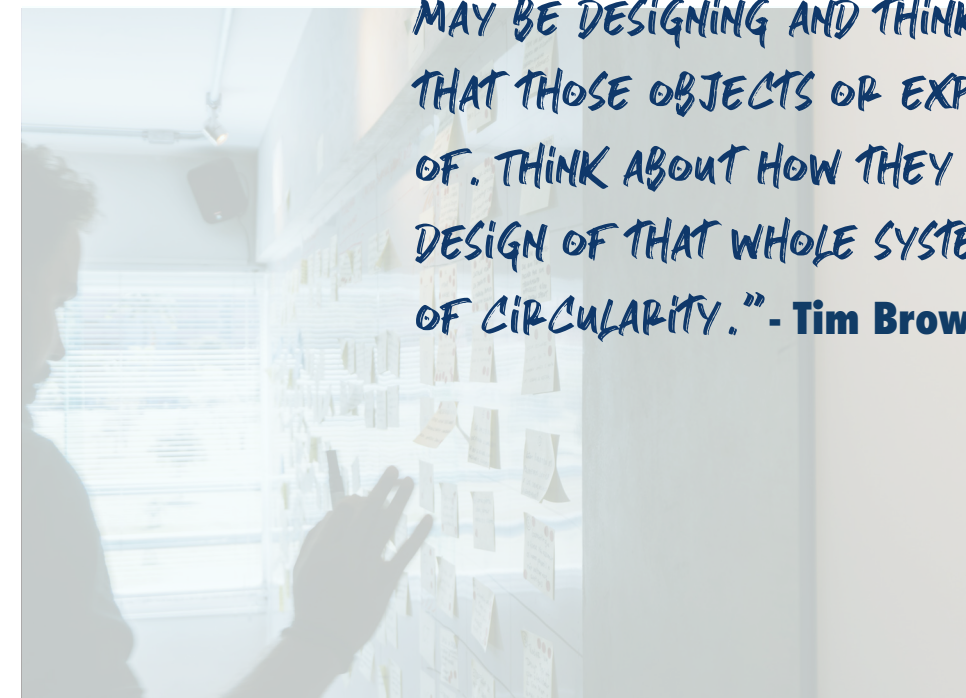
Life cycle thinking | It is important to get an understanding of the impact of the product, service or business. Life cycle thinking gives you an overview of the full life cycle and it's environmental and social impact impact in the whole value chain.

Consider the network of stakeholders | by collaborating with industry stakeholder, value can be created at every stage of the process.

Widen your view of user-centredness | When designing for the circular economy, it's about understanding the needs of all users or usages of the materials within the system. This is corresponding with the way SOD cristises user centred design.

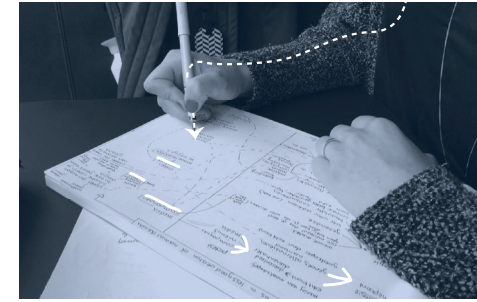
Design for evolution | While we used to design 'finished' products, we should now consider design as creating products and services that can constantly evolve, based on the data we get through feedback.

"WHAT WE'RE ASKING DESIGNERS TO DO WHEN WE THINK ABOUT CIRCULAR ECONOMY IS TO STEP BACK FROM THE OBJECTS OR EXPERIENCES THEY MAY BE DESIGNING AND THINK ABOUT THE SYSTEM THAT THOSE OBJECTS OR EXPERIENCES ARE PART OF. THINK ABOUT HOW THEY MIGHT INFLUENCE THE DESIGN OF THAT WHOLE SYSTEM THROUGH THIS IDEA OF CIRCULARITY." - Tim Brown, CEO of IDEO



SUPPORTING CHAPTER 1.2 A TYPICAL SOD PROCESS

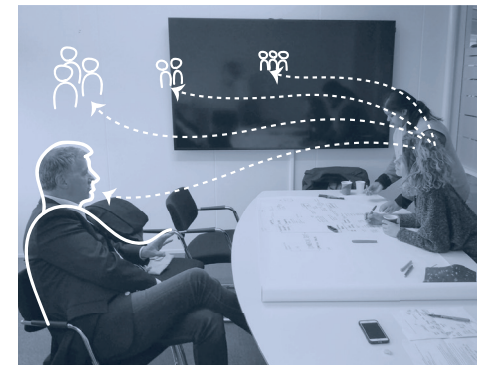
A 'typical' Systems Oriented Design project is described to explain the unique parts of using Systems Thinking in a design process. This explanation illustrates a linear process, to define all the steps. In a real project, you often jump back and forth in this process. This step-by-step guide is based on several academic papers of Birger Sevaldson, on methods and tools created by the SOD network and on the Systemic Design Toolkit created by the System Design Association in collaboration with several companies.



1. FRAMING THE SYSTEM

Map the first knowledge and define system boundaries

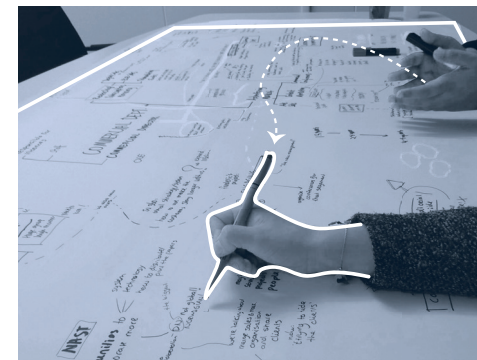
To jump-start your project, it is encouraged to map out your pre-existing knowledge about the topic, especially when working in a group. This map is also called a Brain Dump map (Acaroglu, 2017). This first map can be used to easily define the spots in the system that need deeper research and be the starting point for literature and internet research. Try to find and map the following: long-term trends affecting the issue, current working of the system and emerging alternative initiatives (Systemic Design Toolkit, 2016). By searching for information and filling the gaps, areas will be defined where expert knowledge is needed and this will help to identify the profiles you should interview. It also helps in preparing the expert-meetings, by having background information and forming well-grounded questions (Sevaldson, 2011). When doing the first system mapping, system boundaries will be defined.



2. EXPLORE THE COMPLEXITY

Gain substantial knowledge by using the expert network

Working with 'problem networks' forces designers to pro-actively seek for complexity instead of reacting to complexity when he or she bumps into it (Sevaldson, B. 2011). In this way, resilient systems can be designed, taking all aspects into account. It is important to be highly curious to all different aspects. The first step after preparation is to listen to different viewpoints and agendas. For example, becoming more sustainable is not solely becoming more 'green' but it also has economical, technological, management, cultural and political aspects. Every aspect has its own stakeholders. As mentioned in the last chapter, especially in design projects for circularity, it is important to involve a lot of stakeholders, of different parts of the value chain (Ellen MacArthur Foundation). By asking the right questions and listening to the experiences of people, you gain the information you need to understand how the interactions lead to the system's behavior, but also give your stakeholder the idea to be heard and taken into account in the design phase.



3. PUT IT ON PAPER

Register and analyze a big cloud of information

Designers have an advantage for thinking about complex problems: they are able to visualize information. Our mental capacity is limited; putting complex material on paper helps with accessing, understanding and communicating information and keeping attention to the details (Sevaldson, B. 2011). Visual practice is essential for systemic design interventions. The most central tool in Systems Oriented Design is Gigamapping: a tool to register, analyze and manage complexity. Giga-mapping is creating a big cloud of information, including the details. 'Normal' mapping tries to order and simplify problems, while Giga-mapping does not intend to 'tame' the issue but to grasp the complexity of the problem. Maps will be created including contribution of different experts. Systems thinkers often work analog: pen-and-paper style (Acaroglu, 2017).

Gigamapping

'Gigamaps are extensive, multi-scalar, mixed, inclusive, genre-breaking, unorthodox, creative, messy, myriadic visualizations of fields, problems, issues, subjects, environments, things and social constructs in the world'

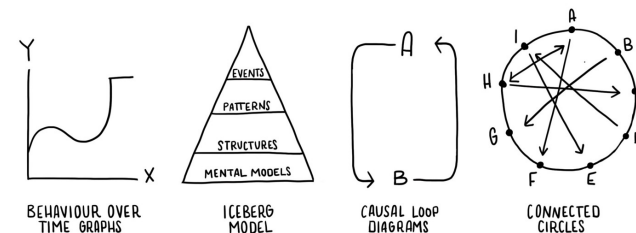
Birger Sevaldson | Professor at the Institute of Design at AHO (Oslo) and initiator of the term 'Systems Oriented Design'.



4. FIND CONNECTIONS

Gain clarity in complexity: define relations and connections

When exploring several aspects of the problem network, it is key to find the connections and relations, as complexity derives from the interconnectedness of things. How do different actors influence each other but also depend on each other? How do problems cause other problems? How do the interactions contribute to the overall complication? One of the strengths of designers is that designers can synthesise from fuzzy material (Sevaldson, 2013). Gigamaps help to do this and find the connections. There are many different ways to map a system from which a few illustrated below (Acaroglu, 2017). GIGA-mapping is not only about big maps full of information, but also about merging different tools together to make sense out of it. The goal is to gain much deeper levels of understanding than a normal research or exploration process can.



5. ZOOM IN ZOOM OUT

Get more detailed insights and global overviews

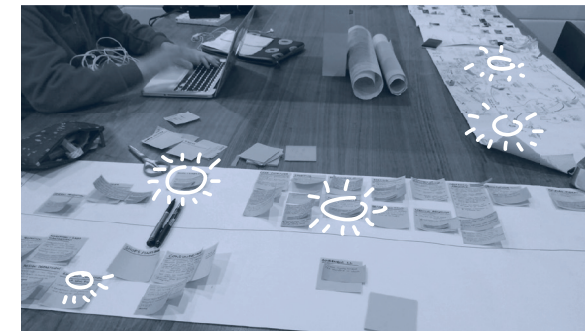
When creating a deeper understanding of the overall working of the system and connections within the system, there will be some areas that need more detailed insight and areas that need a more global overview (Sevaldson, 2011).



6. COMMUNICATE THE SYSTEM

Gain clarity in complexity: define relations and connections

During the whole process, mappings are not only used as process tool for the designer him/her self, but also as communication tool towards stakeholders and other interested people. Maps can be created during an expert meeting and used at the end to review with the stakeholder if the information is understood in the right way. More 'structured' and visual appealing maps (often digitally designed) can be created to present the gained information, defined relations and innovation areas found.



7. INNOVATION AREAS

Find potential places in the system to intervene

During the process of exploring, mapping, zooming in and out and communicating, innovation areas will be discovered: leverage points to intervene in a system which could have impact on that part of the system and ripple effects on the whole. In this stage, it is also important to know what your design should accomplish. Therefore, it is helpful to define a desired future (Systemic Design Toolkit, 2016 + Tassoul, M.). This is especially useful when working with a group or close collaboration with stakeholders, in order to align everyone on the intended outcome. A problem network and design brief can be created.



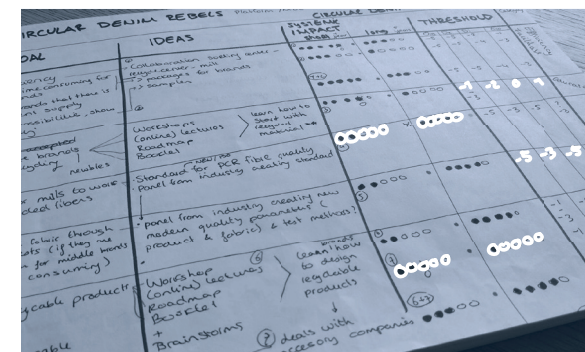
8. DESIGN

Create holistic and synergetic design interventions

When it is clear what affect the design should have, one can start designing. Often design ideas are already developed during the process: ideas to intervene on the leverage points, to find a direct solution to a problem, to use potential factors to work around a problem or to create new relations in the system. As explained before, complex problems, consist of multiple problems and the connections often form the complexity. To solve a complex problem, an intervention that has impact on only one place of the system will probably not be effective. Therefore, Systems Oriented Design often leads to holistic and synergetic solutions;

- An intervention that work at one place but which is very powerful and therefore create a strong ripple-effect
- An intervention that has impact on multiple places in the system
- A combination of interventions that covers the whole system

When creating a combination of interventions, it is important to look at how interventions connect and reinforce each other.

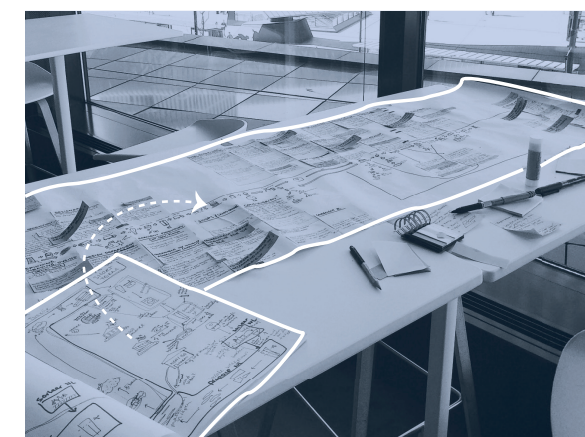


9. EVALUATING AND IMPLEMENTING

In a traditional design process, ideation is followed by the evaluation of ideas, testing of concepts and creating an implementation strategy. For this are multiple methods available, such as the well-known Harris Profile and prototype-testing (Delft Design Guide, 2013).

Evaluating ideas | In evaluating system-changing ideas, it is important to bring your concept back to the system and look at the impact on the system. Try to foresee all possible positive and negative reactions and long term ripple effects. With an impact and threshold analysis, both the short term and long term systemic impact and the economic, technological, cultural and organisational threshold can be analyzed.

Validating concepts | Solutions to Wicked problems cannot be validated as is the case in tame problems (Culmsee, P. en Awate, K. 2013). Rittel states that every solution to a Wicked Problem is a one-shot operation: there is no chance for trial and error, because every effort counts: every try can change the system. At the second try, the system will be different, which may ask for a different solution. That leaves the designer with hypothetically 'evaluating and testing'. Story boards, visualisations and roadmaps can be created to communicate the idea. Experts and stakeholder can be asked to evaluate but, also stated by Rittel, 'judgements on the effectiveness of solutions are likely to differ widely based on the personal interests, values, and ideology of the participants'.



Implementing strategy | Because changing a system does not happen over night, an implementation strategy has to be established. Implementation strategies to solve a Wicked Problem are complex because, as written above, the first intervention in practice can already change your system. Try to think about different scenarios and how your design will react on that. It is useful to write a roadmap for transition (Systemic Design toolkit, 2016). In the roadmap you plan how to grow the intervention in time and space. Start with a minimal implementable version of the intervention and describe how this intervention can become an established practice in the current system.

SUPPORTING CHAPTER 2.1 A BRIEF HISTORY OF JEANS

To dive into the context of the project, the history of jeans is researched and presented in this supporting chapter.

FROM WORKERS PANTS TO (FAST) FASHION ITEM

So, jeans. Everybody owns a jeans. The majority of europeans wear jeans more than once a week. But what actually defines a jeans? What is the origin? And how did it develop?

Jeans are pants made from denim fabric, developed in 1873 by Levi Strauss and Jacob Davis as workers clothes.

Origin of denim fabric | 17th century

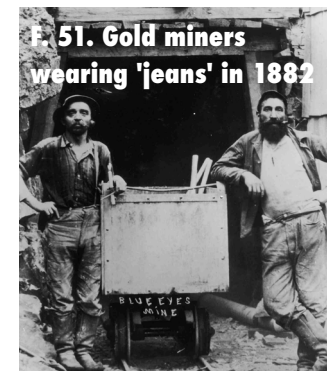
The fabric of the modern jeans, denim, is way older than 1873. Historians still debate about the birth place of denim but most common is the story that the 'jean' fabric emerged in Genoa in Italy. Already in the 17th century, 'jean' was a crucial textile for working-class people in Northern Italy, seen in a series of paintings. The fabric was made from a mix of cotton, linnen and wool, from medium quality and of reasonable cost.

In Nîmes, France, weavers tried to reproduce the typical Italian fabric. An unsuccessful attempt led to a unique sturdy cotton fabric, a 'higher quality' jean. This fabric was classified as a twill weave fabric using one blue thread (warp) and one white tread (weft) in which the weft was passing under the warp. In this way, the fabric had a unique blue colour on one side and was white on the other side. They called the fabric Serge de Nîmes (translated to 'twill of Nîmes'), which has later become 'Denim'.

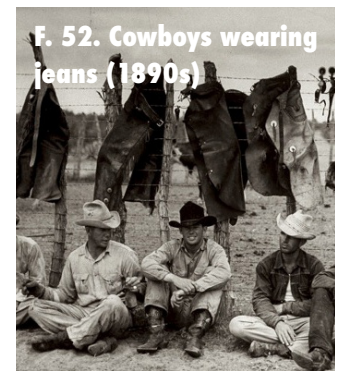
The blue threads were dyed with Indigo coming from indigo bush plantations in India. The indigo colour was chosen so that it would better hide the dirt when worn by miners and labourers. Indigo is an organic dye, made from the plant *Indigofera tinctoria*, with a distinctive blue color. Indigo was used on cotton but there was one problem: the color didn't last long.

