

# Participatory modelling of pathways in the sustainable textile transition

Final wildcard project report

George van Voorn

With: Kim Poldner, Annemarie van Paassen

Contributions by: Hubert Fonteijn

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This project has been funded by the investment theme Transformative Bioeconomies:  
Towards a materials transition that phases out fossil feedstock

## Introducing the format

When submitting your Wildcard project you committed to providing several deliverables:

1. A short accessible document for the inter- and transdisciplinary group of people involved in the programme that describes your methodological innovation project / proof of principle project and its rationale;
2. A presentation at a community meeting of the investment theme;
3. A report of the results of your learning journey that describes the key lessons learned about your methodological innovation or proof of principle.
4. Additional deliverables formulated by you as part of the submission, labelled 'Project specific deliverables' in this format.

All Wildcard projects already provided presentations as stipulated under 2. This format then is meant to document deliverables 1, 3 and 4.

In section 2 of the format we ask some additional questions related to possible follow-up.

### **NOTE TO THIS REPORT:**

Two of the main investigators (Hubert Fonteijn and Geerten Hengeveld) left WUR during 2023. As a result, this report does not include all details from the research.

## 1. A short accessible document following the headers below (max. 600 words to be published on the website)

Please describe your project in a way that people from completely different disciplines and/or laymen can understand using the below headers and instructions. Note that we will use these descriptions for our website as well.

### Innovative idea and objective

*Describe the essence of your innovative idea, and what you wanted to study and achieve in this project.*

The clothing industry is still heavily carbon-based. To achieve sustainability this industry should change to an economy with predominately recycled or regenerative (i.e., fossil-free based) textiles. Legislation is preparing for this transition, e.g., in 2025, 50% of the clothes sold by companies in the Netherlands should be reused or recycled<sup>1</sup>. The development of options for a strategy to accelerate the transition to a carbon-free clothing economy is hampered by challenges and uncertainty faced by stakeholders. Producers experience trade-offs between short-term monetary goals and investments. Technical options for producing carbon-free clothing at realistic costs are lacking. Consumers are financially constrained and influenced by social factors such as what is fashionable. Researchers and policy makers are unsure about the plausibility of transition options.

This project aims to identify factors that hamper or promote factors for a transition to a carbon-free clothing economy. It involves a process in which experts and stakeholders jointly explore technical, social and organizational challenges by using a model of the textile economy for an analysis of system actors, their behaviours, and their experienced disruptions, thresholds, and trade-offs. An inventory of factors that affect this transition should help in designing a pathway for making the transition.

### Relevance to the materials transition in textiles and/or building materials?

*Describe how your project is relevant to reducing the use of fossil carbon in the domain of textiles, building materials (housing and interior) or both?*

The textile industry is responsible for 8-10% of the total CO<sub>2</sub> emission<sup>2</sup>. Textiles are primarily made from carbon-based resources. The CO<sub>2</sub> emission per produced polyester shirt is twice that of a cotton shirt<sup>3</sup>. The textile supply chain involves actors who are geographically distributed and residing in countries that are heavily coal-based. Also,

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<sup>1</sup> <https://open.overheid.nl/repository/ronl-3c0501af0b455986c28881b2f1c48d161560c1d0/1/pdf/bijlage-1-belisnota-s-besluit-uitgebreide-producentenverantwoordelijkheid-textiel-geredigeerd.pdf>

<sup>2</sup> Leal Filho, et al. "An overview of the contribution of the textiles sector to climate change." *Frontiers in Environmental Science* 10 (2022): 1419.

<sup>3</sup> Kirchain, et al. "Sustainable apparel materials." *Materials Systems Laboratory, Massachusetts Institute of Technology, Cambridge* (2015): 1-34.

degrading dumped textiles emit CO<sub>2</sub>. A transition to a fossil-free resource-based textile industry will reduce the CO<sub>2</sub> footprint.

## What did you do?

*Describe briefly what activities you have undertaken to reach your objectives.*

Stakeholders were involved primarily through a workshop held in 2023 at Wageningen UR. A model of the textile supply chain developed in 2022 was extended to aid the visualization of the value chain and feed discussions. Stakeholders were asked what they perceived as important bottlenecks or opportunities for a transition.

