transiti✳ns

D3.2. Technology, Sustainability & Industry Toolkit
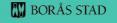
Modacc

FAB LAB BCN   Iaac

BORÅS STAD

Research group
Fashion & Technology   Amsterdam University
of Applied Sciences

U ELISAVA

Nordiska
Textilakademin

NEXT
TECNOLOGY
SOCIETÀ NAZIONALE DI RICERCA E L

N8F
New Order of Fashion

Città Studi
BIELLA

po.in.tex

D3.2 Technology, Sustainability & Industry Toolkit

Transitions Project

Transitions Project	
Project ID	ERASMUS-EDU-2021-PI-ALL-INNO
GA Number	951192
Delivery Title	D.3.2 Final Technology, Sustainability & Industry Toolkit
Leader	Amsterdam University of Applied Sciences – HvA
Type	Report
Dissemination Level	Public
Delivery date	June 2024

REVISION HISTORY

Version n°	Date	Description	Contributors
V0		Draft	Troy Nachtigall, Ineke Siersema, Francesco Sollitto, Pamela Nelson, Merunisha Moonilal, Shannon Riegstra (HvA)
V1	07/06/2024	Prefinal	Troy Nachtigall, Ineke Siersema, Francesco Sollitto, Pamela Nelson, Merunisha Moonilal, Shannon Riegstra (HvA)
V2		Revision	All Partners
V3	23/06/2024	Final Version	All Partners

Table of Contents

1. Executive Summary

Deliverable 3.2 offers a easy to use toolkit for trainers and practitioners to adopt Technology and sustainability for the Transitions in Fashion and Textiles. This project is co-funded by the European Union, which has set a vision for the future in textiles with the EcoDesign for Sustainable Product Regulation. This toolkit aims to have a significant and organic impact by providing practical resources and methods to support the ongoing improvement and innovation of the fashion and textile industries.

This report details the Toolkit and its design, creation, validation, redesign, recreation, and re- validation. The toolkit (and Transitions Project) use Design Thinking and the [double diamond method](#) to help designers, students, and companies boost the transition of the textile and fashion sectors towards a circular economy by leveraging design and lean methods and processes, along with economic models like the business model canvas.; all addressing the [Textile Transitions Pathway](#) initiative by the European commission. The toolkit is intended to help participants describe their current company (or concept), evaluate technology/sustainability use, and understand possible implications of it for innovation, sustainability, and the business model.

The toolkit detailed in this report is built upon an international process of mapping technology and sustainability tools currently used (Work Package 2); this was enhanced with design methods for the Textile & Fashion transformation into a circular economy. Through interviews, literature reviews, and partner co-design action research, an initial Loopholes toolkit was designed and tested in experimental workshops in partner countries and a partner workshop in the Netherlands. Innovative entrepreneurial startups from the sectors were invited from all over Europe, and the capacity of the toolkit to help build companies and organizations that are innovative, sustainable, and circular was verified. Building upon the experiences of students at VET and HEI levels through several testing sessions of the first version of the toolkit, the toolkit was expanded to embody the complexity of the field while making the toolkit inclusive for many kinds of students and entrepreneurs. This report details the collaborative development by the Transitions partners of the various aspects of the Toolkit, including the Modes of Play, Canvas, Cards, multifaceted Journey Canvases, Instructions, and the Loopholes Toolkit and Transitions website.

We made great efforts to include recent developments, such as the adoption of EcoDesign for Sustainable Product Regulations (ESPR) by the European Commission and the Textile Transitions Pathways stakeholder event on June 4, 2024, in Brussels. The toolkit was deeply aligned with these initiatives from the beginning. Still, as the legislation is an ongoing co-design process, there may be a need for future alignment with EU legislation. However, significant care and attention care and attention were given to these ongoing developments to make the sectors innovative, sustainable, and successful.

2. About Transitions

This report is part of work package 3 (WP3) of the **TRANSITIONS Erasmus+** project. TRANSITIONS is a strategic alliance for innovation formed by research and technological centers, Vocational Education and Training (VET), Higher Education Institutions (HEI), public policy actors, SMEs, and sectoral organizations from Spain, Italy, The Netherlands, and Sweden. The aim is to nurture the textile and fashion (T&F) transition to a 4.0 system and a circular economy by developing new learning methods, tools, and practices to help students, young designers, and professionals face real challenges.