The 1800s

During the industrial revolution, textile machines and factories speeded up the production of clothes. Instead of creating clothes on order, clothes are started to be developed in a range of different sizes. In 1846, the sewing machine was patented. This made clothes much cheaper and has increased the scale of clothing manufacturing. The upper class bought clothes from couture houses, middle-class went to local businesses and lower classes made their own garments. Local businesses used



F. 51. Gold miners wearing 'jeans' in 1882



F. 52. Cowboys wearing jeans (1890s)

workroom employees but started to outsource production to local sweatshops (workplace with poor, socially unacceptable working conditions) or people working from home for low wages.

Origin of jeans | 1873

In 1851, Levi Strauss went from Germany to New York. A few years later, he moved to San Francisco where he opened his own goods business. He designed and produced Levi's: pants for gold miners and other workers from the strong cotton sort called Serge de Nîmes. Jacob Davis, a tailor from Nevada, was looking for functional pants that could withstand hard work. He chose the ones produced by Levi Strauss. By placing copper rivets at the places where pants mostly rip, he made them even stronger. They called them jeans, named after the city of Genoa. Together with Strauss he patented this concept in 1873: the jeans we know nowadays was born. They started with manufacturing denim overalls and in the 1890s, they created the first pair of jeans.

1900-1960

The patent ended in 1890. Wrangler (in 1904) and Lee (in 1911) were the first competitors putting denim on the market. These days, jeans were adopted as workclothes for cowboys, miners and farmers in America. The organic Indigo is replaced by the cheaper synthetic indigo.



Figure 50. Workers wearing denim in the 19th century



Figure 53. The first jeans for women by Levi's

The 1930's | Cowboys and the first women jeans

Hollywood started to popularise the jeans in the '30s with handsome cowboys wearing them in movies. Vogue gave it's opinion by calling jeans 'Western chic'. The first jeans for women are created by Levi's (see picture X). Women wearing pants — especially denim— was considered inappropriate and unacceptable in the 1930s (Panek, T. 2017). With launching jeans for women, Levi Strauss & Co sent a powerful message that they believed in women and their ability to do 'men's work'. In the 1940s the jeans was not only a workers pants anymore, it started to be known as a unique fabric that adopts to the body and shows how it's worn.

The 1940's | Jeans in Europe

The jeans was introduced to the Europeans during the Second World War, because American soldiers wore denim when they were not on the battlefield (see picture X). The functional mass-produced clothing that was made necessary by the Second World War has led to an increase in standardized production for all clothing. After becoming used to such standardization, the middle-class consumer accepted to purchase mass-produced clothing after the war. The first pairs of jeans were imported in Europe in 1959 and it started to be popular in the Netherlands. 'Vet' in Alkmaar

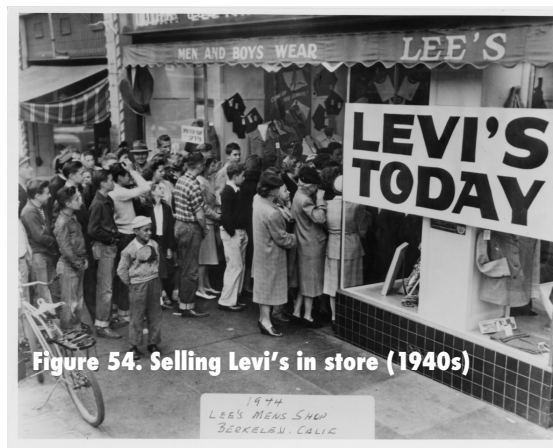


Figure 54. Selling Levi's in store (1940s)

and 'De Rode Winkel' in Utrecht were one of the first shops selling them, but still mostly as workers clothes.

Rebellion

In the fifties, the image of jeans changed. The younger generation began to wear denim trousers as leisurewear. Elvis Presley and Marilyn Monroe started to wear this typical item. James Dean wore the jeans highly stylish and rebellion in the movie 'Rebel without a Cause'. Jeans was used as a symbol for rebelliousness. In the sixties, the idea of rebelliousness made a comethrough. It was the beginning of the hippie protests, and this movement embraced the jeans. It represented freedom and individuality. This was emphasized by customising the jeans with patches and paint. It became more popular among students and motorcycle boys. More women were starting to wear jeans to reflect gender equity. Jean jackets became standard hippie wear, decorated with sew-on details.

Outsourcing labor

In general in the sixties, fashion trends started to move faster and the youth did not want to fall behind. Brands needed to find a way to keep up with the fast moving trends and react to the demand for cheaper clothes. This is the start of massive textiles mills in developing countries, so that America and Europe could save money by outsourcing their labour.

'Washed' jeans

In 1965, a boutique in the New York East Village was the first one who washed a new pair of jeans in production to make it look used; to give it a worn effect. This idea was immediately a hit. New finishings were developed such as the acid wash. Ripped jeans and denim skirts started to be developed. In the seventies the jeans became widely accepted as casual clothes in America and Europe. In the eighties, the industry introduced the stone-washing technique: a process in which the fabric is literally washed with stone to give new jeans the worn appearance and increase the flexibility of the rigid fabric.

Designer jeans

Another important highlight in the eighties was the first designer jeans on the catwalk: the jeans of Calvin Klein (see image X). The designer brands introduced 'premium denim' and having a designer jeans became a true status symbol. Adriano Goldschmied, the father of premium denim, helped popularise a new denim fit in '80s — the skinny fit.

80ties and 90ties

In the eighties and nineties, Dutch denim brands are born. Scotch & Soda is founded in 1985, G-star in 1989, Chasin' in 1992 and Gsus in 1993. In these days, another denim culture developed: hip hop denim. Think of baggy jeans but also wide-legged jeans. Pop groups like the Spice Girls boosted these styles. Jeans in combination with oversized denim jackets was a key look for celebrities. For daily wear, the 'boot cut'- a subtle denim flare-



Figure 55. American soldiers wearing jeans in WW2 (1940s)



Figure 57. Marilyn Monroe wearing jeans (1950s)

was popular. In the '90s, fashion houses such as Versace, Dolce & Gabbana and Dior had also entered the jeans market.

Fast fashion

Also in these days, small clothing shops that started in the mid-twentieth century expanded exponentially. These shops, offering affordable clothing, spreaded all around Europe and America and developed into the big fast-fashion chains we know nowadays such as H&M, Zara, Topshop and Primark. The rapid growth has gone hand-in-hand with cost-cutting measures making use of overseas sweatshop labor. The fast fashion businesses started to develop the first cheap jeans. Fabric companies saw a chance to sell cheaper fabric and mixed indigo cotton with synthetic fibers to meet the demand of cheap high street jeans. Fast fashion chains started to sell mass-market jeans: stretch and polyester 'denim'.

2000s

In the last twenty years, every denim style, cut and wash has had it's comeback. The 2000s started with the trend of low-rise jeans popularized by pop stars like Britney Spears, but is completely overruled between 2005 en 2010 when an improved skinny jeans returned, legging-style jeans. This was made possible thanks to innovations in denim stretch technology.

Now

The skinny jeans never left the streets but the high-waisted denim, the flared jeans and straight-legged model have also made short comebacks. It could be this diversity that has made the jeans survive all fashion changes and economic challenges. Expensive high quality but also cheap fast fashion jeans are on the market nowadays. It is available for everyone and the jeans has become a mainstream item in the closet. The average consumer is not aware of the history, the characteristics and the political and cultural importance of this fashion item.

Where once Italy and America were the producing countries, the mass production moved to China, Bangladesh, Turkey, Brazil, India and Vietnam. Local mills and craftsmen are priced out. 30 euro jeans are produced with incredibly high volumes. This is always combined with unjust labour practises, using an enormous amount of water, using lots of chemicals and producing a massive volume of waste. Fast fashion mass production has put pressure on the 'real' denim brands. It is hard to compete against the big retailers, but Levi's and Lee remain iconic names for their heritage status.

A slow movement has started with consumers concerned about sustainable and fair production. The industry has reacted and is innovating and investing in more sustainable ways of washing and finishing jeans. New denim brands with the same concerns have popped up, such as Kuyichi (2001) and Mudjeans (2012). Also premium denim brands have implemented sustainable practises.



Figure 58. Jeans as symbol for rebelliousness at Woodstock (1960s)

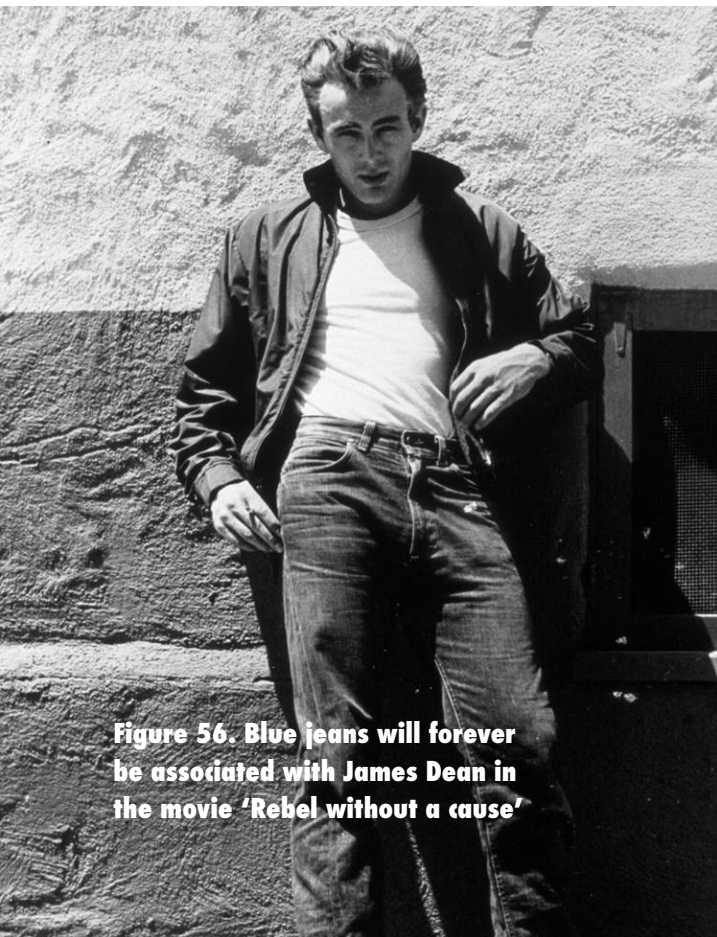


Figure 56. Blue jeans will forever be associated with James Dean in the movie 'Rebel without a cause'



Figure 59. The first designer jeans. Calvin Klein gives the jeans sex appeal. (1980s)

SUPPORTING CHAPTER 2.2

ELABORATING ON THE CYCLE OF JEANS

This chapter presents the full cycle of jeans. Every step of the cycle is explained thoroughly and in the story, bottlenecks, opportunities and point of relevance for producing and using PCR cotton are indicated. The first page is similar to the part in the main report, the elaboration starts at page 156.

The lifecycle of jeans

The full cycle of jeans, visualised in figure 21, involves many steps and stakeholders. Every step of the cycle will be shortly explained. The information is based on desk research and interviews with different stakeholders.

Bottlenecks and opportunities are indicated by:

-  **Difficulties** in producing and using recycled cotton
-  **Possibilities** for producing and using recycled cotton
-  **Relevance** of producing and using recycled cotton

A short introduction

As mentioned before, denim is made of cotton. Therefore the cycle starts at the **cotton farmer**. There, the cotton is produced and from there, it will be transported to a **denim mill**. In the denim mill traditional spinning, chemical dyeing and weaving takes place. The result: denim fabric. This is shipped to the **jeans manufacturer**. Here it gets cut into pieces and sewn into completed jeans, all in an assembly-line. Then, the jeans is ready for finishing, a combination of wet treatments and dry treatments is given for the right appearance. The finished jeans is transported to warehouses from where it is sent to **retailers** and wholesalers. They sell it to the **consumer**. The consumer is wearing the jeans, or gives it to someone who is wearing it. When the user does not want the jeans anymore, he or she gives it to someone else for a second life, throws it in the **trash bin** or donates it to a collecting organisation. The **collector** sorts the textiles and gives it different destinations. A part will be used as second hand clothes, a part is incinerated and a part is shipped to a recycle facility. The **recycler** shreds the jeans. The recycled fibers are downcycled by using it in low-value applications or they are shipped to a denim mill that use them to make new yarn. The (jeans) brand is involved in almost every step.



Figure 21. The lifecycle of jeans

COTTON FARMER

The main raw material of denim is cotton. The cotton is harvested and bundled into cotton bails, which can be shipped over land or sea to different fabric mills. More than 29 million tons of cotton are produced yearly: the same as 29 t-shirts for everyone on Earth (The world counts, 2019). Most of the cotton grows in India, China and USA. Other leading countries are Brazil, Pakistan, Australia, Turkey, Uzbekistan (Statista, 2018).

Environmental impact

The cultivation of conventional cotton is linked to various environmental, social and economic issues (Oxfam Novib and others, 2009). A lot of water and chemicals are used in growing the cotton. The use of chemicals causes (drinking) water and soil pollution, loss of biodiversity and soil erosion. About 8500 liter water is used to grow 1 kg conventional cotton, from which 2 pair of jeans can be made (Oxfam Novib and others, 2009). According to a Life Cycle Assessment conducted by Levi Strauss & Co, 68% of the water consumption of a jeans (including consumer care) is consumed during fiber production. Using this amount of water leads to severe water depletion, causing loss of biodiversity, a shortage in irrigation- and drinking water.

Social impact

In the cotton farming, there is still a lot of forced labour and child labour. Yearly more than 1 million people are forced to pick cotton during the cultivation period (BNN, 2018). Refusal often leads to mistreatment. The pesticides used in farming are toxic: they can cause abortion, cancer, sterility and other negative physical effect. Financially, cotton farming is not a viable activity for farmers in developing countries. The wages are too low and structural losses and debts for farmers lead to suicide frequently.

Organic cotton | BCI | Fairtrade cotton

The demand for 'better' cotton have lead to multiple initiatives and benchmarks. Organic cotton is a benchmark for cotton grown without chemical pesticides. The BCI, Better Cotton Initiative, is a multistakeholder initiative to develop good farming practices, reduce the use of water and chemicals and protect working conditions. Fairtrade cotton is mostly focused on the workers and social issues.

No transparency

Despite the good initiatives, there is a lot of corruption and no transparency in the cotton chain. Therefore the place of origin, the way of cultivation and working conditions are often unknown. There is a lot of 'cheating' and corruption regarding the benchmarks and this makes it hard for brands to invest in the 'right' cotton.



Cotton cultivation leads to extreme water consumption and use of chemicals. This causes negative environmental (and social) impact. Because there is no transparency, it is hard to invest in the 'right' cotton.

Growing demand but less available

Because of the fast fashion development, the demand for cotton is still increasing: more and more cotton is needed to meet the growing need. Hans Bon of collecting center Wieland predicted in a interview that the cotton prices soon will go sky-high because of the demand on the one hand and the availability on the other hand: more and more farmers stop growing cotton and the draught has negative impacts.

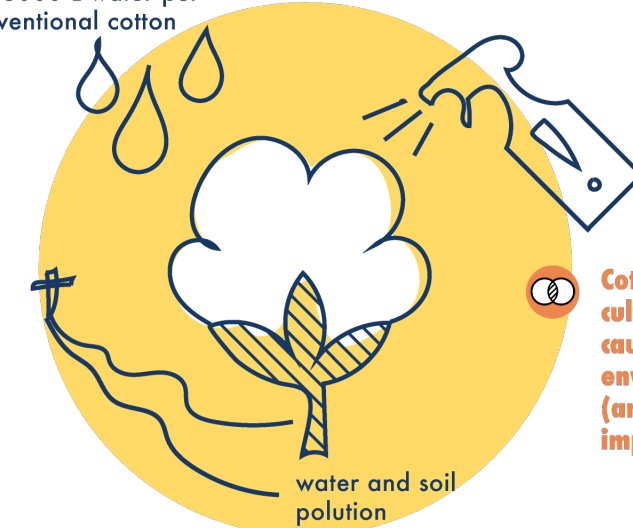
Also Franck Belochi, president of Calvin Klein, explained in the interview that there is not enough cotton, water, or 'anything' to continue producing like we are doing now. According to him, we are using the full capacity of the world to provide only 1/3 of the world to consume fashion (Europe and USA), while there is a 2/3 coming (Asia). "We have to change our way of working. Everyone still think thinks 'Okay, tomorrow will be fine' but..", as Belochi continues, "we are facing an exponential situation, which our brain cannot understand. At one time there will be not enough cotton, or not enough water. If we continue working in a linear way, we are not able to serve the population of China and India, followed by Africa'.

The speculations of Belochi about the growing need in the future are confirmed by the fashion report 'The State of Fashion 2018' of McKinsey & Company. In 2018, for the first time more than half of the apparel and footwear sales are originated outside of Europe and North America. The emerging markets are countries in Asia-Pacific, Latin America and other regions.



There is a growing need for cotton because of the new emerging markets and the fast fashion development. In the future, prices of cotton will rise because the availability will relatively decline.