## Main result, achievement and highlight

*Describe the key results of your work. What insights have been generated? What is it you want to highlight?*

Important factors mentioned by stakeholders are: 1/ While several producers are genuinely motivated by sustainability, money is always a limiting factor. Labour costs are high, and fair pricing is needed for sustainable products; 2/ Consumers display ostrich behaviour resulting from tension between what is sustainable and what is desired, and furthermore suffer from addictive buying behaviour driven by fashion. They need to be helped in achieving a sustainable mindset; 3/ Small sustainable companies cannot compete with large companies who opt for large-scale, risk-free, but unsustainable strategies. Persisting entrepreneurs with strong leadership are essential to lead by example and thus convince consumers to buy sustainable, resulting in a snow-balling feedback effect towards producers; 4/ Current legislation is insufficient, and focused new legislation is essential in forcing businesses to make a transition; 5/ Words like 'value chain' restrict thinking in circularity. A new vocabulary based on a 'regenerative' mindset is needed.

## Key message

What is the key message that people working on the materials transition should remember from your project?

There are multiple initiatives by people and small businesses dedicated to a more circular and sustainable clothing industry, via reselling, recycling, and even regenerative fashion (in which old clothing items are fully broken down to new inputs, achieving full recycling). Hence, there is a potential for making a transition to a more sustainable clothing value chain. To mobilize this potential, new legislation, more effective and efficient technology, and policy aimed at making consumers more aware of sustainable clothing are required to push this transition.

## Visual abstract

Please place a visual abstract below. Please add a caption of the visual abstract below the image.

### Participatory modelling approach



A previously developed and expanded model of possible clothing supply chain organizations (including reselling, recycling, and regenerative clothing items) was discussed with stakeholders in a workshop, together with the question to the stakeholders to identify bottlenecks and opportunities around a possible transition to a more circular and sustainable clothing industry. The output of this workshop is presented as a list of identified bottlenecks and recommendations.

## 2. Additional questions about progress and 'readiness' (max 200 word, not for the website)

This section serves the investment theme to understand the development the project has undergone.

### Where you started

*Explain where the project started. E.g. was there already some foundation, or did you have to start from zero?*

A model of textile buying by consumers was already developed in 2022. This model was extended to cover the textile supply chain. New people (Van Paassen, Poldner) with experience in stakeholder involvement and connection in the textile industry were involved in the project to lead the stakeholder involvement. [48]

### Where are you now

*Compared to where you took off, where are you now? What progress has been made? What remains to be done when looking at where you intended to be with this project at the start?*

The stakeholder involvement has led to the identification of some concrete points (as listed in the results mentioned earlier). An additional positive effect is that the workshop brought together people who did not know each other and thus aided in capacity building for a sustainable transition. Unfortunately two of the three people involved in the modelling / programming have left during 2023, which has seriously hampered the model development. Nevertheless, the modelling work served its purpose in aiding the identification of factors for transitioning. [84]

### Potential and next steps

How do you currently assess the potential of your project to contribute to the materials transition? What are logical next steps to take it further?

The recommendations listed by the stakeholders in the workshop can serve as input for follow-up research and policy advice. In particular, a better overview of the available technical options for recycling and regenerative clothing and options for improving consumer awareness would be beneficial for researchers, stakeholders, and policy makers. Additional workshop could be organized to bring the current stakeholders and researchers into contact with more stakeholders and policy makers for a more direct transfer of the recommendations and to identify which recommendations can lead to actual policy actions and investments in new technologies on sustainable clothing.

### Innovation readiness

Where does the project/innovation stand in terms of *readiness*? Is this something that can be piloted or rolled out in the outside world, or is this something that needs some further development and (lab) testing before it can be piloted in society? Is it possible/meaningful to indicate an 'innovation readiness' level using the below scale? If so, how would you score your project idea?

I would put it around 4-5. There are several useful pointers, but further steps are needed to develop tangible technologies and relevant, executable policies to push the clothing transition.