The objective is to create collaborative, real-life-based training in which the different actors in the value chain work on using technology to generate new value propositions and new business models within a circular service economy.

Transitions propose a multidisciplinary pedagogical approach based on transition design theories and emerging disciplines and practices at the intersection of textiles, biology, economics, and digital fabrication.

2.1. General Transitions Objectives

To foster new, innovative, and multidisciplinary approaches to teaching and learning, innovation in education design and delivery, teaching methods, assessment techniques, learning environments, and new skills development, facilitating the flow and co-creation of knowledge between higher education, vocational education, and training, research, the public sector, and the business sector.

Create a modular training program based on Industry 4.0 for a new T&F circular system.

Set up innovation-focused training modules based on actual practice and challenges (Transition Labs) to skill, reskill, and upskill students and professionals.

Develop new ways to generate innovation in textile and design processes, production, and commercialization.

3. Deliverable Objectives

The main goal of this deliverable is to provide a clear description of the toolkit and evaluate the collaborative development process of the Loopholes Toolkit by explaining all the steps taken to finalize it. A further aim is identifying potential tasks for upcoming project development and research plans. After completing deliverables 3.1 and 3.3, the draft version of the toolkit, in January 2023, this report describes the toolkit and details the steps taken to achieve this deliverable 3.2, the final version. The overall process can be seen in the visual management plan in Figure 1.
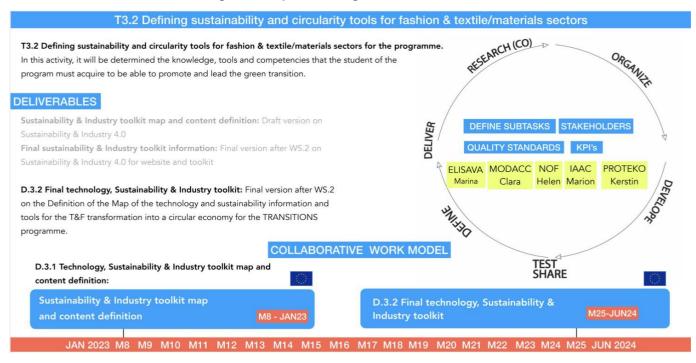
Figure 1 Deliverable 3.2 from the Visual Management Plan for Transitions

4. The Technology, Sustainability & Industry Toolkit

Over two years, a toolkit was developed to help trainers and participants make their fashion and textile organizations more sustainable and technological. These were closely aligned with the EU Commission for the Transitions Pathways goals for the Textile sector. We followed a co-design process similar to the Textiles Ecosystem Transition Pathway co-creation and co-implementation process. We found comparable results in our process and strategies similar to those of their co-design process. That this research was performed simultaneously is confirmatory for each project.

The toolkit was named Loopholes because it helps companies find opportunities within the challenges of Sustainability and Digitalization, addressing new EU objectives such as the Corporate Sustainability Reporting Directive (CSRD), Textile Labeling Requirements (TLR), Waste Framework Directive (WFD), Pact for Skills - Textiles (TCLF), Market Surveillance Regulation (MSR), Digital Product Passports (DPP), Extended Producer Responsibility (EPR), Chemical Strategy for Sustainability (CSS), EcoDesign for Sustainable Products Regulation (ESPR).

The Loopholes toolkit comprises 50 strategies categorized by Digitalization, Sustainability, Business & Finance, and Stakeholder Engagement. These Strategies and categories were co-created with participation from project partners, local partners, academic literature, industry surveys, and expert interviews. The toolkit was tested and refined with entrepreneurs, companies, and students from many levels in the Netherlands, Italy, Spain, and Sweden. The process of creating the toolkit is detailed in sections 0 and 6.

4.1. Strategy Cards

The 50 developed strategies are presented as a series of cards, each supported by an online resource page containing detailed information, literature, and case studies. Each card includes a prompt question to help students or companies consider how the strategy can be applied. The questions are tailored to two levels, VET and HEI, ensuring the strategies are accessible to a wide range of individuals, students, and companies, which has proven necessary and challenging throughout the testing.

4.1.1. Digitalization

The digitalization strategies are Personalization, Virtual Fashion, Digital Production, Digital Product Passports, Technographic Web-Tracking, Digital Twin, Blockchain and Unique ID technologies, Advanced Sorting Technologies, Wear and Tear, AR Try-on, Data Science Artificial Intelligence and Machine Learning (DS, AI, and ML), Digital Worlds seen in Figure 2.