Use of 8000 L water per kg conventional cotton



Cotton cultivation causes negative environmental (and social) impact.

GROWING THE COTTON

More than 29 million tons are produced each year



HARVESTING THE COTTON



BUNDLING
into cotton bails



Prices of cotton will rise because of the growing need for cotton.

DENIM MILL

In a denim mill, cotton fibers are turned into a denim fabric.
Denim is spun, dyed and woven at one location, unlike many types of fabrics. The three processes will be explained shortly.

THE SPINNING PROCESS

(Main source: G-star Raw Denim College, 2014)

The spinning process is a dry proces; the environmental impact comes from the extensive energy consumption due to the mechanical processes and the climatizing of the spinning (and weaving) area.

The cotton arrives in bails and get stored in the storage room. When the time has come, the bails are opened and placed on the assembly line. The cotton is cleaned and rigged, the seeds are removed. The fibers are sort by length and then, different lengths are blended into a perfect mix. From that a so-called 'sliver' is made. Rough lengths of sliver are drawn into a finer yarn, prepared for spinning.

There are two types of spinning: ring spinning and open end spinning. Open end spinning is more efficient and cheaper but the result is weaker. Ring spinning adds strength to the yarn by putting tension on the sliver before spinning. After spinning, the yarns are ready for dyeing. Therefore they are wound onto a beam: a warp (which hold 4500 yarns arranged one next to the other) .

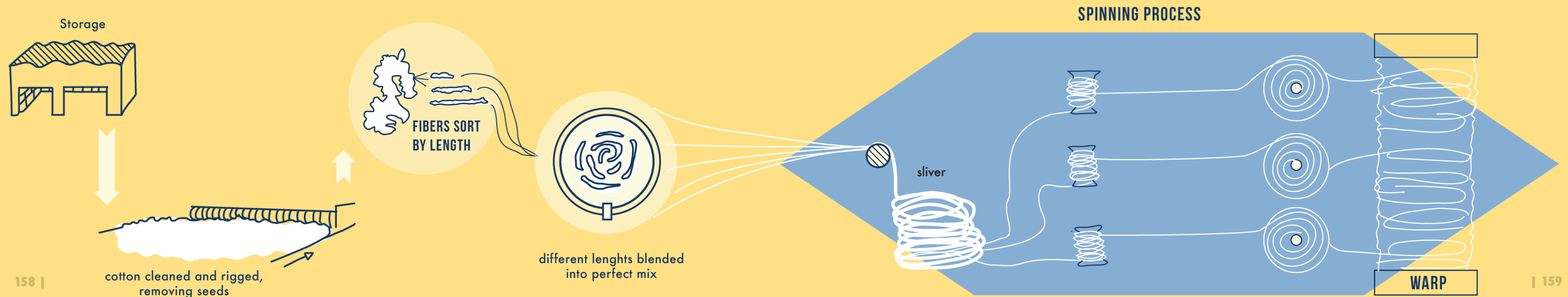
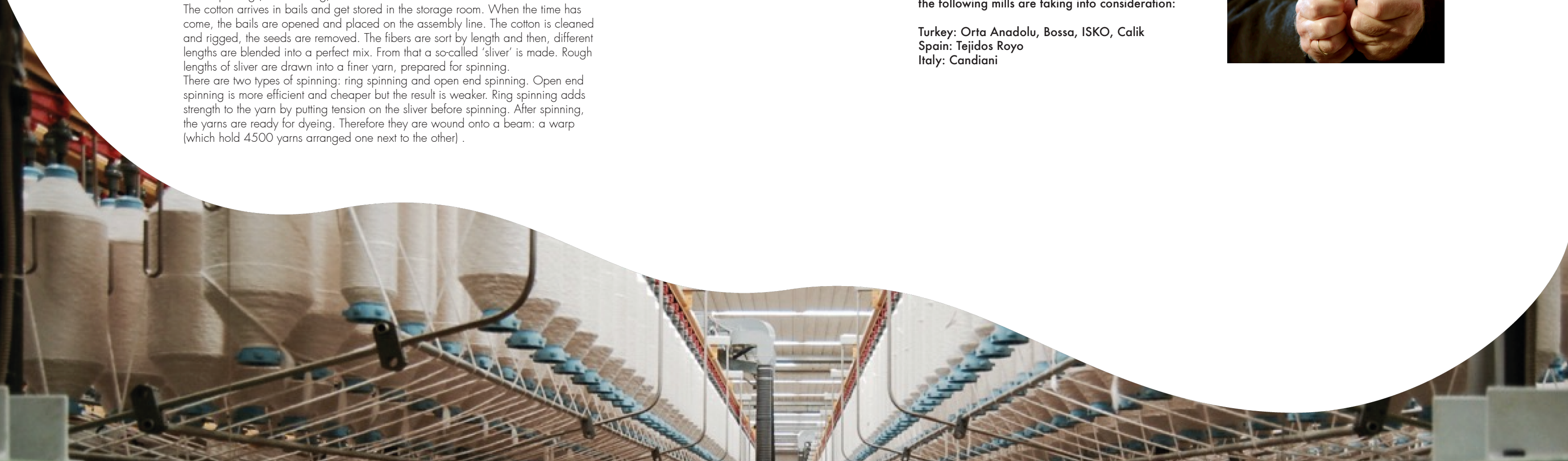
Worldwide there are 513 denim mills (Fashion United, 2016). Most denim mills are located in China,Bangladesh, Italy, India, Japan, Pakistan, Spain and Turkey.

Since this project concerns using recycled material from the Netherlands in producing denim, the denim mills which are taking into consideration are as close to the Netherlands as possible. Shipping discarded textiles from the Netherlands to Asia goes beyond the point of sustainability. Therefore the following mills are taking into consideration:

Turkey: Orta Anadolu, Bossa, ISKO, Calik
Spain: Tejidos Royo
Italy: Candiani

To make a right quality yarn, the cotton fibers are inspected:

- * White colour
- * Cleanness
- * Length of the fiber (ideal length: 3,.. cm)



THE DYEING PROCESS

(Main source: G-star Raw Denim College, 2014)

For higher quality denim the yarn is dyed individually, easier is to dye yarn in ropes. In the conventional way of working, yarn is cleaned before dyeing by sodium hydroxide in order to remove natural hydrophobic substances and bleached using sodium hydroxide and hydrogen peroxide (Saxion & Alcon Advies, unknown). To attach colour to the yarn, it is dipped in several indigo baths, the indigo baths all have the same indigo mixture. This can be synthetic or natural indigo. Natural indigo seems to be better but the way how indigo is extracted is highly toxic. The dye covers the yarn in layers, in- or de-creasing the amount of baths gives the yarn a different colour. During dyeing, the indigo dye has to be chemically reduced, using hydro sulphite as a reduction agent (Saxion & Alcon Advies, unknown). The reduced dye adheres to the fibre and oxidises back to blue by exposing it to air. When the warp is dyed, the yarn is rinsed with water to remove excess dye. To make it ready for weaving, the yarn is dried and sized to make it stronger.

Environmental and social impact

The indigo dye process is associated with (chemical) pollution and extreme water consumption. Washing and dyeing the yarn uses an enormous amount of water. The chemical used to clean the yarn before and after dyeing and the coloured waste water causes water pollution (Saxion & Alcon Advies, unknown). The way natural indigo is extracted is toxic. Innovative mills such as Candiani in Italy have water recycling systems and use less chemicals to make the process cleaner.

THE WEAVING PROCESS

(Main source: G-star Raw Denim College, 2014)

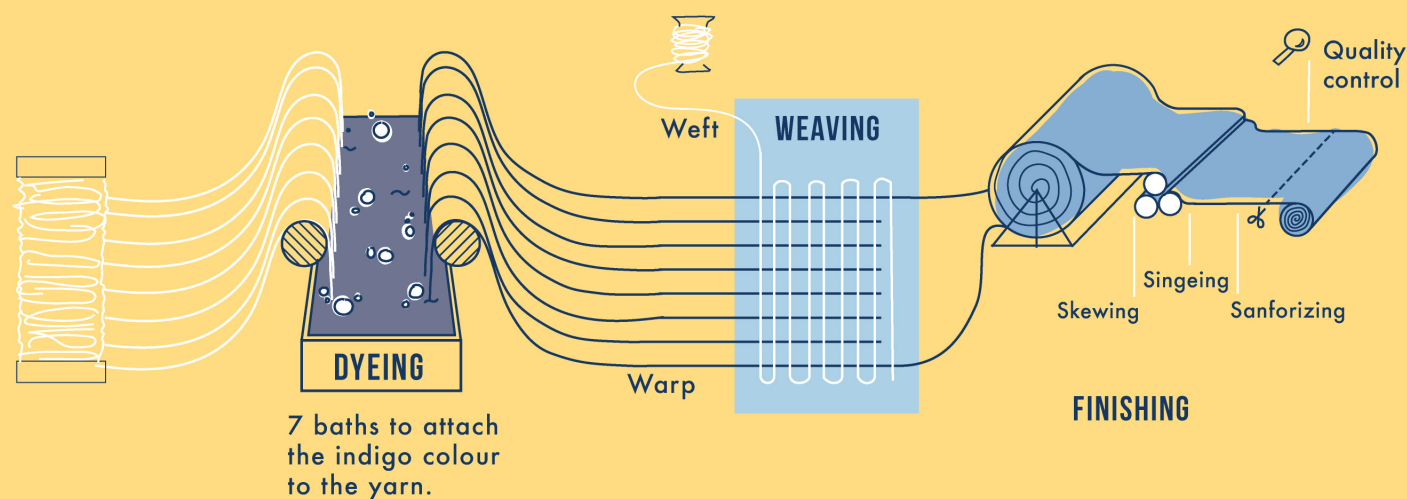
As mentioned before, denim is woven by inserting a undyed white yarn [the weft] into the dyed blue thread [the warp] (see visualisation below). Most common is projectile weaving, which shoots the weft yarn with air with an extremely high speed, resulting in denim with unfinished edges. Higher quality traditional denim is woven by shuttle looms, in which a shuttle carries the weft yarn. Resulting in selvedge denim: denim that has self-finished edges. There are different weaving patterns, such as the right hand twill (most used for denim), the left hand twill and the broken twill (fabric with no specific direction). Besides the different patterns, the fabric also comes in different weights.

Weaving with a white weft yarn and a blue warp yarn results in a fabric with a blue outside and white inside. The impact of the weaving process is comparable to the spinning process: it is a dry process that uses a lot of energy.

FINISHING

To be shipped to the jeans manufacturer, the fabric goes through a basic finishing process. It starts with a singeing process to give it a smoother look. The fabric is rinsed again to remove any remaining unwanted residues. A skewing process is applied to prevent the denim from twisting. The fabric also undergoes sanforizing, which works against shrinkage. Additional finishes can be added to give the fabric a certain look. At the end, the fabric undergoes a final quality control to test solubility and visual quality.

From the denim mill, the denim is transported and/or exported to denim manufacturers, often abroad. When the denim only has had a basic finishing, it's known as 'Raw denim' (G-star term) or 'Virgin denim' (Denham term). You can recognise a jeans made of this denim by a dark consistent colour and stiff feeling.



JEANS MANUFACTURER

The process

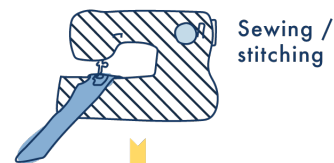
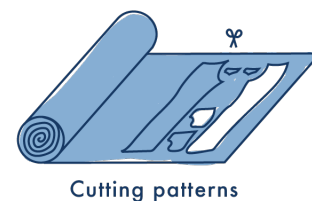
At the jeans manufacturer the jeans, or other denim product is created and finished. The pattern is cut out of the fabric in layers on a large table with a mechanical knife or saw. The pieces are sewn manually. The cutting waste is often already recycled. The result of the sewing is a 'raw jeans', which rarely appear in the shops. Nowadays almost all jeans are 'finished' to make the denim look worn, rugged, broken and used. Several finishing techniques are used to obtain or avoid colour changes. Because of the white inside of the fabric, lighter areas and white spots can be created. Jeans are bleached and washed with stones or sand. In many cases, besides the wet treatment, a mechanical treatment is applied to the jeans to make the denim look damaged on specific places in the garment. Lighter areas are created by sandblasting or PP spray (which is now prohibited), both less popular because of environmental and health impact. Sandpaper and especially laser treatment are more popular nowadays. After finishing, accessories are attached, the pair of jeans is inspected and ready for transport to retail (CBI, 2016).

Most of the jeans are manufactured in Bangladesh, Brazil, Cambodia, China, India, Mexico, Pakistan, Sri Lanka, Thailand, Turkey, Vietnam.

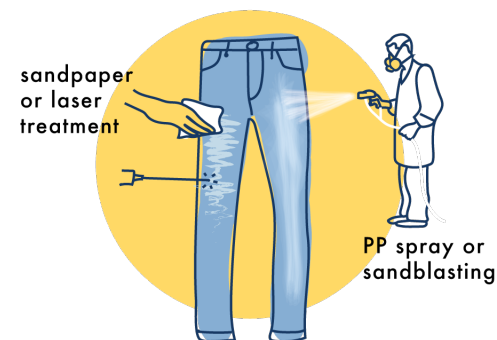
Environmental and social impact

The jeans production mostly lead to negative social impact. People have to work very hard, making long hours, for low wages in bad working conditions: the so-called sweat shops (Saxion & Alcon Advies). The manual and mechanical finishing treatments are toxic, luckily the most harmful ones are starting to disappear. The old school finishings result in reducing the strength of the jeans: this decreases the technical life time of the jeans.

PRODUCING THE JEANS

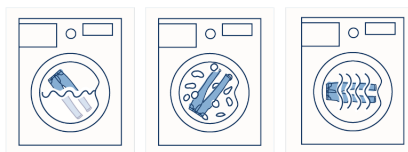


FINISHING TREATMENTS



Bleaching with chemical bleach, Ozone and/or Enzymes.

LAUNDRY: FINISHING



MAKING READY FOR SALE



RETAILER

The products are transported to warehouses. From there, they are distributed amongst the different sales channels: retail, wholesale and e-commerce (online sales). In the Netherlands, 21 million jeans are sold yearly (Chung, 2016). In 2013, the average import price was plus minus 9 euro and the average consumer price was 45 euro (CBI, 2014). The largest suppliers of jeans to the Netherlands are Bangladesh, Turkey, Tunisia and China (CBI, 2014).

Environmental impact of transport

The transport throughout the whole process combined with the retail is responsible for 11% of the CO2 emissions of a pair of jeans, consumer care included (Levi Strauss & Co., 2015). This is the biggest contribution after Consumer Care (37%) and Fabric Production (27%).

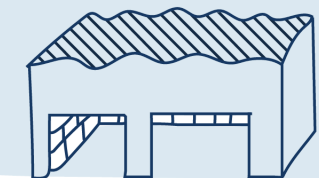
Overproduction

The yearly production of jeans counts 2 billion jeans worldwide (CBI, 2016). Only 1.25 billion jeans are sold annually (Goldman, 2017), so more than 35% is never sold. The overstock: unsold, never used products consist of sample stocks, returned clothes after web-shop sale, unsold batches and rejected batches due to production mistakes. Approximately another third leaves the shops with a discount (Matevosyan, 2016). The overstock, yearly 750 million pairs of jeans, gets incinerated or end ups as landfill without being used. This has a huge environmental impact. Overproduction could be prevented by a more efficient process and better communication between brands and factories (Matevosyan, 2016). But also by 'slower' fashion (going against fast fashion, keeping collections longer in store), better listening to the customers wants and needs and different business models in which re-use or recycle is profitable. Recycling overstock (included in post-industrial waste) has huge possibilities but is out of the scope of this project. This Denim Deal is focused on post-consumer waste.

TRANSPORT TO DISTRIBUTION CENTER



Warehouse in Europe



1/3 OVERSTOCK

1/3 SOLD
1/3 SOLD WITH DISCOUNT



Store NL

Online retailer

CONSUMER & USER

Buying jeans

In the world of fast-fashion, consumers are used to a new collection every week, cheap clothes and sale most of the time. Fast-fashion has led to a culture in Europe in which regular consumerism of clothes is normal. In the last 15 years (2000 - 2015), we buy more than twice as much but wear it 36% less long (Ellen MacArthur Foundation, 2017). When we look specifically at jeans, we do not see such a rapid growth but the consumption

of jeans has increased as well. From 2012 to 2016, worldwide retail sales of jeans have increased by 20% and is forecasted to grow another 30% the 5 years after (Statista, 2017). As mentioned before, the Dutch love jeans. The average Dutch consumers owns 5.4 pair of jeans (Prescient & Strategic Intelligence, 2018) and buys 1.2 pair of jeans per year (FashionUnited, 2016). A survey under 530 inhabitants of Amsterdam revealed that a majority is wearing jeans more than half of the week (Gemeente Amsterdam, 2013).

Caring for your jeans

After cotton cultivation, the consumer care stage has the most negative impact on the environment regarding water use and CO2 emission. 37% of the CO2 emissions are due to washing and drying and the average lifetime of a jeans leads to the use of 860 liter water during washing (Levi Strauss & Co. 2015).