Innovation readiness score	Innovation readiness level	Description
0	Idea	Genesis of the innovation. Formulating an idea that an innovation can meet specific goal.
1	Hypothesis	Conceptual validation of the idea that an innovation can meet specific goals and development of a hypothesis about the initial idea.
2	Basic Model (unproven)	Researching the hypothesis that the innovation can meet specific goals using existing basic science evidence.
3	Basic Model (proven)	Validation of principles that the innovation can meet specific goals using existing basic science evidence.
4	Application Model (unproven)	Researching the capacity of the innovation to meet specific goals using existing applied-science-evidence.
5	Application Model (proven)	Validation of the capacity of the innovation to meet specific goals using existing applied science evidence.
6	Application (unproven)	Testing of the capacity of the innovation to meet specific goals within a controlled environment that reflects the specific spatial-temporal context in which the innovation is to contribute to achieving impact.
7	Application (proven)	Validation of the capacity of the innovation to meet specific goals within a controlled environment that reflects the specific spatial-temporal context in which the innovation is to contribute to achieving impact.
8	Incubation	Testing the capacity of the innovation to meet specific goals or impact in natural/real/uncontrolled conditions in the specific spatial-temporal context in which the innovation is to contribute to achieving impact with support from an R&D.
9	Ready	Validation of the capacity of the innovation to meet specific goals or impact in natural/real/uncontrolled conditions in the specific spatial-temporal context in which the innovation is to contribute to achieving impact without support from an R&D.

Table 1: Innovation readiness levels as distinguished by Sartas et al, 2020.

### 3. Learning Journey (max 300 words)

We would like to understand a bit more about the process you went through, and whether and how being part of the investment theme Transformative Bioeconomies influenced your learning. We ask the project leaders to consult others when answering these questions.

1. Did your Wildcard project involve new collaboration with disciplines or people? If so, briefly explain what was new.

Yes. The wildcard team from 2022 on the 'never waste a good crisis' project got into contact with Kim Poldner and via her with many stakeholders who are active in reselling, recycling, and regenerative clothing. The discussions with these contacts have positively affected the modelling work as they led to better insights in the current developments in the clothing industry. Also, they made the team better aware there are multiple people and small companies who have a genuine interest in making this transitions, and who are not (primarily) motivated from making money.

2. If applicable, did the new collaboration alter your original thinking about the topic? Did it change research directions or courses of action? If so, briefly characterize how.

Yes, it did. The contacts with the stakeholders made the team aware of how actors in the clothing business operate, which led to model redesign. Eventually, the listed recommendations are (semi-)independent from the modelling work, which is not a problem, as the modelling was a good step to get an overview of the clothing business. The project has led to useful output.

3. Did interactions during community days and/or meetings organized by the investment theme alter your original thinking about the topic? Did such interactions change research directions or courses of action? If so, briefly characterize how.

The interactions with the stakeholders were very informative. Interactions on the community days with other researchers were helpful as well, but mostly to discuss technical options or to reflect on steps made in the project. The actual output and changes made to the project resulted mostly from interactions with the stakeholders.

4. Did you meet any challenges during implementation of your wildcard project? If so, what kind of challenges were these?

Technically, there were heavy discussions on the model development: What are realistic assumptions? What level of realism is required? What are realistic and relevant possible clothing production pathways? It proved also more challenging to get the team members on the same page than it was to get the stakeholders together and have them produce output. Another challenge was the departure of the main modeler (Hubert Fonteijn) halfway during the project and the departure of the member who got the initial team together and who played a major role in the conceptual modelling (Geerten Hengeveld).

5. If applicable, how were these challenges eventually addressed? Did activities organized by the investment theme contribute to overcoming challenges? If so, briefly indicate how.

We sped up the organization of the stakeholder workshop to have all modellers physically present and involved. A transfer of the modelling work was done before the departure of Hubert Fonteijn, while all transcript of the interviews with stakeholders were stored by the people from HHS.

6. Has your involvement in the investment theme resulted in any new initiatives or spin-offs that would probably not have emerged if you had not participated? If so, briefly indicate how these new initiatives came about.

I suspect we could have started some spin-offs with stakeholders, and we have had discussions on follow-ups. Because the modelling 'leg' of the work has essentially disappeared – which is the core activity of the primary author, George van Voorn – and I have had little time to pursue things in this direction, this has not materialized.



## 4. Additional project specific deliverables

Copy-paste the deliverables provided in your submission document and explain how you have met these deliverables. If deliverables could not be reached, please explain.

The following deliverables were envisioned:

- 1) Model specification, including the exploration of basic model behaviour, and identifying main transition triggers from literature and together with domain experts; [DONE, SEE ANNEX]
- 2) The organization of two workshop sessions with the elicitation of textile experts and stakeholders for the development of the model (set) as well as analysing the plausibility of triggers and barriers for transformation options towards renewable textiles informed by modelling results; [DONE, ONE WAS HELD IN UTRECHT ON 11 MAY, 2023, AND ONE AT WUR ON 22 JUNI, 2023]
- 3) A paper manuscript on the methodology, model (set), and identified transition options. [NOT DONE, AS THE PRIMARY MODELLER AND THE CO-MODELLER BOTH LEFT WUR DURING 2023]

[Additional deliverables proposed when submitting the Wildcard project](#)

Copy/paste from proposal

N/A

[Status of each project specific deliverable](#)

Please report the status of each deliverable.