Personalisation

Digital Manufacturing allows for the creation of custom-fit clothes and a personalized fashion experience using data from social media, 3D scanners, and online profiles. These can be tailored to fit the wearer's body size, personal style, social role, or wardrobe needs.

VET: How can we use information about people to make clothes that fit them perfectly?

HEI: What information from data sources can be used to make clothing and textiles that match personal preferences and needs? What are the risks of using that data?

DIGITALIZATION

Virtual Fashion

Making virtual clothing and textiles (in programs like Clo3D, Browzwear, Blender, or Optitex Lectra) can facilitate fitting, sharing, or entirely digital fashion. Fewer physical garments are needed, and users can even wear the garments digitally.

VET: How can creating clothes digitally on a computer change the way we wear and share fashion?

HEI: In what ways can virtual fashion and textiles be better than traditional methods in design, production, fitting, and use?

DIGITALIZATION

Digital Production

Advanced digital manufacturing technologies such as 3D printing and computer-controlled machines (spinning, cutting, sewing, knitting, weaving, dyeing, pressing, coating, logistics) streamline the fashion process, enabling innovative and sustainable textile creation and modification.

VET: How can new machines and technology like 3D printers change the way clothes are made and worn?

HEI: How can advancements in digital manufacturing technologies revolutionize the fashion ecosystem workflows and value chains?

DIGITALIZATION

Digital Product Passports

Digital Product Passports provide transparency on garment origins, including material sources, environmental impact (water, energy, carbon), and manufacturing locations, facilitating transparent information practices.

VET: How can tracking where and how clothes are made help us recycle and reuse them better?

HEI: How can the implementation of Digital Product Passports enhance trackability and traceability of garment life-cycles, supporting the transition to a circularity?

DIGITALIZATION

Technographic Web-Tracking

Everything we do on the internet creates information that is recorded and often retained as data. Digitalizing fashion and textile processes over the internet creates new opportunities for data science. Small data about the time, place, and frequency of interactions can tell us many things about the stakeholders and our business model.

VET: How can people's information from the internet help us make it more sustainable?

HEI: How can data collected from stakeholders digital activites be leveraged to create circular fashion systems and comply with new EU reporting requirements like CSRD?

DIGITALIZATION

Digital Twin

A digital twin is a digital model of a physical product, process, or system. In fashion, this could mean a detailed, dynamic 3D model (or, more often, a data model) of a garment, factory, store, entire value chain, and/or the interaction of many value chains. This helps us understand how product/service eco-systems are working at a practical level

VET: How can making a virtual copy of clothes or factories help us understand and improve fashion production?

HEI: How can the use of digital twins in fashion ecosystem improve efficiency, sustainability and collaboration?

DIGITALIZATION

Blockchain and Unique ID technologies

Tracking every garment and who is wearing it is a complex process. Web3 uses Blockchain technology to create decentralized systems that log data about the life-cycles without central authorities, promoting stakeholder empowerment.

VET: How can blockchain technology help track and trace garments, ensuring fairness throughout the fashion value chain?

HEI: How can blockchain and decentralized technologies be integrated into the fashion ecosystem, and what impact will transparent ownership have on fashion ecosystems?

DIGITALIZATION

Advanced Sorting Technologies

Sorting clothes for reuse and recycling is a difficult process, often with more than 300 categories. New technologies like visual identification AI can be used to help sorters identify and sort materials into recycling and reuse by material and brand. Using phone cameras, wearers could be encouraged to dispose their clothes at an optimal time.

VET: How can using new technology to sort and recycle clothes make recycling easier and better?

HEI: How can visual identification technologies improve the fashion ecosystem processes and encourage sustainable behavior?

DIGITALIZATION

Wear and Tear

As worn garments come back to the brand under the EPR, wear and tear on these clothes can provide valuable data about use, consumption, and the wearer's habits. For example, an iPhone has a 3D scanner that can scan your garment and compare it to the original factory scan to see what has changed.

VET: How can we set up places to fix and repair clothes that look at how jeans age and wear out?

HEI: How can integrating wear and repair photos help businesses promote sustainability, repairability and circularity? What are the initial challenges in implementing such systems?