Consumers are not aware enough of the impact of buying fast fashion

By buying a denim product, a consumer contributes to all the negative social and environmental consequences of producing the cotton, the dye, the fabric and the product. The majority of the consumers is not aware of this. Besides the impact of the item before it is in the hands of the consumers, it also has a negative impact during use and it causes an enormous amount of waste after use. Especially when buying fast fashion: the quality of the clothes is less good and the trends pass by fast. Therefore clothes end up in the back of the closet very fast. As Hans Bon of sorting center Wieland stated: 'The mindset of the consumers need to change. People need to think about what is happening. At the moment there are political discussions about the climate agreement, while people are standing in line at the Primark buying bags full of clothes for 50 euros. And after wearing it 2 or 3 times, they throw it away and we receive this mess'.

Awareness versus behaviour

Brand- and specialty store owner Menno van Meurs told that there is only a very small percentage of the consumers, almost negligible, asking for sustainable jeans. But the awareness of the possibility to buy sustainable fashion is growing amongst a small group of conscious consumers. However, only a part of this group is really buying sustainable clothes: being aware is often not enough to make the right action.

As with a lot of sustainable practises, there is a gap between attitude and behaviour. Shopping is for a lot of people an emotional practise. We do not only shop for clothes replacement, but also for leisure and out of social pressure to follow the trends or the group you belong to. The act of purchasing clothes can be an experience in itself (sometimes called 'retail therapy') (Ellen

MacArthur Foundation, 2017).

Besides that, buying clothes is often impulsive: the conscious consumers walk with good intentions in the shopping street, but a 'wrong' purchase is easily triggered by unique and cheap offers, marketing and sale.

Another negative influence on sustainable shopping behaviour is the higher price often linked to sustainable products. People want to do good, but do not want to spend more money on their products. This is confirmed by industry expert Alberto di Conti stating: 'I do not say that consumers do not care but I do not think that the level of appreciation is high enough, not yet. It is still about look and price'. Also Belochi tells that the consumer starts selecting products by the price. In his opinion, the average consumers nowadays will only buy sustainable products when the product is exactly the same for the same price. Even the Gemeente Amsterdam (2013) shows that for the majority of the Dutch consumers the price is most influencing when buying a jeans.

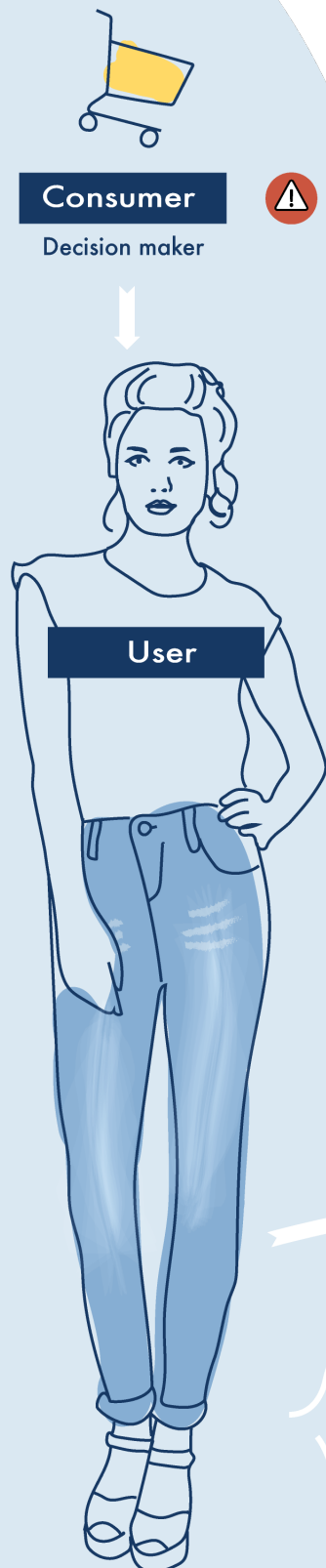
Demand versus supply

Brands react on the demand of consumers. Consumers react on the supply of brands.

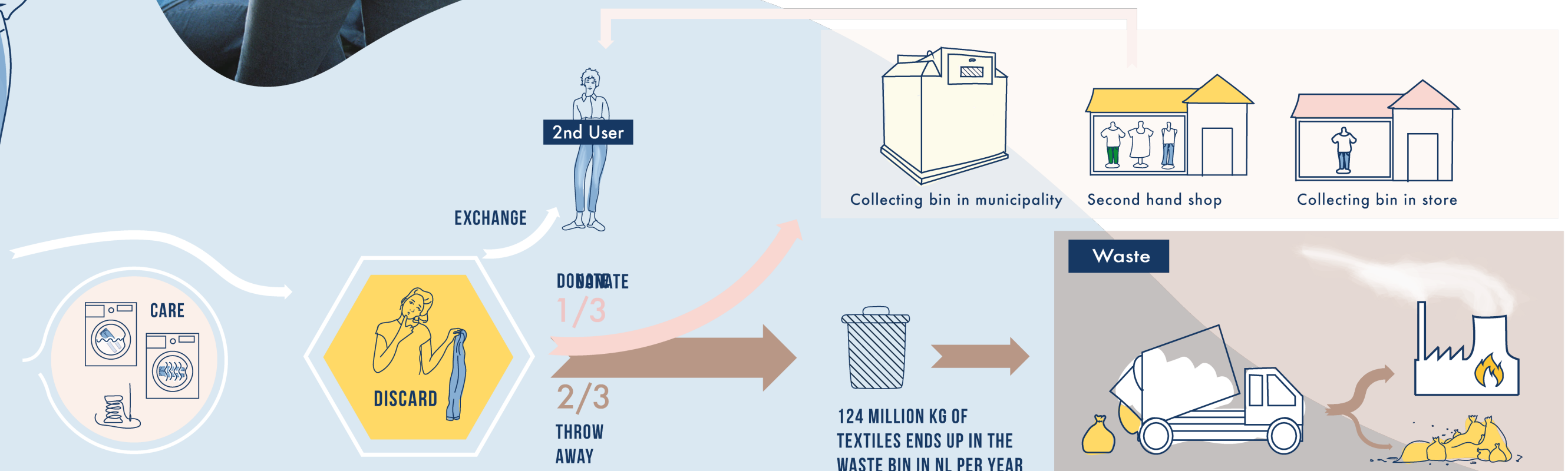
Because of the growing awareness amongst consumers more and more brands step into the market of sustainable products. Often, this is not done out of an idealistic purpose, but because brands can use sustainable initiatives as marketing story which will lead to more sales.

However, making jeans of recycled material is not the easiest way of doing something 'sustainable' (more about this in the following chapters). In much easier ways, brands can tell a 'good' story to the consumer. Therefore, the supply of recycled jeans stays very low. There are not enough options easily available for the consumer to choose from. Finding a sustainable, or even recycled, jeans is a time consuming effort for the consumer.

A research of the ABN Amro amongst Dutch consumers showed that 46% of the consumers are open to buy recycled products. Of the consumers who are not open to buy these products, 34% thinks it is time-consuming to figure out which products are recycled.



Consumers' demand and supply for recycled clothes



So, brands are not stimulated to start producing with recycled cotton: there is a lack of active demand from the consumer. However, because there is only a minimal supply of recycled jeans for the consumer, consumers are not aware of the possibility and therefore the demand will not grow. Hans Bon explains it like a chicken and egg story: Where does it have to start? Who's responsibility is it to make the demand and or supply for recycled items grow?



CONSUMERS' DEMAND AND SUPPLY

There is no active demand for recycled denim from consumers and there is not enough supply of recycled items for consumers to choose from, which influences each other negatively.

Discarding jeans

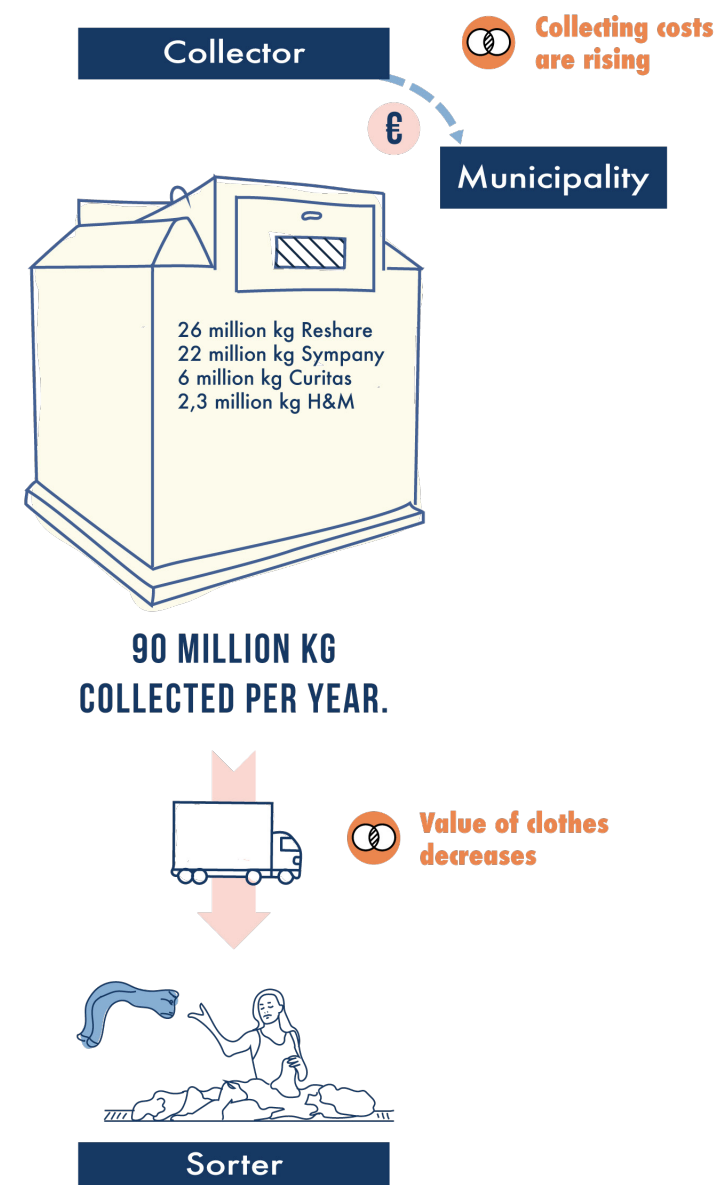
When you're not keen on wearing your clothes anymore; when they are worn out, damaged, outgrown or out of fashion, they often end up in the back of the closet. Worldwide, clothing utilisation – the number of times a garment is worn – has decreased by 36% compared to 15 years ago (Ellen MacArthur Foundation, 2017). After a while, you decide to clean up your closet and make the decision to discard your clothes. Where does it go?

Still 2/3 of all the clothes end up in the regular trash bin: 124 million kg of textiles in the Netherlands per year (Sympany, 2017). This is an enormous waste, because these textiles are incinerated or end up as landfill. Incineration happens in a safe way, which produces 'green' energy but incinerating clothes does not only lead to wasting existing resources but also contributes to the greenhouse effect.

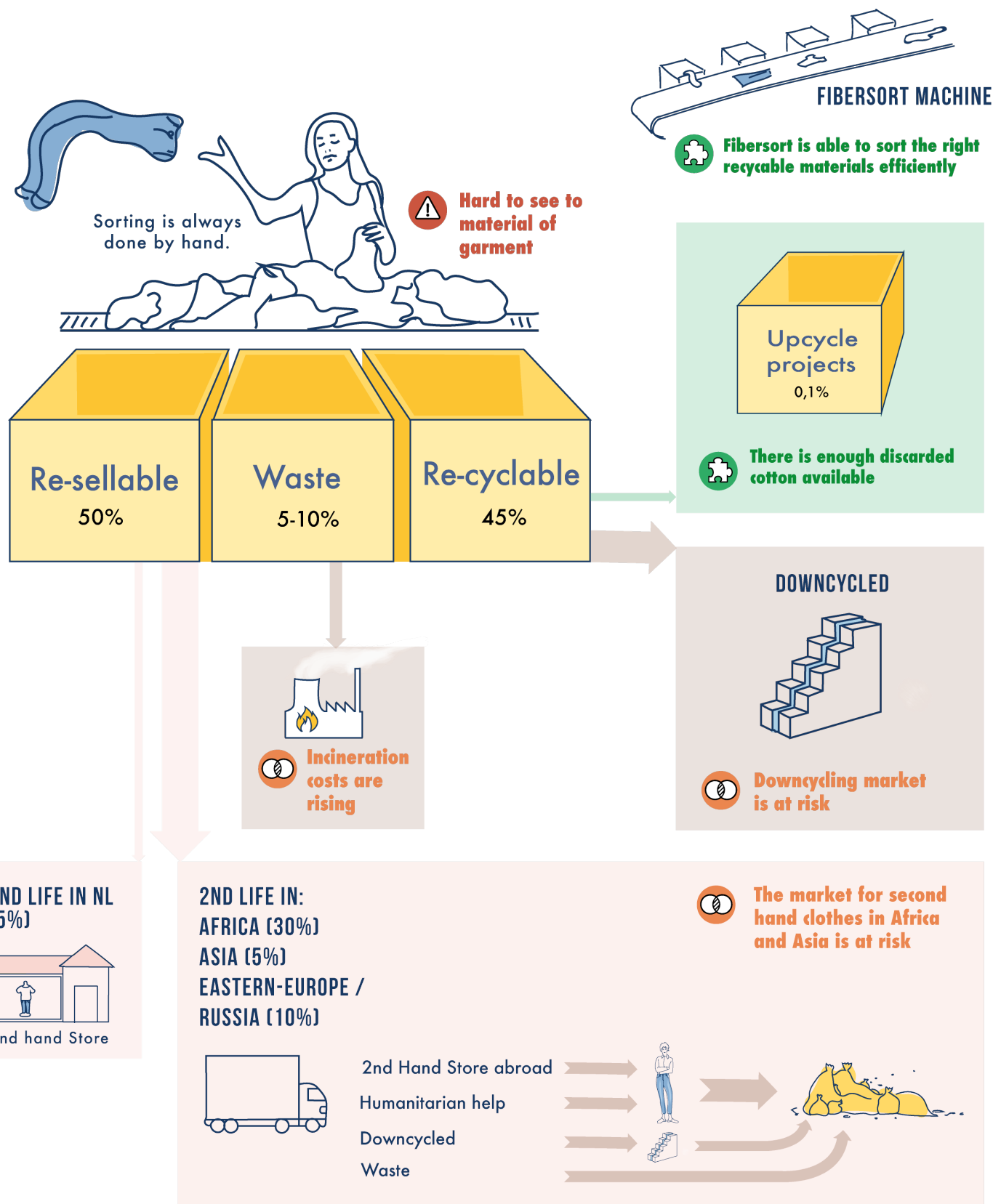
The other 1/3 of the textiles are donated: the biggest part to collecting bins in the municipalities, a smaller part directly to second hand shops or to recycling initiatives of fashion stores, often in exchange for discount on new purchase. Although 11% of the consumers do not want to contribute to recycling initiatives of retailers, mostly because they do not trust that the garment is really used for recycling (ABN Amro, 2018).

COLLECTOR

In the Netherlands, most of the clothes are collected in the collecting bins placed in municipalities. In the past, the charity organisation Leger des Heills had the right to collect textiles in the Netherlands. Nowadays, collecting is a business at its own. In every municipality different private parties and organisation have to bid against one another to place a container. Therefore, the costs of collecting are increasing, sometimes even up to 0,40 euro per kg (half of what collectors can get for it) (Behindmycloset, 2015). With this, municipalities earn a few million euros a year. Collectors sell the textiles to sorting centers, some collectors have their own sorting center. The most important players in the Netherlands are Reshare (collecting party of Leger des Heills) and Sympany. These are both charity organisations. The business of collecting is at risk. More and more clothes are collected but the quality of the clothes gets lower, and therefore the value (now 0,80 euro per kg) for collectors also decreases (Leger des Heills, 2019). They have to pay higher prices to municipalities but receive less for it.



SORTING CENTER



The clothes are transported from the collecting bins to sorting centers. In different rounds, the clothes are sorted. Firstly, the destination of the clothes is determined.

1. Re-sellable

Fifty percent of the clothes is re-wearable and therefore re-sellable. These clothes can have a great second life elsewhere and provide the main income of sorting centers. A small part of the re-sellable clothes get a second life in the Netherlands, by selling it in second hand store. The largest proportion goes to Africa, Asia, Eastern-Europe and Russia. The interest for our second hand clothes in these countries is decreasing. According to Simon Smedinga, director of Reshare, fast fashion is a big competitor for our second hand clothes (Reshare, 2019). Also Hans Bon of sorting center Wieland told that a rapidly growing supply of cheap clothes from China and the Chinese government who puts pressure on the import policy for second hand textiles of these countries (for example when constructing roads) makes it more and more difficult to sell the second hand clothes. Besides that, East African countries want to ban the import of second-hand clothing to protect its local textile industry. Rwanda raised import duties from 0,20 euro to 2,50 euro per kg [BBC]. This development is having unfavorable consequences: making new (bad quality) clothes for everyone who now buys second hand clothes, causes an enormous extra footprint and the collected clothes are more and more incinerated or downcycled.