See above.

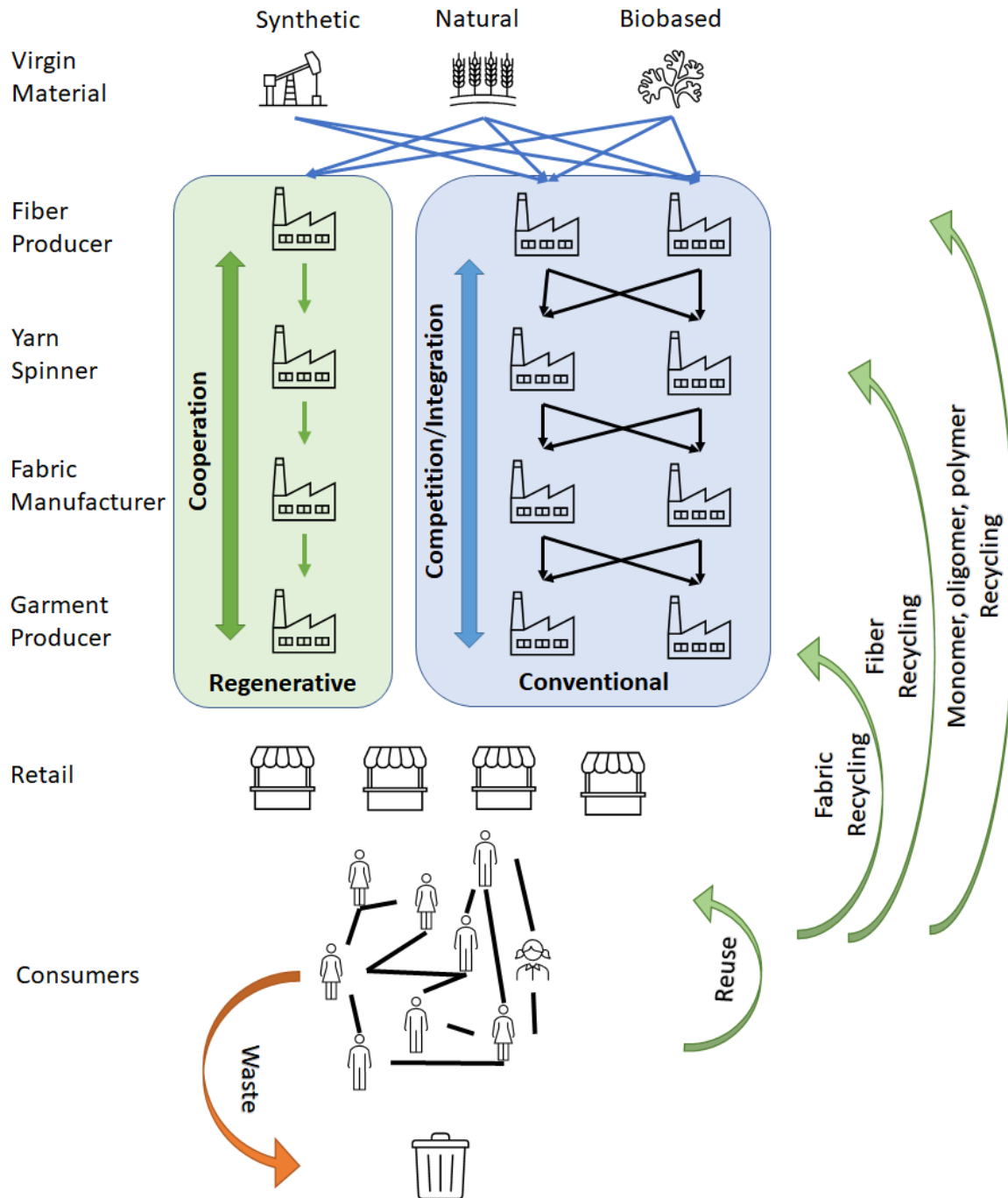
[Links to or copies of deliverables](#)

Please provide links to or copies of deliverables below. You may insert them as Annexes in this document.