DIGITALIZATION

AR Try-on

Augmented Reality (AR) for clothing and textiles can bridge the gap between digital and physical retail by using phones, VR and computer cameras to create a realistic virtual representation of a product over the users body in real-time for physical and digital fashion.

VET: How can using Augmented Reality (like trying on clothes with your phone) make fashion more fun and useful?

HEI: What are the potential benefits and challenges of implementing Augmented Reality technology in the fashion mnufacturing, retail, use, or recycling?

DIGITALIZATION

Data Science, Artificial Intelligence, and Machine Learning (DS, AI, and ML)

DS, AI, and ML play a crucial role in Fashion ecosystem processes. From image generation for design, user profile creation, business systems, and production optimization; DS, AI and ML have been a powerful tool. They can support sustainability by analyzing images of you to understand what is in your wardrobe to help companies understand what to make or connect you with existing items.

VET: How can DS, AI and ML help make fashion more eco-friendly and reduce waste?

HEI: How can DS, AI and ML predict demand for sustainable fashion, cut waste in production, and boost eco-friendly material use?

DIGITALIZATION

Digital Worlds

Digital worlds merge virtual platforms where creators trade digital clothing and fabric patterns (often as NFTs), blending fashion and gaming for avatar customization and immersive experiences. The goal is innovation, waste reduction, and new creative avenues, with fashion brands, designers, and tech firms like DressX and The Fabricant lead this innovation.

VET: How can digital fashion platforms boost creativity and help the environment in Fashion?

HEI: What role do NFTs and other unique identifiers play in transforming the fashion and design industries, especially in virtual and gaming worlds?

DIGITALIZATION

Figure 2 The Digitalization strategy cards co-designed for the Loopholes Toolkit

4.1.2. Sustainability

The sustainability strategies are EcoDesign, Biobased, Environmental accounting, Extended Producer Responsibility (EPR), Design for Disassembly (DfD), Collaborative Consumption, Waste Reduction, Regenerative Fashion, Closed Loop Water and Renewable Energy, Design for Repairability (DfR), Sustainable Packaging, Post-Use Materials seen in Figure 3.

EcoDesign

EcoDesign is a design approach that considers the entire life cycle of a product, from its conception to the end of its useful life, with the aim of minimising waste and environmental impact. EcoDesign includes a synthesis of innovative design strategies, sustainable material choices, and comprehensive end-of-lives management.

VET: How can you ensure that a T-shirt is environmentally friendly and does not harm the environment during design, production, use and when you no longer need it?

HEI: What strategies are needed to ensure an approach that considers entire life-cycles of a product?

SUSTAINABILITY

Biobased

Biobased material are considered sustainable depending on many factors, including recyclability and how they are made and how they can rejuvenate clothing. Biomaterials are considered circular when they can decompose into the ecosystem or can be easily recycled/reused.

VET: How can you change to a biobased materials?

HEI: How can you create a system that restores clothing in use by biorejuvinating the material or coating?

SUSTAINABILITY

Environmental accounting

Recording a comprehensive set of environmental indicators, such as water, energy, carbon, chemicals, land use, air pollution. This will pave the way for CSRD compliance and needs to be developed to assess the impact of product service lifetimes.

VET: What information do you need (including from suppliers) to understand how many resources are used?

HEI: Does a Life Cycle Analyses of environmental accounting support the adoption of new materials compared to mainstream or curent practices?

SUSTAINABILITY

Extended Producer Responsibility (EPR)

EPR requirements ensure that producers are responsible for post use waste and recycling as well as pre-consumer waste (unsold production). When done using a product, users take them back to the place they were purchased for reuse and recycling. To close the loop and reduce this fiscal load, companies need to devise processes that facilitate repair, re-use and recycling of their products from the beginning.

VET: How would you reuse the materials of the things that you make?

HEI: How can you create long use materials that are easy to recycle when they return to you, often seven years from now?

SUSTAINABILITY

Design For Disassembly (DfD)

DfD requires designing the recycling phase while designing the garment product or system. Thingking about the End-of-lives first improves the chances of the textile being recycled or upcycled instead of being trashed. Melting stitching yarns and hand removable metal findings are examples.

VET: What could be changed in your project to enable disassembly?

HEI: What technologies can be used to make it easier to disassemble your product and salvage the materials?