2. Waste

The second group are clothes that are dirty or wet: destroyed with oil, paint or polluted by garbage. This category costs the sorting centers money because they are obligated to collect these clothes but they have to pay the incineration costs, which are rising. Incineration contributes to the greenhouse effect.

3. Re-cyclable

When textiles are not sell-able anymore, they are sorted by colour and fibre type to be recycled. Almost all these clothes are downcycled: the value of the material drops. The majority of the textiles are shredded to use as insulation material in cars and buildings, or are prepared as industrial wipes for garages and factories. These applications can be considered a very fast downgrade of the cotton material, because recovery of the fibres after this application is not possible. Also this market is starting to be at risk. Hans Bon of sorting center Wieland told their concerns about the possible arrival of more and more electric cars, which makes insulation material for cars not needed anymore because of the silent engines.

With the current developments, the sorting business is at risk. Sorting centers have to pay more and more money to be able to collect clothes, that have lower value and therefore more often need to be incinerated, which also costs money and contributes to the greenhouse effect. The markets for both second hand clothes abroad and downcycled products are endangered.

Upcycling

In this way, no collector will keep going. 'We have to start collaborating with the municipalities to set up a circular textile economy and we have to focus on recycling more textiles' according to Smedinga, 2019. At the moment, less than 0,1% of the collected textiles in the Netherlands are recycled into products with the same or higher value. The Ellen MacArthur Foundation states that there is a yearly loss of more than USD100 billion worth of material, that could be recycled into new clothing. When we look at denim, most of the upcycling is done in small projects and always focused on creating denim out of old denim. However, denim is made out of cotton so can be made of all recycled cotton, preferable white, grey, blue or black. There is only one setback: upcycling of cotton is at the moment only possible if it's a pure material. Mixed materials, for example cotton mixed with polyester, cannot be recycled in the same way. However,

Hans Bon of Wieland is sure that there is 'enough' pure cotton available to set up an upcycling chain.

2/3 of the recyclable textiles are pure materials, of these pure materials, cotton is by far the largest fraction (research result from a label sort batch test that was conducted on recyclable PCT bales from the UK, the Netherlands and Germany). The biggest bottleneck at this stage is to sort the pure cotton. Sorting is nowadays mostly done by hand.

Manually, it is hard to see the material of textiles and to be able to sort the textiles right.

It costs too much time to check labels and these labels are often not reliable or cut out. Many automatic sorting systems and software programs are available or under development for sorting textile waste according to colour and chemical composition (Luiken & Bouwhuis, 2014). Wieland has developed 'Fibersort': a machine that is able to sort the right recyclable materials efficiently.

Automatic sorting machines need to become widely available for all sorting centers in the Netherlands in order to provide the industry with high and consistent quality of recycled materials.

MECHANICAL RECYCLER

There are two ways of recycling textiles: mechanical and chemical. The traditional and most common way is mechanical recycling. In this process, textiles are shredded into fibers (small, thin threads). If needed, these fibers can be mixed with virgin fibers and eventually, new yarn can be spun.

Where?

There is not an extensive recycle capacity in the Netherlands; there is only one mechanical recycling facility (Frankenhuis). Most PCR projects so far are done in Spain and Turkey. These places have denim mills in close collaboration with mechanical recycling facilities and are the closest to the Netherlands (for example Royo Teijdos in collaboration with Recover(tex) in Alicante, Spain). In Southern Europe, there is enough recycling capacity to set up a 'pilot' circular chain.

Process

In order to recycle jeans, the garment needs to be prepared. Only the textile part can be shredded. This is seen as a big obstacle by many players in the chain. All non cotton parts; rivets, zipper, buttons, leather label and thick seams needs to be removed and these elements are downcycled or incinerated (Circle Economy, 2016). Often the legs of the jeans are cut out like the visual below. It is most often done manually but also weight and metal detectors are used to remove certain parts. 60 to 65% of the total weight of the jeans can go into the shredding machines. In order to increase this percentage, the recyclability of jeans should be taken into consideration in the design phase. Most of the time, the recycled fibers are sold to denim mills. Some recycling facilities do the spinning process themselves and sell yarn to denim mills.

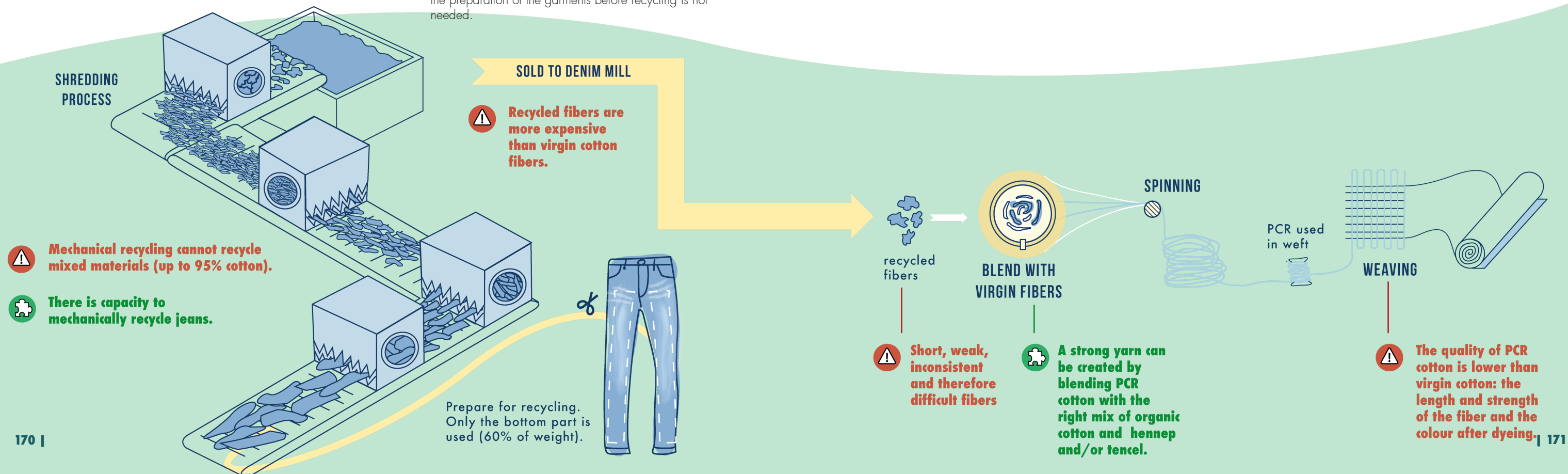
Mechanical recycling cannot recycle mixed materials. Cotton textiles should contain more than 95% cotton. Nowadays a lot of jeans consist of cotton mixed with polyester and stretchy content like elastane.

The mechanical recycling of denim results in fibers that are shorter than virgin fibers. Therefore the strength and quality of the yarn and the fabric will be less (Arzaga, D. of Royo Teijdos). Recycled fibers are on average 1.5 mm versus virgin fibers of 26-33 mm (Wentholt, 2019).

Recycled fibers and yarn are more expensive, less consistent and less available than virgin cotton. Quality, price and availability makes virgin cotton more popular than recycled cotton.

Denim mills who are working with PCR denim fibers want to work in a close collaboration with the recycling facility: they need to have full control over the content of the fibers because even a small piece of metal can cause destruction during the spinning process. Therefore, it is not yet an option to shred the textiles in the Netherlands or elsewhere and transport it to denim mills.

Shredding other cotton garments
As mentioned before, most projects so far are focused on creating denim made of recycled denim. However, shredding cotton textiles such as t-shirt or linnen, results in cotton fibers as well, which can be used to make denim. Since denim is woven much more tied than t-shirts, shredding these will leave longer fibers and also the preparation of the garments before recycling is not needed.



DENIM MILL 2.0

Where?

According to F. Bruinsma, Sustainability manager of G-star Rawy, it is quite a technical expertise to make a strong cotton material out of the short PCR fibers. Therefore not all denim mills do this.

There are traditional mills that do not want to change their way of working and invest in the right facilities to work with PCR fibers.

Denim mills in Turkey and Royo in Spain are most active with PCR cotton compared to other mills, but for Royo PCR cotton is still less than 5% of all the cotton produced (Guzetti, 2019).

Process

Denim mills that produce PCR denim buy recycled fibers from their recycling partners. PCR fibers always need to be blended with virgin fibers, since spinning with only PCR fibers results in very weak yarn. Often, the recycled yarn is only used as a weft yarn during weaving, see the visualisation below. The weft thread receives less pressure in weaving and wearing the jeans and therefore the warp thread needs to be stronger. The weft yarn makes 40% of the total denim volume. Therefore, using 30% PCR in the weft thread, results in a total recycled denim content of 12% (Circle Economy, 2016). The highest percentage so far is reached by Royo Teijdos in collaboration with the jeans brand Mudjeans: they created jeans with a 40% PCR fiber content (Engelen, 2019). In this denim, probably the PCR cotton is used in both weft and warp. During the process of recycling and spinning, there is another 15% of waste (Circle Economy, 2016).

Because of their short length and inconsistency, PCR fibers are difficult to work with.

However, with good research & development, a strong yarn can be created. Tony Tonnaer of jeans brand Kings of Indigo told about creating a strong yarn by :

Blending PCR fibers with organic cotton and a strong fiber such as hennep and or tencel.

As mentioned before, the strength of the PCR fabric is less than virgin cotton but this depends on the percentage of PCR used. There is a huge debate within the industry about up to what percentage the quality is good enough. As already stated, Royo created denim with 40% PCR for Mudjeans. Other brands have critique on this percentage since a weaker fabric will make the jeans last long.

Besides the strength, the colour of recycled denim is slightly different.

Because recycled fibers are often grey/light blue, the inside of the jeans will not be white but will be blue. This results in a less fresh jeans colour when washing and finishing the jeans (Arzaga, 2019).

Recycled jeans manufacturing

Because of the unsimilar fabric characteristics, brands that want to create recycled jeans need to collaborate with a jeans manufacturer that has extra knowledge about washing and finishing PCR jeans. The fabric will react different and can break faster. It's important to know the possibilities of the fabric: for example, unwashed or overdyed PCR denim looks better than washed PCR (Tonnaer, 2019).



Shredded jeans fabric



Shredded jeans fibers



Spinning PCR cotton

CHEMICAL RECYCLER

Another recycling technology for cotton is chemical recycling. Chemical recycling is chemically dissolving of textiles into its basic chemical building blocks. Through this high-value recycling route, new fibers with the same or higher quality can be created.

In chemical recycling, cotton is used to produce a lyocell type of viscose. This process is only done at small scale and is studied under different names in different places: Re:newcell (Royal Institute of Technology in Stockholm), SaXcell (Saxion University in Enschede), Worn Again (England) and an anonymous project in the United States.

All of the different projects show that at least in theory, cotton waste and more particularly post consumer denim waste can be upcycled to new textile fibres for a broad range of applications (Luiken & Bouwhuis, 2014).

Gerrit Bouwhuis is interviewed to understand the process, advantages and disadvantages of chemical recycling. He explained that chemical recycling is a technique to regenerate a virgin fibre made from cotton waste. Cotton fibers are shortened, chemically dissolved and a new cellulose-like fiber is created with wet spinning. Wet spinning is used more and more to create viscose and tencel from wood. Saxcell and Re:newcell now use cotton waste as raw material instead of wood.

Process

Garments are manually prepared for shredding, just as for mechanical recycling. Then, garments are shredded into fibers as short as possible. The fibers are cleaned: polyester, metal content, and color dyes are removed. The secret SaXcell method makes the cotton fibers ready to be dissolved: the adjustment of the degree of polymerizations creates a pulp, which is dried afterwards. Then, the wetspinning process can begin. This starts with dissolving the pulp in NMMO to create a viscous liquid: viscose. An extrusion process creates from the viscose a filament of cellulose: a long SaXcell fiber. The filament is cut into fibers of the right length (mostly 38 mm). The result are Saxcell fibers which can be spinned into Saxcell yarn or can be mixed with cotton fibers. Fabric made from 100% Saxcell fibers feel very soft and fluid. To make a denim-like material out of this, it needs to be blended with

a more rough and tough material.

Advantages of chemical recycling:

- Chemical recycling doesn't require any agricultural land, pesticides and uses less water (250L per kg). The chemical solution used for dissolving the cotton can be re-used for more than 99% and the SaXcell fiber itself is recyclable many times.
- The created fiber has no colour, is stronger and more evenly than mechanically recycled fibers. Therefore it is possible to make fabric of 100% SaXcell fibers.
- In the process mixed materials can be separated.
- The costs of the Saxcell fiber is similar to competing fibers such as tencel and viscose. Tencel has the same characteristics, and almost the same production process but is made from wood.
- SaXcell is planning on selling licenses to use this technology.
- SaXcell expects to be available on big scale in 4 or 5 years.

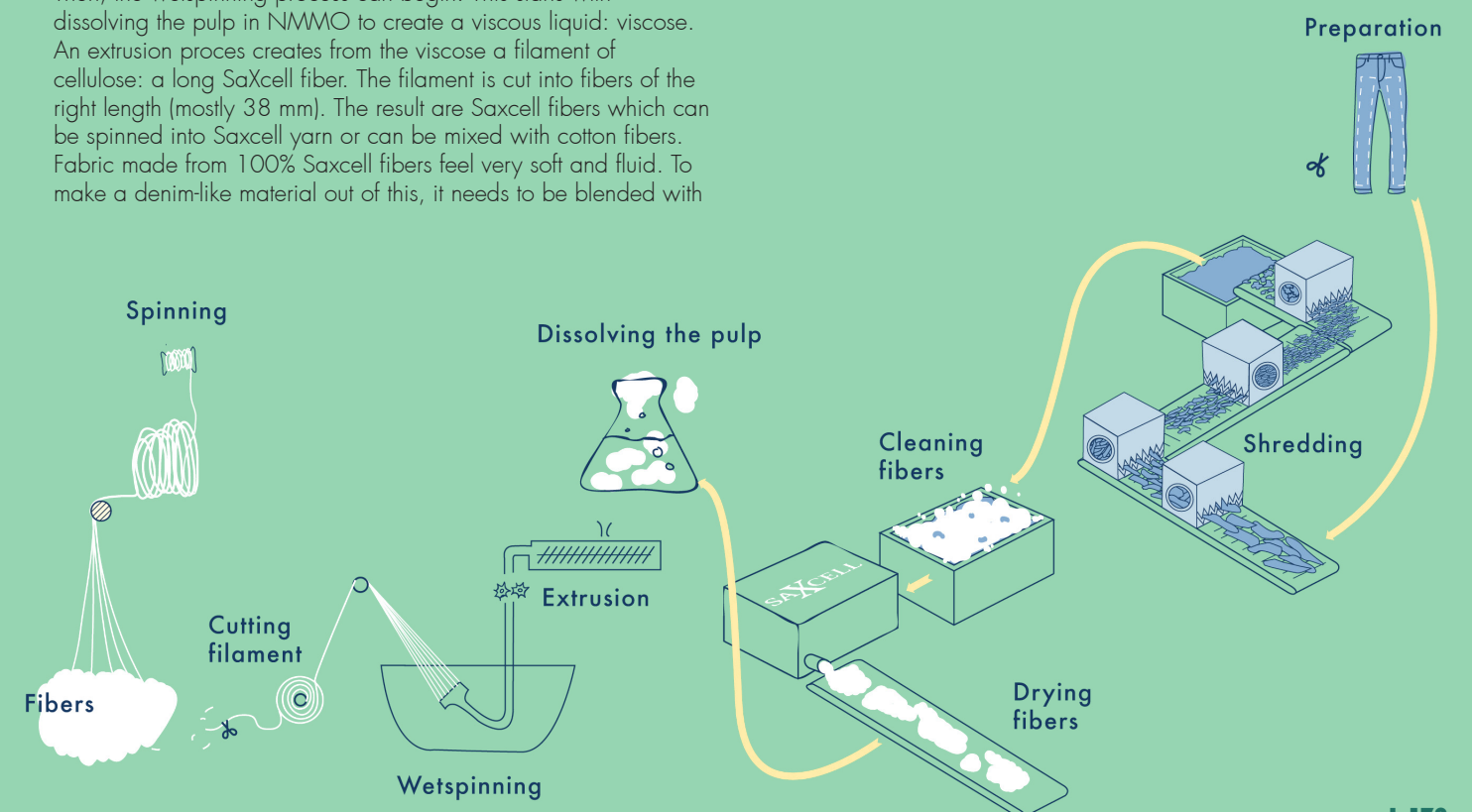


Chemical recycling can recycle mixed material and create 100% recycled fabric, which is stronger than cotton itself. By mixing this with other fibers, a strong denim like fabric can be created.

Chemical recycling is not yet available for commercial use and is more expensive than mechanical recycling. To make SaXcell available for bigger scale, investment is needed. Investment is a risk, and Dutch companies are often risk-averse. [Bouwhuis, G.]



Investment is needed to scale up chemical recycling.



BRAND

As you can see in figure 21, we have walked through the whole cycle. In the middle of the cycle, the brand is positioned. The brand is the driver of the chain and has interactions with every actor of the cycle.