As Annex below.

ANNEX of DELIVERABLES  
 GRAPHICAL OVERVIEW OF THE MODEL

### Fashion supply chains



## MODEL DESIGN PRINCIPLES of the AGENT BASED MODEL

Purpose and patterns:

Current fashion supply chains are linear and not optimized for reuse of materials in the broadest sense. They therefore require continuous supply of virgin material, which puts pressure on land use, fossil fuels and water reserves, while emitting a substantial part of our CO2 budget. Sustainable fashion supply chains:

1. Use materials and production methods that minimize pollution and (material) resource broadly and CO2 emission more specifically
2. Promote reuse of clothing items to increase their life span and reduce the demand on newly fabricated clothing items
3. Enable recycling at various levels of product/fibre integrity to reduce the demands on virgin materials and make waste streams as useful as possible.
4. Promote fair pay and safe working environments across the supply chain.

In conventional supply chains, each supply chain actor is still confined in their actions to their own level of operation. The interaction between supply chain actors is mostly market-driven and competitive, which promotes the commodification of material, intermediate products and the eventual clothing items at every level of the supply chain.

Regenerative fashion producers face a number of challenges in competition with conventional fashion producers:

1. Price: Regenerative production is probably more expensive at each supply chain level, even if economies of scale are discounted.
2. Scale: Regenerative production is niche, which precludes economies of scale
3. Integration: a clothing item can only be claimed to be regenerative when this principle has been applied along every level of the supply chain. This is especially true when maximizing the potential for recycling, since this requires collaboration and communication between supply chain actors at different levels to know the materials that went into a clothing item that is to be recycled and to determine the optimal method of recycling.
4. Consumer awareness: Even consumers that are sensitive to the environmental and societal impact of their wardrobe are often insufficiently aware of the alternatives to conventional clothing.

However, regenerative fashion also offers benefits and opportunities to both consumers, retailers and other societal actors:

1. Durability: Regenerative products are often made to last, which reduces the need to buy clothing items.
2. Repairability: Some regenerative producers offer reparation options, again increasing the lifespan of a clothing item

3. New business models: More focus on durability affords new business models, for instance fashion as a service (FaaS/CaaS). Here, one could offer clothing for rental/as a subscription.
4. Development potential: Increasing the living standards of workers in the fashion industry (often in Low and Middle Income Countries) increases the opportunities for their families and broader community.

It is unclear what the appetite is of consumers to buy regenerative clothing and at what premium above conventional clothing they are willing to buy. But even taking consumer demand as a given, it is unclear under what circumstances an ecosystem of regenerative clothing producers can emerge. Given the fact that the chain to get from raw material to clothing items should ideally be regenerative at every step, this requires both investments at each individual level and integration across levels. The purpose of this Agent-based model is to understand under which circumstances such integration can occur to successfully compete with conventional clothing items, given a consumer demand (and willingness to pay a premium) for regenerative clothing.

Model properties:

Agents

- Consumers
  - Preference for Sustainability (expressed as the premium a consumer is willing to pay for sustainability)
  - Budget
  - Item bought in this iteration (Boolean)
- Clothing item
  - Sustainable (Boolean)
  - Production stage
  - Price
- Producer
  - Production capacity
  - Premium required for operation
  - Conventional/Sustainable producer (Boolean)
  - Number of items sold in this iteration
  - Number of years that were unprofitable
- Here, we deliberately ignore (mainly for reasons of simplicity):
  - retailers and other actors (distributors, warehouses, policy makers) that can influence clothing supply chains to focus on the formation of regenerative fashion supply chains at the producer side.
  - Investment costs for producers to switch to sustainable production

We assume:

- Producers can be hatched and die

- They die when they are X years unprofitable (meaning selling only Y % of their production capacity)
- Random producers get hatched (with fixed production capacity and random sustainability and production margin) at the start of each production cycle
- This implements the optimization that normally would happen within a producer (sustainable or not, what production margin) as a search across producers