SUSTAINABILITY

Collaborative Consumption

In collaborative consumption, users minimize the negative impact by sharing, swapping and exchanging clothes. This extends the use phase of garments and reduces the need for new clothing. Companies can engage resale, rental and remake platforms to reduce the overall consumption.

VET: How could you share your wardrobe with someone else?

HEI: What kind of services could you provide to promote this alternative business model?

SUSTAINABILITY

Waste Reduction

Waste is generated in multiple stages during the loopholes process: cutting, sewing, dyeing, finishing, washing, and more. Strategies like Zero Waste Pattern Cutting limit waste from the process.

VET: How can you design clothing that minimizes waste from the outset of the design process?

HEI: Which step in the value chain is generating most waste and how can you minimize the waste?

SUSTAINABILITY

Regenerative Fashion

Regeneration embodies practices that give back to people and planet. Examples include cultivating bioregional materials using crop rotation and intercropping to improve soil health. Another example is creating product-services that embody indigenous or ancestral knowledge (such as ways of making, materiality, and land management practices) directly with people from those communities, providing meaningful work.

VET: How do you make clothing that makes another system better?

HEI: What does your system look like from ground to wardrobe and back again?

SUSTAINABILITY

Closed Loop Water and Renewable Energy

Closed-loop water systems recycle and reuse water in production and use, conserving resources and pollution. Renewable energy uses sources like solar or wind power, reducing fossil fuel use and environmental impact.

VET: How can reusing water and using renewable energy like solar help make fashion better?

HEI: How can the integration of closed loop water systems and renewable energy sources in the fashion ecosystem contribute to sustainable production practices and reduce environmental impact?

SUSTAINABILITY

Design for Repairability (DfR)

Making somthing that it is easy to repair is an artform. Extended Producer Responsibility (EPR) requires repair (or recycling) of garments by the brand who sold it. Designing for the repair of the garment from the beginning makes the process easier and reuse/resale possible.

VET: What can you change in your current clothing to make it more repairable?

HEI: How can you Design for Repair (DfR) in a circular process? How might that change if seven years pass for the garment to go back to the company?

SUSTAINABILITY

Sustainable Packaging

Alternative solutions for packaging including biobased or recycled materials, increase the reuse of packaging, while minimizing the impact for example by reducing the amount and impact of packaging used.

VET: How can you make packaging that creates less waste?

HEI: How can you change your logistics in terms of procurement or packaging processes?

SUSTAINABILITY

Post-Use Materials

Post-use materials are textiles and garments that have finished their initial use. These textiles are recycled or upcycled to create new products, promoting a circular economy.

VET: How can we use old clothes and materials to make new things instead of throwing them away?

HEI: What are the challenges and opportunities associated with integrating post-use materials into new fashion products, and how can designers overcome these to support a circular economy?

SUSTAINABILITY

Figure 3 The Sustainability strategy cards co-designed for the Loopholes Toolkit.

4.1.3. Business and Finance

The business & finance strategies are Building Product-Service Ecosystems, Textile Labelling Requirements (TLR), Developing Competencies, Economic Resilience, Life-Cycle Costing, Market(ing) Opportunities, Circular Loyalty Loops, Person To Person (P2P), Re-positioning, Circular Revenue Model, Technology Readiness Levels / Society, Technological Dependency, On-Demand Production shown in Figure 4.

Building Product-Service Ecosystems

An ecosystem is composed of a range of companies, organizations, governments and other systems that support each other. This could be companies who provide yarn, textile (finished goods), confectioning, retail, brand, recycler, or legislators and the users themselves. Large companies silos are often ecosystems within themselves.

VET: How can you change (add or subtract) partners to make your product-service ecosystem more circular?

HEI: How can you engage the user or government to extend your ecosystem and be more circular?

BUSINESS & FINANCE

Textile Labelling Requirements (TLR)

New laws such as the Textile Labeling Requirements provide information that creates new opportunities for future repair and recycling along with the sharing understanding with all the people involved in the textile process (Stakeholders).

VET: How can you provide clear information for the person who will be repairing or recycling the garment seven years from now?

HEI: How can you design a system that allows for future changes within the system (legislation, new materials, prodution processes) that do not exist yet (futureproof)?