Process

In the previous chapters, we have seen the production process of a jeans and the material flow. But where does a jeans made of conventional cotton start? It all begins at the brand. The brand decides that it wants to put a new jeans on the market. A designer will analyze the trends and will design a new jeans. A fabric specialist or the designer, depending on the size of the brand, will choose the fabric from samples sent by the denim mill they usually work with. In some cases, the brand develops their own fabric in collaboration with the mill (Bruinsma, 2019). The brand will tell the manufacturer what fabric they need to buy and make the jeans from.

In order to produce a jeans from recycled denim, the jeans brand does not only have to interact with a denim mill and manufacturer, but it needs to contact, collaborate and interact with a lot of different parties. The difficulties for the brand in using PCR denim will be described for every interaction.

Brand - Collector/Sorter - Recycler - Denim mill

When brands want to use recycled material, they have two options: choosing a sample of PCR denim that is already produced by the mill they are working with, or managing the collection of textiles themselves, getting these recycled and made into new denim. Choosing the pre-produced denim is not common, probably because there is not much to choose from and because the marketing story is stronger when the recycled material is made from garments collected by the brand itself ("Jeans made out of our own jeans") (Guzetti, 2019).

In order to go for the second option, the brand needs to establish a source of post consumer garments. One option is to collect it's own clothes in the shops. These textiles need to be sorted to select the part that can be used for recycling. This is most often outsourced to a sorting center. Another option is use certain textiles (type of clothes, brand, colour etc) that a sorting center has received in the collecting bins. A deal needs to be closed. Next, the brands needs to manage and pay the transport of the sorted garments to a recycling facility abroad. To get the garments recycled into fibers and made into denim fabric, the brands needs to set up a connection and agreements with a denim mill and 'connected' recycling facility.

Complicated logistics for brands.
To obtain post consumer garments, get these clothes sorted by a sorting center and get them shipped to a recycling facility which is in close contact with the denim mill is quite an expensive and time consuming operation for a brand: it's quite an economic challenge.

Brand - Denim mill

Denim mills wait for demand

PCR denim is mostly created in projects executed in collaboration with a brand. As mentioned above, on most of the projects the



Figure 21. The lifecycle of jeans

brand wants to use it's own collected garments, in order to have a strong marketing story. Therefore mills wait for brands and have only a small offer of PCR denim made of locally collected garments. As Guzzetti for Royo Tejidos told: "We have some PCR denim in the collection but the denim industry needs big volumes to make it profitable. There is no focus on increasing the use of PCR from within the mill, we wait for the brands".

Denim mills wait for demand of the brands.
Mills wait for brands to raise the demand and do not offer a lot of PCR denim themselves. Therefore, brands need to actively ask for PCR at their current mill.

Brand need to create demand, mills need to execute

Since the mill wait for the demand, the brand needs to push. Tony Toannaer from jeans brand KOI mentioned that they actively ask for recycled material: 'We stimulate Calik in Turkey to put more recycled cotton in their denim. If they have a fabric which we like, we ask them; can you make it with recycled and organic cotton?'. Since only a few brands have created jeans made of PCR denim, all the operations around recycling cotton are at small scale. In order to make it economically feasible, the process needs to be industrialised and a volume of scale needs to be reached. As Tonnaer explained; 'This will only happen we raise the demand. The more demand, the more mills will develop PCR denim by themselves. Then, it will be more easy for everyone'. He also explains that eventually, the mills, the industry, has to do it. 'Recycling factories and denim mills are very technical, we, as brands, are not. I believe in using the know-how of these companies. We can give them our wishes and help them where needed, but the industry itself has to do it eventually'.

Time consuming and expensive for brand

Mudjeans is one of the only brands in the Netherlands that offers a collection consisting of almost only recycled jeans. Eva Engelen, Corporate Social Responsibility manager of Mudjeans explained that creating jeans of recycled denim is more expensive. Not only because recycled fibers cost more money than virgin fibers but also because as a brand you're collaborating with the denim mills in a partnership instead of a customer-supplier relationship. The brand starts a trial and error process with the denim mill to get to the perfect recycled denim. This process costs a lot of time and money.

Time consuming and expensive process.
Creating a PCR denim with the same quality as conventional denim is difficult because of the short and coloured fibers. Creating a fabric that is desired by the brand, asks for a trial and error process for brand and mill which costs more money and time.

Expensive fabric
The price of recycled denim, offered by the denim mill, is higher than conventional denim.

Brand - Consumer - Denim mill

Quality (perception)

As mentioned, PCR cotton is less strong. In the industry there is a disagreement amongst brands and denim mills about the quality of PCR denim: Up to what percentage of PCR fibers is the strength of the fabric good enough?

Some articles mention a barrier of 5%, others say that up to 20% the quality is similar. Mudjeans has put products on the market with 40% mechanically recycled fibers: a milestone for the industry but widely criticised by other brands. A percentage of 40% could lead to a jeans that doesn't last long enough.

Brands in general perceive the PCR denim as an inferior version of conventional denim instead of a new material with it's own possibilities. Brands want the fabric to have the same characteristics as virgin cotton and by using old quality parameters, the two different fabrics are always compared. Industry expert Alberto de Conti argued that brands should give consumers the chance to evaluate this themselves. In his view we shouldn't expect in a circular economy to get exactly the same product back into the cycle. Instead we should accept the differences, and communicate them in a way that can be adding value in the eyes of consumers.

Quality (perception): Brands want the fabric to have the same characteristics as virgin cotton. They perceive the PCR denim as an inferior version of normal denim instead of a new material with it's own possibilities. Are brands to critical about the quality?

Brands - Collector - Government

Waste management

In the Netherlands, fashion companies are not responsible for collecting and recycling. According to Hans Bon of collecting center Wieldand, 'these companies, such as the H&M's and C&A's of this world, put textiles in the market and do not take any responsibility for the mess they create'. In France, the government has taken action. French fashion companies are considered responsible by law for managing the recycling of their products: this is called Extended Producer's Responsibility, whereby the transaction between brand and consumer doesn't end at the point of sale. Brands can either organise their own recycling program or contribute financially to the nation wide organisation to provide it for them (Eco TLC).

Incentive for using PCR cotton

In France, companies will get a discount on the financial contribution when using recycled material in their products: a good incentive for PCR cotton. In the Netherlands, there is no incentive from the government to use PCR cotton.

Brand - Consumer

Alberto Guzzetto from Royo Tejidos explained that the main obstacle for brands in using PCR cotton is to enter the market. He told that when the brands starts saying that one particular product is sustainable, all the customers are thinking; what about the other collection? So the big obstacle is conceptual more than practical: how to enter in the sustainable world with a plan that can help to grow the brand.

Marketing of recycled items
For brands, it can be hard to enter the market of sustainable items in the good way: to market a few recycled items to the consumer in a whole collection of non-sustainable items.

There are much easier ways to do something sustainable as a brand. Therefore, brands who start with sustainable practises will first do other things and wait for consumers to raise the demand.

Brands without a focus on sustainability or that are still in the beginning phase of sustainable practises, wait for consumers to raise the demand.

Greenwashing

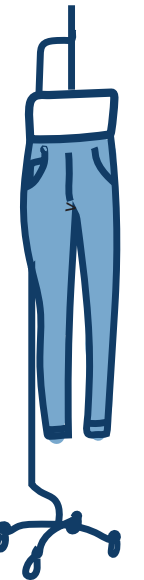
Some brands use minimal sustainable practises only for marketing: Greenwashing can make a company appear to be more environmentally friendly than it really is. A big marketing campaign about only 1 recycled jeans in the whole collection can be seen as greenwashing, although attention for the topic positively contributes to the awareness in the industry and at the consumer.

Brand - Recycler

Design of a recyclable jeans

The way a jeans is designed and the choice of fabric determines if it is recyclable or not. In order to work towards a fully circular economy, all fashion items need to be designed with recyclability in mind. Therefore, knowledge about recycling, possibly from the recycler, needs to be educated to designers. A few examples:

- Stretchy jeans are popular at the moment. A lot of elastane in the jeans makes it not possible to recycle mechanically.
- Experiments are done with glued seams, printed/lasered labels and recyclable buttons.
- G-star has created 'the most sustainable jeans yet', that is cradle-to-cradle certified, and 98% recyclable: detachable buttons, no rivets, printed or paper labels.



Brand internally

Besides difficulties in the interactions with different players, the brands also have two obstacles internally.

(Unexperienced) brands do not have enough knowledge about sustainable options, PCR denim and/or circularity and there is no clear information widely available about the possibilities and restrictions of PCR recycled cotton.

Often, when the design & development department is willing to make sustainable choices, the only thing that last is to convince the manager (Wentholt, 2019). But especially the management department is lacking the knowledge about PCR cotton.

Besides the knowledge, also intrinsic motivation at the brands side is often lacking. Out of hope for extra revenue, pilots are done with recycled material. Only 1 or 2 models are put into the market. Often, when this is not immediately a success, no further trials are done. The focus will be shifted to another innovation.

Intrinsic motivation of brands
Most brands do not have enough intrinsic motivation to continue developing PCR product when it's difficult or when sales are disappointed.

APPENDICES >

APPENDICES

A. All maps created in the research phase of the project

1. Final Giga-map: The cycle of a pair of jeans
2. Exploration map of the cycle of a pair of jeans
3. A map of all current initiatives, agreements and labels of the denim industry
4. Image map, a zoom in on the production and recycling of denim
5. A process map with SWOT elements

B. List of difficulties for producing and using PCR cotton

C. Interconnected Circle Diagram

D. Life cycle of denim with the most important problems

E. Problem network diagram

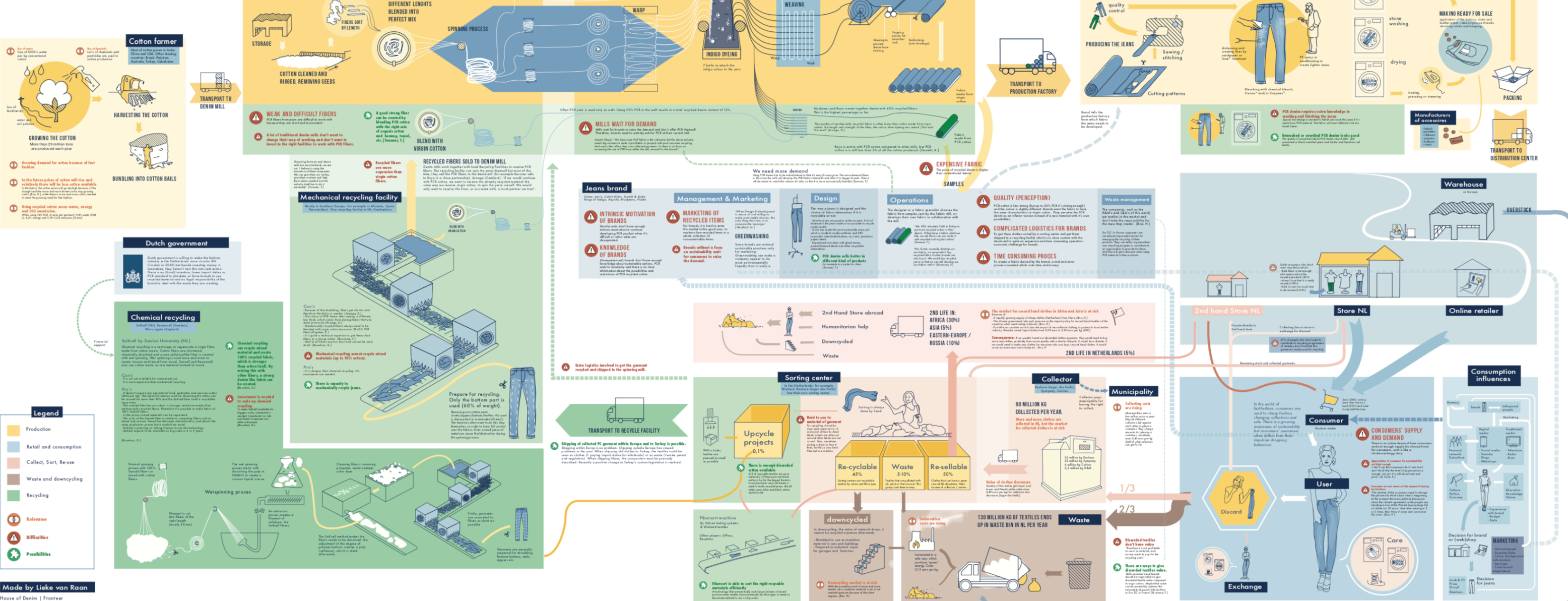
F. Actor mapping

G. Future perfect story

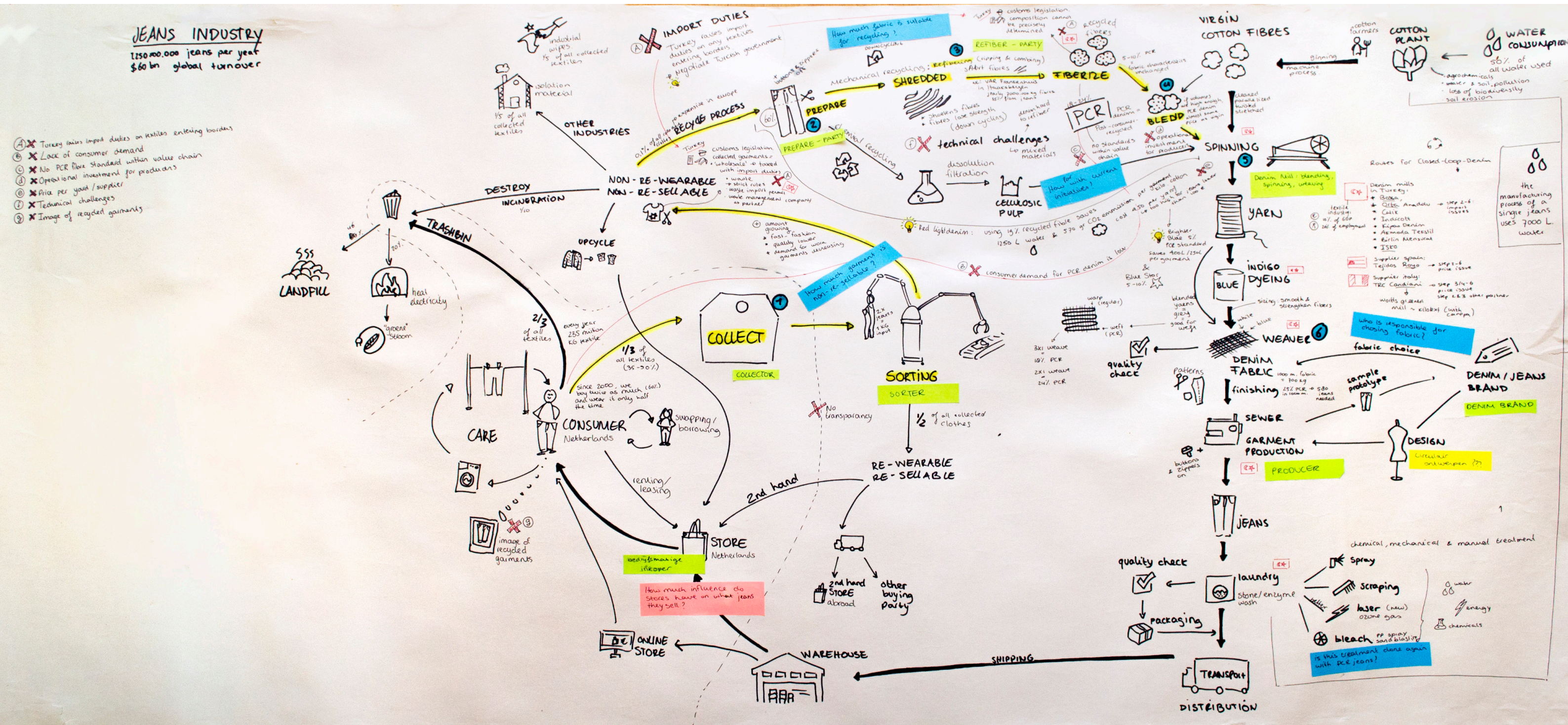
Final Giga-map: The cycle of a pair of jeans

THE CYCLE OF A PAIR OF JEANS

How can the use of Post Consumer Recycled Cotton in Jeans Production be increased?