#### Collectives

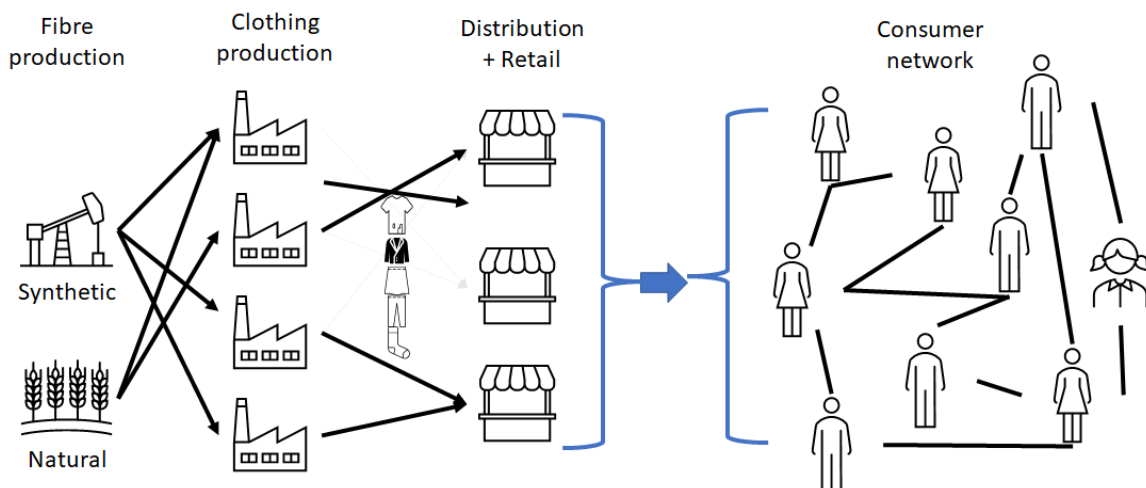
- Consumers form networks such that they can change their preferences
- Producers form chains within the supply chain by their trade relationships, i.e. the producers at different supply chain levels from whom they buy and to whom they sell. We define a supply chain as complete when the chain covers all levels of production (from virgin material to clothing item ready for consumption). We define mini chains as incomplete chains. The formation of mini chains and complete chains is the subject of study for this model.

#### State variables

- Number of consumers able to buy clothing items
- Number of consumers buying sustainable clothing items
- Price of conventional/sustainable clothing items

#### Process overview:

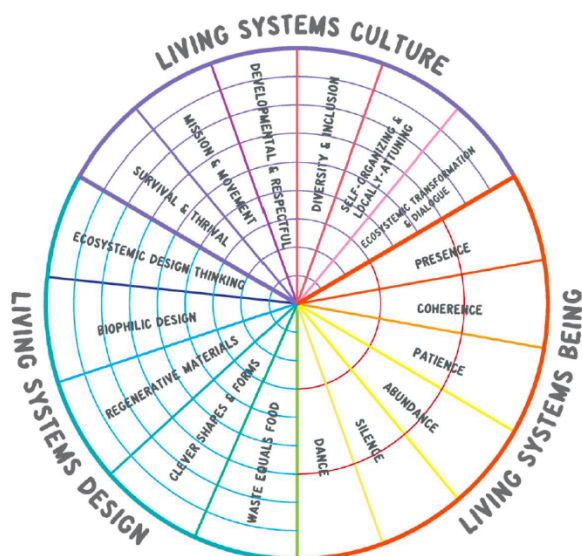
## Current fashion supply chain 1.0



1. Initialize clothing items (at the first production layer)
2. Production, at each layer
  - a. Select producer at random
  - b. For this producer select the cheapest clothing item in the previous layer that corresponds to their preference.

- c. Add production margin to price clothing item
  - d. Advance production level of clothing item by 1
  - e. When clothing item is sold to next layer, keep track
3. Consumption:
- a. Select consumers in order (descending) of budget
  - b. Find cheapest sustainable clothing item
  - c. If the priceclothing item < budget AND priceclothing item < pricethreshold, sustainable
    - i. Buy sustainable clothing item
      - 1. Set # clothing items sold of corresponding producer +1
      - 2. Set Item bought in this iteration to True
  - d. Else
    - i. Find cheapest conventional clothing item
    - ii. If priceclothing item < budget
      - 1. Set # clothing items sold of corresponding producer +1
      - 2. Set Item bought in this iteration to True
4. Eliminating producers
- a. All producers with number\_iterations\_unprofitable > U
    - i. Die ## They go bankrupt
5. Hatching new producers
- a. At each layer hatch V new producers with randomly distributed sustainable/conventional production and randomly distributed margins (conventional and sustainable production margins shouldn't overlap too much)

DNA WHEEL USED TO ALIGN STAKEHOLDERS:





## Outputs from break-out groups:

PRESENCE

CAN I BRING ME TO MY WORK  
IS IT DEPENDING ON COUNTRY CULTURE  
TYPE OF COMPANY?  
THE TYPE OF WORK ALSO ATTRACTS CERTAIN PEOPLE  
BUT THE WORK ASKS PART OF ME; I USE OTHER PARTS  
IN OTHER TH

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HOW DO BRING CALM INTO AN ORGANISATION?  
COUNTRY DIFFERENCE IN INDIA OVERWORK IS HONOURED.  
IN JAPAN IT HAS A TERM

IN CULTURES THERE IS DIVERSITY: WE MAY LEARN FROM OTHER  
COMPANIES AND LISTEN AND SEE HOW IT FITS YOUR SYSTEM

NOT ALL PERSONALITIES ARE ABLE TO LET GO. OR IS IT ABOUT  
THE COMPANY TO TRUST & LET GO

AS LEADER / COMPANY OWNER I CHANGED DOING YOGA, AND NOW IN THE  
LINNEN GROUP THE ATMOSPHERE IS DIFFERENT

DO WE NEED TO LEAD? I PREFERRED FACILITATION BUT MY BOSS TOLD  
ME TO LEAD, BUT IT DOES NOT FIT HE EVERYBODY IS DIFFERENT

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DO YOU NURTURE RELATIONSHIPS

COHERENCE

WHO ARE WE INTERNALLY. AND DO WE ALIGN  
HOW TO CREATE? BEING TOGETHER, SHARING, SOCIAL  
WE FACILITATE CONVERSATIONS TO ALIGN  
COMMONS; SELF ORGANISING, SELF LEARNING GROUPS  
IN A BIG COMPANY YOU LOOK FOR A SPECIFIC PERSON; NOW SOMEONE  
COMES TO US AND WE SEE HOW WE CAN ALIGN  
CRITICISED BY THE BOARD, AS I ALIGNED WITH THE TEAM  
AS 'THIS IS NOT BEST FOR THE COMPANY'. IT IS ABOUT TIMING, AND  
WE NOW WE TEAR UP BUT MAYBE IN FUTURE WHEN WE ARE BIG  
WE LOOK FOR SPECIFIC PEOPLE

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PATIENCE (IN DECISION MAKING)

I WANT TO, BUT I AM NOT  
MODELER/FARMER: PATIENCE CAN MEAN NOT GOING WITH THE ENERGY  
BUT INDEED YOU NEED TO SLOW DOWN TO REFLECT.  
WHEN WE ALL RUN WE DO NOT NOTICE / LISTEN  
BUT IT REMAINS A PITFALL

TO HAVE SUCCESS, YOU HAVE TO BE A BRUTAL DISCIPLINE FOR YOUR  
OWN WELL-BEING FOR THE (MORNING HOURS) TEAM!

AS WE CANNOT DO EVERYTHING IT HARMS BUT WE NEED THIS FOR OURSELF

ABUNDANCE

- YOU NEED WIN-WIN-WIN? WE HAVE TO GET AWAY WITH COMPETITORS
- BUT HOW MUCH DO I SHARE? PROTECT? DO THEY SHARE?
- TRUST CAN COME IN TIME
- 'FREE FAIR ONE LIFE' BOOK ON THE COMMONS: WE CAN SHARE  
BUT BE CLEAR ON THE BOUNDARIES
- THE UNIVERSITY IS VERY INDIVIDUAL, INTERESTS, HARDLY TEAM WORK.

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SILENCE PART IN YOUR DAY & INTERACTION

TALK TO BRING DOWN STRESS OR WALK  
WALK HELPS TO CHANGE THE MIND

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DANCE, GOING WITH THE FLOW

AS LINNEN PROJECT YOU HAVE TO GO WITH PROCESS, THE SEASON  
HOW SEASON AFFECT BODY & MIND; TUNE IN ON ENERGETIC SEASONS

FOR ME SUMMER DRAINS ENERGY, I TRY TO WORK WITH IT BUT I ASK  
OTHERS AT TIMES TO TAKE OVER.

MARTIN KNOWS: IT CAN BE THAT SEASONS ARE IN THE COMPANY, AND YOURSELF  
INSPIRATE SPIRAL

WHAT TO IMPROVE? WHERE TO COLLABORATE?