BUSINESS & FINANCE

Developing Competencies

Developing competencies involves identifying, training, and enhancing key skills and knowledge areas vital for the fashion industry, such as circular design, AI trend analysis, sustainable ecosystems, advanced supply chain management, digital marketing, and emerging digital technologies.

VET: Why is it important for people in the fashion ecosystem to keep learning new skills?

HEI: How can a systematic approach to competency development enhance organizational performance in your fashion system?

BUSINESS & FINANCE

Economic Resilience

Companies usually rely on external funding, meaning investments are mostly covered by institutional banks or other investors. However, this makes companies less willing to take risks and more vulnerable (liable) to economic issues.

VET: Can you think of alternative ways of financing entrepreneurial risk (e.g. crowdfunding, or sharing risks with others)?

HEI: How has the financial landscape changed in the last few decades, and how does it impact your organization today and in the future?

BUSINESS & FINANCE

On-Demand Production

Each phase of the fashion and textile process is often made to a future forecast. On-demand production waits until the order is placed, making the textile or garment to order. This can be done in micro factories geographically close to the user.

VET: How can you help the users see the benefit of waiting a bit longer to receive a product in this age of fast fashion?

HEI: How can you shift a company process to be more made-to-order instead of made-to-forecast?

BUSINESS & FINANCE

Life-Cycle Costing

Life-cycle costing (LCC) is an accounting method that considers the total cost of a product throughout its life cycle, from raw material extraction to end-of-lifes disposal. This helps businesses make informed decisions about production, pricing, and sustainability, promoting the use of durable and high-quality products.

VET: Why should we think about all the costs of making, using, and throwing away a product?

HEI: How can life cycle costing support sustainability initiatives and improve decision-making in a fashion system?

BUSINESS & FINANCE

Market(ing) Opportunities

An important source of revenues (rents) is to find new markets or new ways to present and sell products. This can be the result of new possible applications of existing products and services, but also of new technologies, channels, demographics and/or geographic markets.

VET: Can you think of new uses/markets for your product-service?

HEI: How can innovative marketing strategies help sustainable companies enter new markets effectively?

BUSINESS & FINANCE

Circular Loyalty Loops

Circular Marketing goes beyond convincing people to buy and includes supporting life-cycle activities (like repair events, information exchange, or reuse suggesttions) that reinforce sharing and community building.

VET: Which marketing activities could you develop aimed at creating collective experiences through sharing for the users, and other stakeholders?

HEI: How can you communicate the importance of circularity to encourage user loyalty without it being marketing?

BUSINESS & FINANCE

Person To Person (P2P)

Person-to-person sharing moves a garment directly from owner to owner without the need for a company to sort and restore it. For example, P2P platforms such as Vinted encourage users to sell their clothing directly to other users.

VET: What do you like and dislike about reselling fashion directly between users?

HEI: Can you make a system where a garment is moved into its second or third life directly between users, where the owners remain anonymous?

BUSINESS & FINANCE

Technological Dependency

A company uses many tools, materials, machines in order to create its products and services. Some of these are however more important than others. That means companies are particularly dependent on them. A problem can arise if one of these become unaccessible as the company becomes dependent.

VET: On which technologies (Tools, Materials, Software, Machines) do you depend on?

HEI: What is the impact of the technogies needed for your product-service? Can you find alternatives that are more sustainable?

BUSINESS & FINANCE

Re-positioning

Price elasticity is what we call the extent to which people react to changes in price. Sometimes changing the prices could lead to a higher economic, but also societal impact (more people using the product/ service). Pricing however is a crucial marketing variable that also informs potential users about the quality of the value proposition.

VET: How does circularity affect the price of your product/service?

HEI: How do you work with governments, society, academia and companies to re-position a circular sustainable product/service that has a higher price?

BUSINESS & FINANCE

Circular Revenue Model

Circular revenue models focus on generating income in ways that promote sustainability, such as through recycling, upcycling, and reusing materials. This includes traditional models like direct sales and innovative approaches like subscription services and digital platforms, aligning with sustainable practices.

VET: How can fashion companies make money while also helping the environment by reusing and recycling?

HEI: What are the key components of circular revenue models in the fashion system, and how can they be implemented to drive sustainability and profitability?