Exploration map of the cycle of a pair of jeans



A map of all current initiatives, agreements and labels of the denim industry

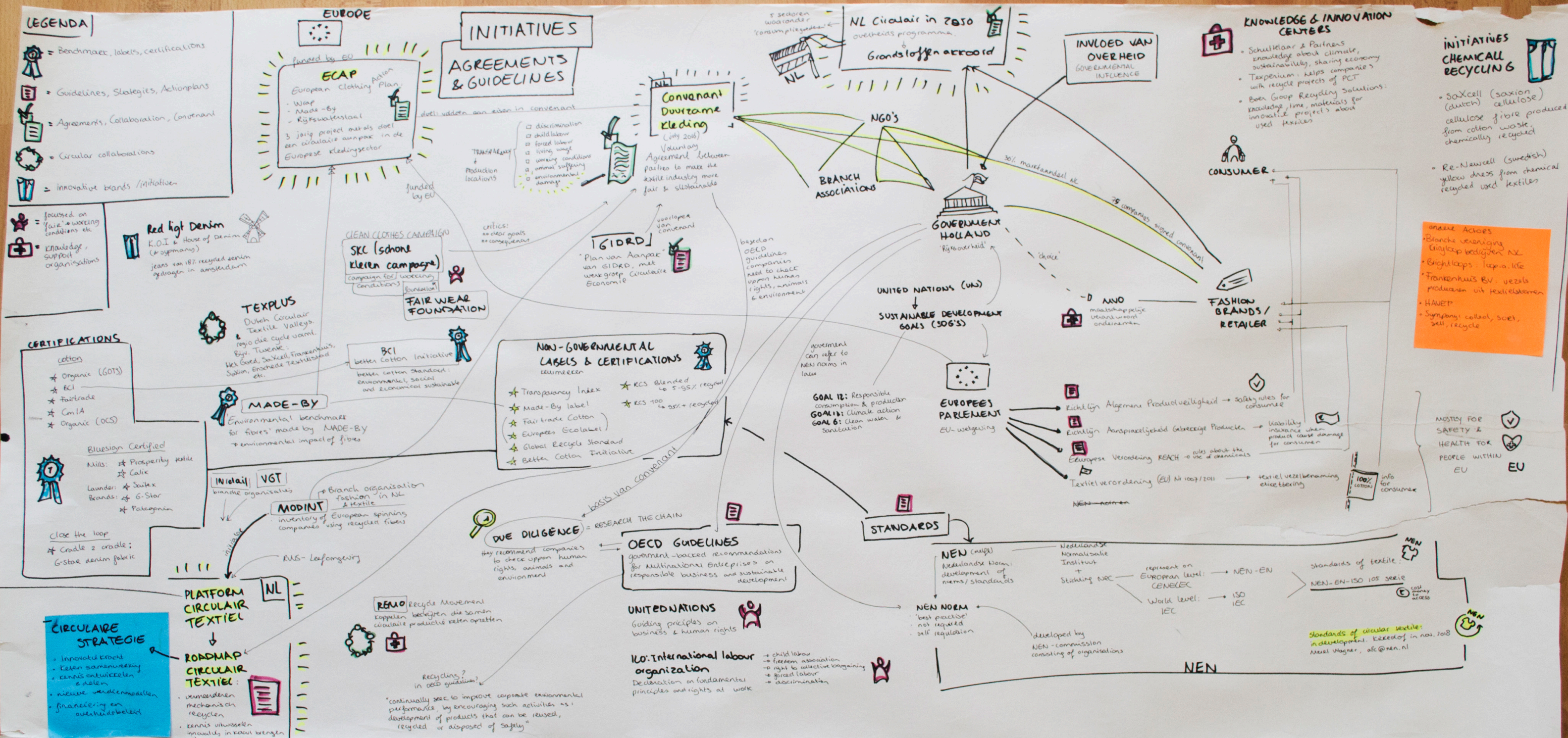
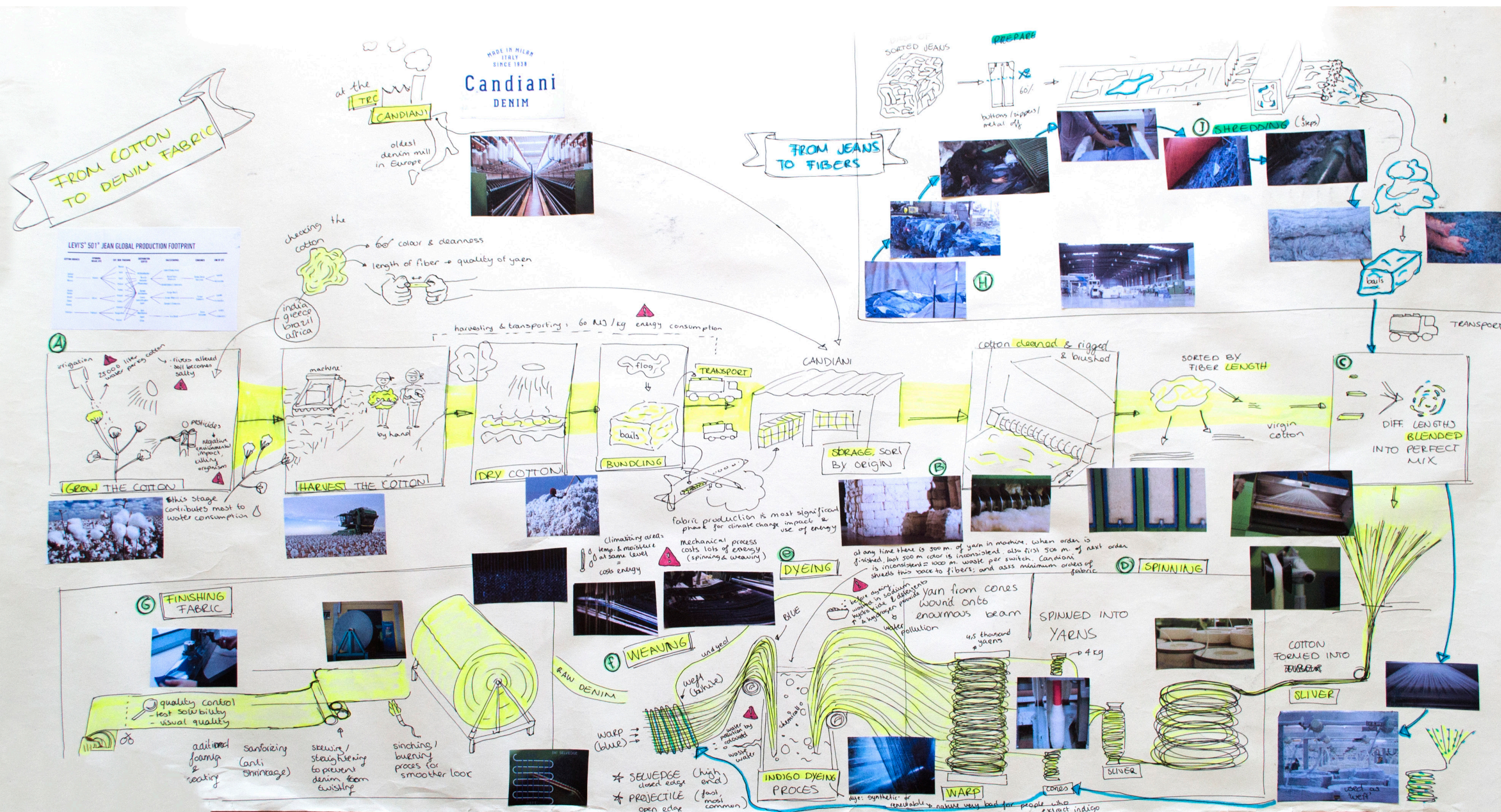


Image map, a zoom in on the production and recycling of denim





List of difficulties for producing and using PCR cotton.

Difficulties collecting and sorting

- Discarded textiles (in small volumes) do not have value.
- It is hard to efficiently sort textiles (to see the material of the garment)

Difficulties recycling cotton

- Investment is needed to scale up chemical recycling
- Mechanical recycling cannot recycle mixed materials (up to 95% cotton)
- Shredding denim result in short fibers

Difficulties for mills to produce PCR denim

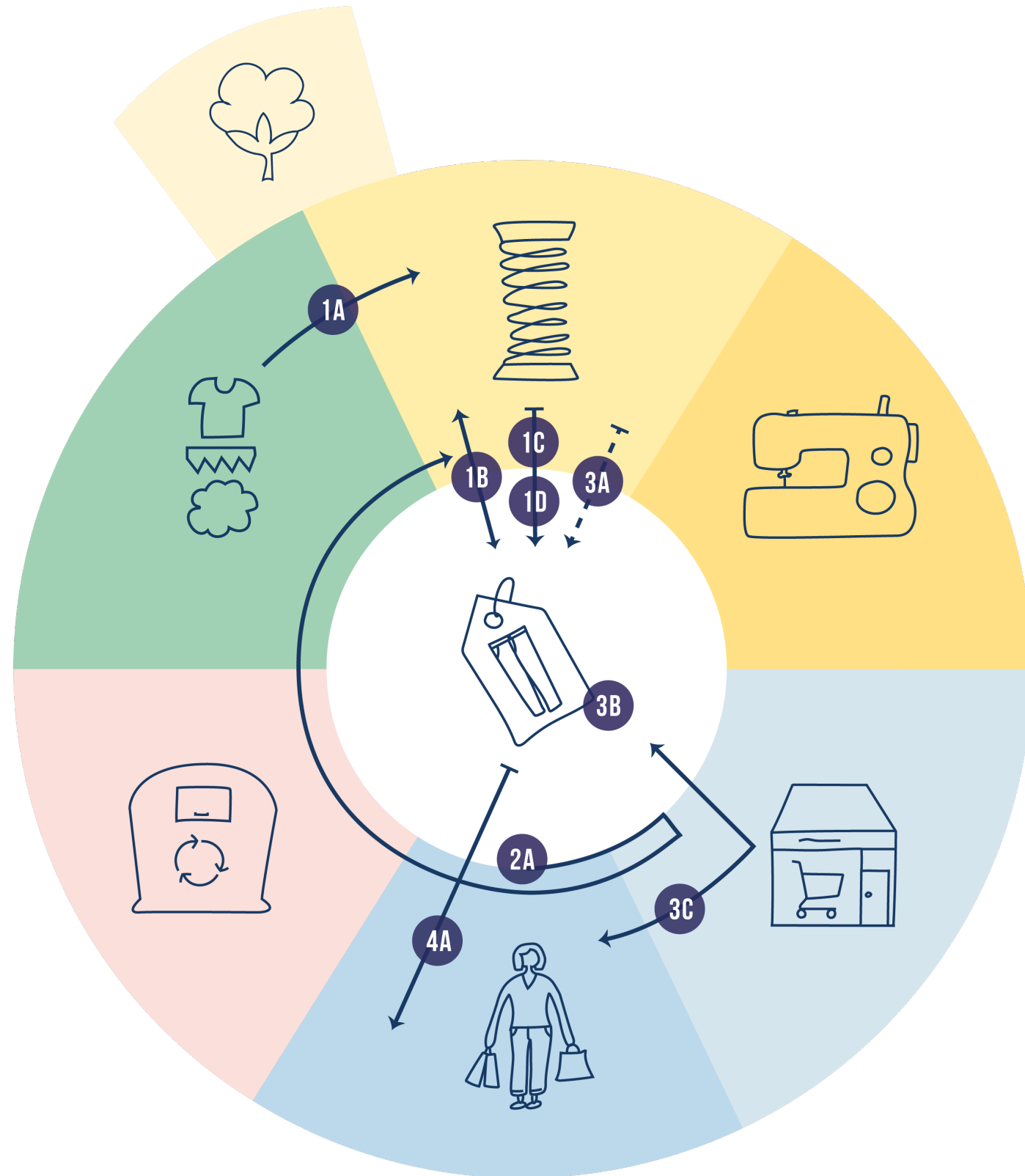
- Recycled fibers are more expensive than virgin cotton fibers
- It is difficult for denim mills to work with pcr fibers, because they are more inconsistent and cause more problems.
- A lot of denim mills are traditional, do not want to change their way of working, do not have the right facilities to work with PCR fibers, do not want to invest in this.
- PCR denim requires extra knowledge in washing and finishing the jeans.
- Denim mills wait for brands to raise the demand. They work mostly with collected garment of the brand itself and only develop small amounts of PCR fabric by themself.
- Brands do not switch mill easily
- It is hard to get a GRS certification

Difficulties for brands

- Brands are hesitating because often the quality (strenght) of the fabric is less (because of the short fibers) and often the colour is different in washed jeans (less fresh)
- The development of a PCR fabric is a trial & error proces for recycling facility, denim mill and brand
- Extra logistics involved to get the garment recycled and shipped to the spinning mill.
- Brands expect PCR denim to be the same as original denim
- The PCR denim that suppliers offer brands is more expensive than ‘normal’ denim.
- Not enough intrinsic motivation of brands
- Unexperienced brands have not enough knowledge
- Hard to collect clothes themself as brand
- Brands use old quality parameters
- It is hard to market a few sustainable items in a non-sustainable collection
- No demand for recycled jeans from consumers
- Appreciation of consumer for sustainability not high enough
- Consumer are not aware of the impact of buying fast fashion.
- Consumers do not see positive impact of recycled material



Life cycle of denim with the most important problems



1A WEAK AND DIFFICULT FIBERS

PCR fibers from jeans are difficult to work with because of their short length and inconsistency.

1B QUALITY (PERCEPTION)

Brands want the fabric to have the same characteristics as virgin cotton. They perceive the PCR denim as an inferior version of normal denim instead of a new material with its own possibilities. Are brands too critical about the quality?

1C EXPENSIVE FABRIC

The price of recycled denim is higher than conventional denim.

1D TIME CONSUMING AND EXPENSIVE PROCESS

Creating a PCR denim with the same quality as conventional denim is difficult because of the short and coloured fibers. Creating a fabric that is desired by the brand, asks for a trial and error process for brand and mill which costs more money and time.

2A COMPLICATED LOGISTICS FOR BRANDS

To obtain post consumer garments, get these clothes sorted by a sorting center and get them shipped to a recycling facility which is in close contact with the denim mill is quite an expensive and time consuming operation for a brand: it's quite an economic challenge.

3A MILLS WAIT FOR DEMAND

Mills wait for brands to raise the demand and don't offer a lot of PCR themselves. Therefore, brands need to actively ask for PCR at their current mill.

3B NOT ENOUGH KNOWLEDGE AND/OR MOTIVATION OF BRANDS

(Unexperienced) brands don't have enough knowledge about sustainable options, PCR denim and/or circularity and there is no clear information widely available about the possibilities and restrictions of PCR recycled cotton. Most brands don't have enough intrinsic motivation to continue developing PCR product when it's difficult or when sales are disappointed.

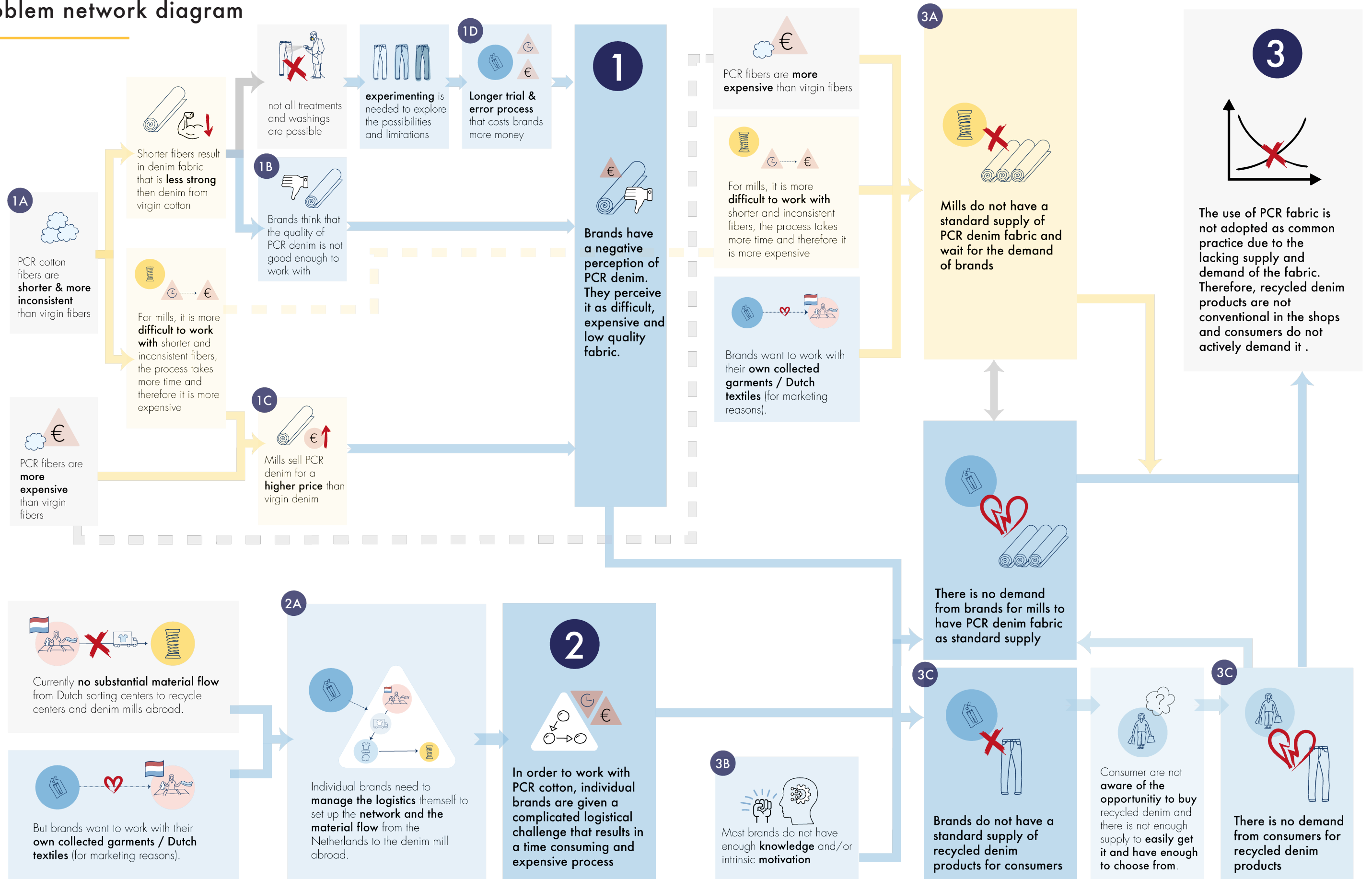
3C CONSUMERS' DEMAND AND SUPPLY

There is no active demand for recycled denim from consumers and there are not enough options available to choose from for consumers (not enough supply), which influences each other negatively.