Living System Design

$W = f$

- Post-consumer textiles recycled
- Partners / collaboration for non-waste generated
- Sharpshop

Clever SHAPES & FORMS:

- Sheep wool into felt → water resistant, fire resistant, anti-bacterial
- Paper packs → achieve self-repairs / heals

Req. Materials:

- Official collaborations, e.g. RSL to guide choices & Research
- Focus on less synthetics
- Struggle between wanting to 'reuse' & knowing original materials not 'regenerable'

Biophilic Design:

- Bringing nature inside → plants

Ecosystemic Design Thinking:

- Considered but difficult to implement
- Most practices & actions taken with the goal of improving the ecosystem
- LCA important to quantify & track progress

## Important observations from the notes in the workshop:

- Many consumers and producers are focused on monetary goals (as one would expect). Even as a company driven by other values, money is always a realistic limitation that has to be kept in mind. However, it is not the end goal, but a means to the end;
- It was mentioned that word usage itself is restricting mindsets. E.g., 'supply chain' implies a linear process from resource to waste, while we should talk of networks or something like that to reflect the circularity;
- It would help if consumer mindsets would change. It was not specified how this could be achieved (which is where the ABM work and the collaboration with Sophie could come in).

- An important remark was that it is believed that many stakeholders operate on deep intrinsic psychological impulses and cannot be swayed by social interactions (my comment: I think that agent diversity plays a role, and while some are driven primarily by internal impulses, others are affected more by social interactions and reflecting to the actions of others);
- Consumers intrinsically stay away from tension (there is a name for this principle that people resolve internal conflicts by, e.g., changing their behaviour or their internal values). It would help if such internal conflicts could be lowered;
- It would help if there was more legislation in place aimed at this (this was also mentioned in the Wageningse Berg session on April 11, 2023; note from myself: policy often does not achieve the intended purposes, which is one main reason of working with ABM);
- BUT... The present stakeholders and others they know of are intrinsically motivated to follow other objectives, and even quite strongly. Some are driven by the value they want to do something for the planet, or that it is nonsensical to simply produce larger and larger quantities for no obvious purposes (it was even described as a type of addiction to produce and consume more and more cloths). Others try to change the company from within;
- Being a small company is not necessarily an issue. The big companies do not see you as a threat.
- Stakeholders believe in showing by example. There is no point in trying to change the system from the outside-in, as it will never happen. It is impossible to compete with the companies that produce 100,000's of similar clothing items. Change will only occur through individuals who persist and then function as beacons. The stakeholders felt their mission was to convince others that money (alone) is not the prime objective and that other values can and should be followed. It is easier to start anew than to try and compete with settled companies;
- It was mentioned that many traditional companies “have no guts and go for the risk-free options”. Change is “scary”, and decisions are based on calculated risks and avoiding risks;
- Many of the present innovative companies make use of some type of LCA (most people referred to Anton Kool? of, I think, Radboud University??), but exact quantification is difficult (I would also argue it is unnecessary);
- The ideal goal would be to have no waste but to have a fully regenerative system in which fibres are reused and recycled and in this way we can even regenerate the global system a bit (personal note: I think this is not achievable due to entropy, and in fact many of the stakeholders also did not believe that a 100% efficiency can be gained).

#### Important bottlenecks:

- Costs of labour: many companies operate cross-border while these companies try to keep it local, but labour costs are excessive;
- Traditional companies have scaled up to a scale that cannot be achieved by these new companies;
- Current legislation is not sufficient to help make a transition;
- The consumer market is problematic: too many consumers are considered to be ‘addicted’ to buying more and more, and driven by deep internal motivations

#### Potential rough suggestions for improvement:

- More connections are needed. The workshop was considered useful by several of the participants because they did not all know each other. They also enjoyed the WUR setting (and they do not know everything either);
- More legislation is needed around the reuse of materials and banning of non-natural resources, polluting toxins, etc. (these policies would need to be tested for efficacy);
- More thinking in terms of ecosystem Planet Earth and ecosystems of companies and consumers with recycling and regeneration rather than optimized supply chains in mind. This must be achieved by education;
- Resolve internal tensions for consumers and producers. This could be achieved by showing by example, which would need to be scaled up. We need ways of gaining more attention of consumers and producers and convincingly demonstrate to them a more regenerative, circular approach is not only achievable but actually can thrive. One particular way that was mentioned was that people should be made aware of looking for happiness and wellness rather than consumerism, and that you don't need to buy new cloths all the time to achieve your personal happiness;

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