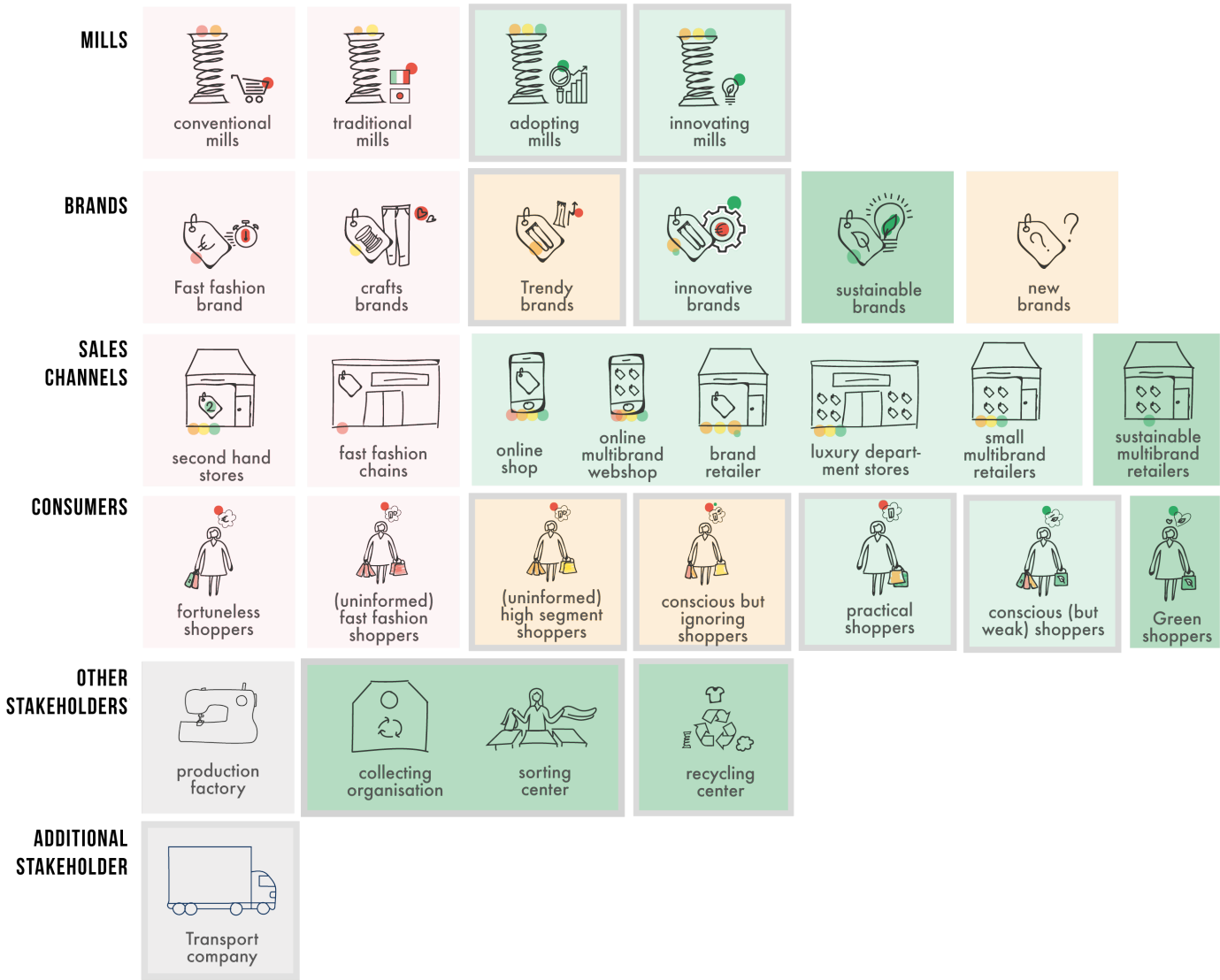
4A MARKETING OF RECYCLED ITEMS

For brands, it is hard to enter this market in the good way: to market a few recycled items in a whole collection of non-sustainable items.

Problem network diagram

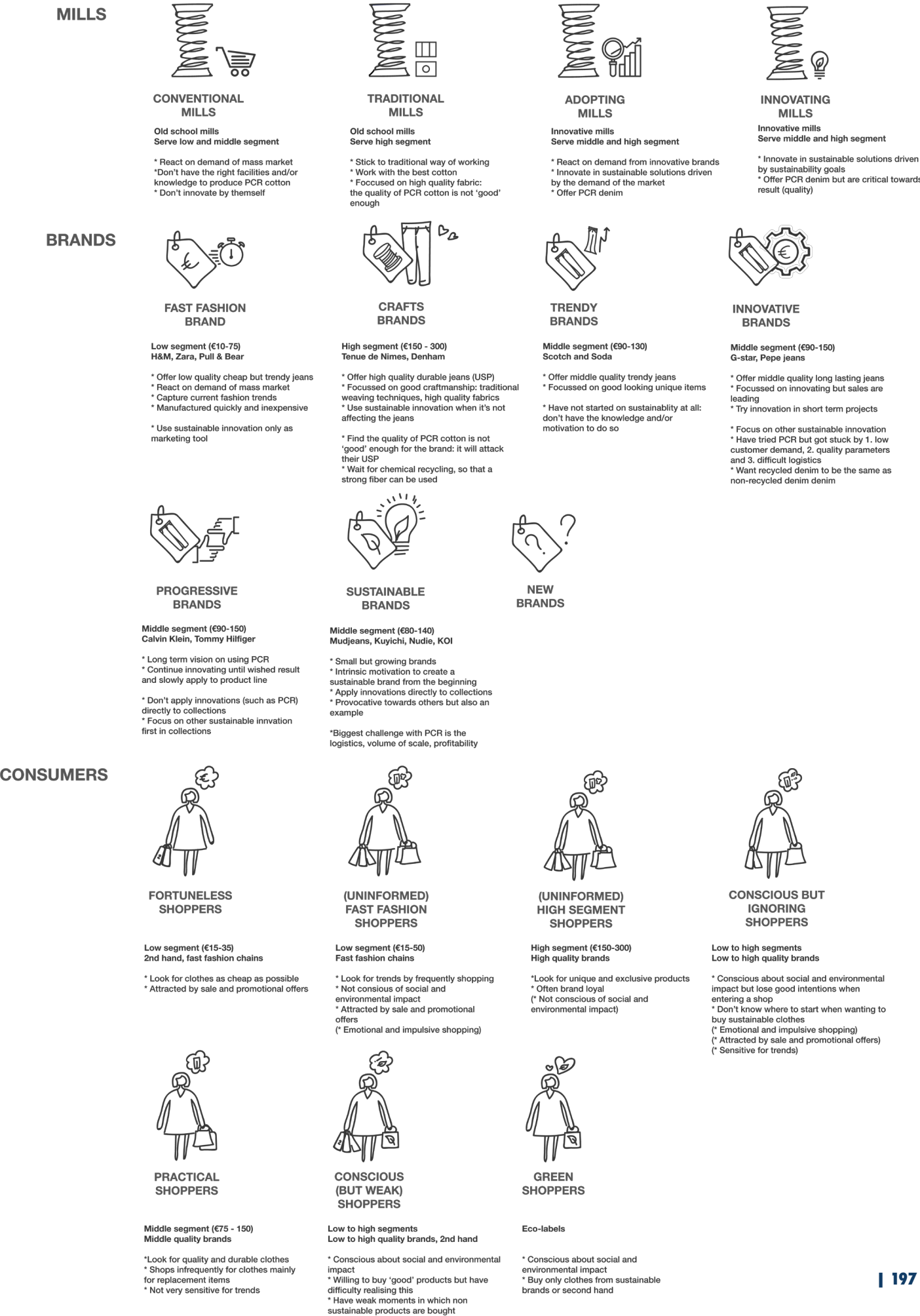


Actor mapping



- LOW SEGMENT JEANS
Price €10 - 75
- MIDDLE SEGMENT JEANS
Price €75 - 150
- HIGH SEGMENT JEANS
Price €150 - 350
- SUSTAINABLE JEANS
Price €90 - 150
- DRIVER AGAINST PCR COTTON
- DRIVER FOR PCR COTTON
- NON POTENTIALS
- POTENTIALS
- NEED A PUSH
- CONVINCED

ACTORS WITH EXPLANATION



FUTURE VISION

The goal, the current situation and the problems are clear. But what are we actually working towards when designing an intervention? What does the future look like if the design intervention works out as it should and the industry changes according to circular economy principles?

A Future Perfect Story is written. Marc Tassoul (Tu Delft) created this approach to achieve a sense and vision about issues of change. The story takes readers in an easy way to an imaginative future of the denim industry. This story is used as a sense of inspiration for the design brief and the final design.

A STORY IN THE YEAR 2040

'THE PERFECT FUTURE OF THE DENIM INDUSTRY'

A fully circular denim industry has been formed. A connected **network of actors** in the system is established and all people stepping into the industry immediately have got a clear image of how this network collaborates. A broad **knowledge** about the lifecycle of a denim product, the recycling of denim and design recyclable denim items is shared amongst the network. All denim items sold in the Netherlands are made from recycled material. There is a **material flow** from the Netherlands to mills within Europe. By now, all 'old' items have been recycled or incinerated and no non-recyclable items are in the loop anymore. In other countries, non-recycled and non-recyclable items are still for sale but importings these in the Netherlands is illegal.

Chemical recycling

Chemical recycling has developed quickly and one is now able to recycle all kind of materials and form these materials into all different kinds of fibers. The Netherlands and Germany have opened enough chemical recycling facilities to recycle all suitable textiles and mixed textiles consumed in the Netherlands and form these textiles into ISO certified fibers. These fibers get shipped to South and East European denim mills with zero-emissions trains because almost all production of fashion items consumed in the Netherlands happens in facilities within Europe. All European mills have adopted their facility and have learned how to work with these fibers and turn them into good quality yarn.

Brands

Decades ago, **the government has stimulated brands to work with post consumer recycled materials** by constituting a fiscal incentive: less taxes had to be paid for importing recycled fabrics or garment. This has quickly stimulated all important brands to move forward and work with recycled material and this has accelerated the development and adoption of automated textiles sorting and chemical recycling. After a while, when recycled material was the new standard, the decreased tax for recycled material turned into an increased tax on non-sustainable material and this has encouraged the last 'not yet convinced' brands to also move. A few years ago, a legally binded PCR standard was constituted. Now, garment without a certain percentage of recycled material cannot be sold anymore in the Netherlands, it is illegal.

On top of that, all garments sold in Netherlands are now fair & clean: ethical and sustainable. The materials as well as the items are produced in a sustainable way. Most of the work is automated but for the people who are working in the production, there are healthy and safe working conditions and fair living wages. Therefore, in general the price of fashion items has increased. Consumers have adopted to this.

Besides using recycled and sustainable materials in their products, all Dutch Denim brands have learned how to design fully cradle-to-cradle denim products. Because this is widely adopted, everything needed for cradle-to-cradle design has decreased in price.

Besides designing recyclable products made of recycled material, Dutch fashion brands are considered responsible by law to manage the recycling of their products at the end of their lifetime. Brands have got the choice: they could organise their own collecting and recycling program or contribute to an organisation accredited by law to provide it for them. In this way, there is now enough money to recycle all textiles.

Consuming

By now, all textiles get collected and nothing ends up in the trash bin. The Dutch consumers have got more and **more aware of the impact of the fashion industry and the sustainable options**. The next generations are educated that clothes are not disposable products but that it's lifetime continues after they do not want it anymore. They have understood how to consciously consume and how to give the items a second life. The culture has changed: Fast fashion is far in the past, the quality of clothes has improved and clothes have got more and more personalised. People have got their own digital character which is completely alligned with their body measurement. All sales happen online, offline there are only brand experiences and services, no shops anymore. When ordering online, people use their digital character to look for perfectly fitting models or they let products make especially for them. People are more attached to these clothes, because they are found or made especially for them, they fit perfectly and the quality stays good. Therefore, they use their clothes longer. When saying goodbye to their clothes, they never throw away their clothes in the trash bin. They have learned where to bring them to keep their value high. Besides owning (personalised) clothes, rental business have become the new standard. When you want to wear something special occasionally, you choose an outfit of one of the multiple clothing rental services. Consumers only buy clothes that they use daily and will appreciate for a long time.

One other thing has contribute to this development: Years ago, the government introduced deposit money on all garments (in Dutch: statiegeld). Everyone pays 10% extra when buying new clothes, and when you return them, you get to money back. This has created a major awareness growth and a changed the habits of millions of people.

In a few decades thing have drastically changed, because of **regulations**, but also because of **a change of mindset** of brands (and consumers) and more **collaboration** within the industry.

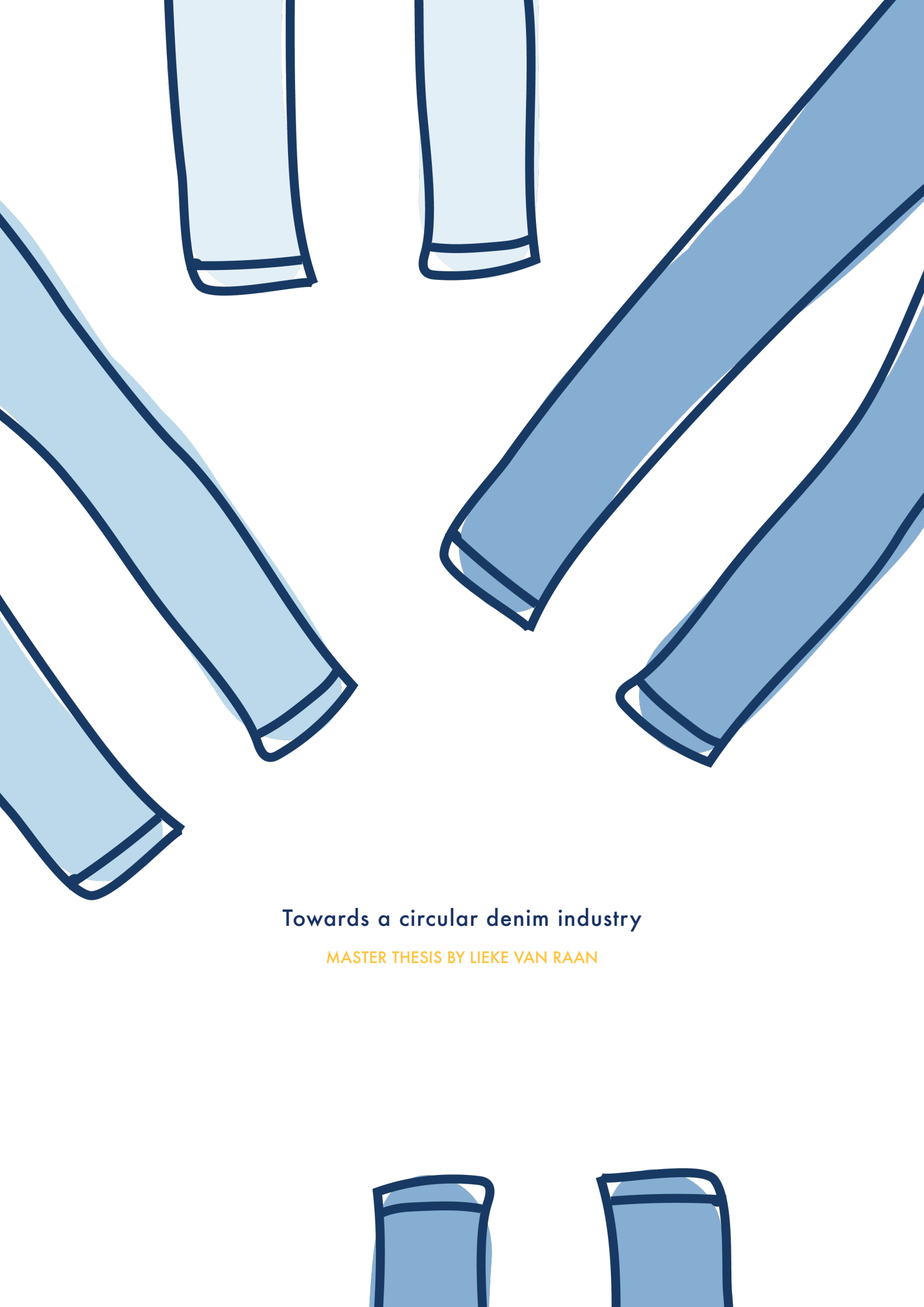
The yellow highlighted elements are used to form the design brief. The blue highlighted elements are used as elements of the design intervention.



Towards a circular denim industry

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