BUSINESS & FINANCE

Technology Readiness Levels / Society Readiness Levels

Technology Readiness Levels (TRLs) assess the maturity of technologies, while Society Readiness Levels (SRLs) gauge societal acceptance of these technologies. In fashion, these assessments help evaluate the feasibility, scalability, and market adoption of innovations.

VET: How can we tell if a new fashion technology is ready for people to use and like?

HEI: How do Technology Readiness Levels (TRLs) and Society Readiness Levels (SRLs) influence the adoption of innovations in the fashion system ?

BUSINESS & FINANCE

Figure 4 The Business and Finance strategy cards, co-designed for the Loopholes Toolkit

4.1.4. Stakeholder Engagement

The stakeholder engagement strategies are Open-Source Co-Production, Fair Labor Practices, Fluid Fashion Consumption, Local Community, Considering More-than-Human Ecosystems, Refreshing Roles, Shared Governance, Social Responsibility, Socioeconomic and Governmental Factors, Feedback Loops, Users As Stakeholders, Co-Design, Strategic Partnerships seen in Figure 5.

Open Source Co-Production

Instead of copyright, licences like Open Source creative commons empower co-production allows global communities to share knowledge and collaborate, accelerating innovation and enhancing fashion sustainability through collective learning. 3D printable fashion is an example.

VET: How can sharing knowledge and ideas freely, with others help us create better fashion together?

HEI: What types of knowledge and processes can be shared through open-source licenses to facilitate collaborative innovation in fashion production and use?

Stakeholder Engagement

Fair Labor Practices

Industry 5.0 seeks a transition towards sustainable, human-centric and resilient industries. In this, workers should be paid fair wages, have safe working conditions, and not be subjected to exploitation or abuse.

VET: Are your workers treated well? What about the companies you work with?

HEI: Are there any points in the supply chain where it is unclear how workers are being treated? What steps would you have to take in order to improve these points?

Stakeholder Engagement

Fluid Fashion Consumption

Fluid fashion consumption promotes reimagining ownership and embracing innovative models like renting, borrowing, swapping, and sharing items.

VET: How can you share clothing with others in a way you are comfortable with?

HEI: How can your business model incorporate building community, extending garment life and/or facilitate user interaction?

Stakeholder Engagement

Local Community

Employing and/or involving local communities in processes like designing and manufacturing often leads to positive benefits for the company, environment, and society.

VET: Who are (part of) your local communities (residents, artisans, designers, and businesses)?

HEI: Are there processes that, if done by local community stakeholders, could bring value to your company as well as the local community?

Stakeholder Engagement

Strategic Partnerships

Strategic partners are the stakeholdes that impact your value proposition and value chain. The level of dependency can be high or low, balanced or unbalanced.

VET: Who are your strategic partners and why do you choose them? Are your users strategic partners?

HEI: What new partners would you need in your organization to make enable circularity? (e.g. textile recycling)

Stakeholder Engagement

Considering More-than-Human Ecosystems

Considering non-humans in fashion ecosystems emphasizes the impact on the environment from the point of view of materials, production, supply chain, and ecology. The aim is to minimize environmental harm and conserve resources.

VET: What non-humans like insects, water systems or animals are affected by your whole process?

HEI: What more-than human ecosystems does your practice impact? How can you consider these ecosystems for mutual, regenerative, or sustainable benefits?

Stakeholder Engagement

Refreshing Roles

For organizations to grow and change it is important to reorganize task into engaging positions that attract talent and keep good employees connected. This helps organizations address emerging needs, adapt to shifting market dynamics, adopt technological advancements, and evolve with challenges and opportunities.

VET: Which tasks are most important in your organization?

HEI: What new tasks will need to be added, and how could you integrate these tasks over existing and new roles to keep people engaged?

Stakeholder Engagement

Shared Governance

Shared governance models split the responsibility and accountability of an organization with stakeholders across the value chain. Shared Governance ensures an inclusive approach to decision-making and management, but collaboration between stakeholders is needed.

VET: Who makes the decisions in your organization? Who is impacted by the decisions that are made and how can you involve them in the decision-making process?

HEI: How can you add more stakeholders from your value chain to your current decision-making process?

Stakeholder Engagement

Social Responsibility

Social Responsibility is the commitment to act ethically and contribute to economic, social, and environmental well-being. It includes upholding ethical conduct, promoting sustainability, engaging with communities, ensuring economic accountability, and adhering to legal compliance.

VET: How is your organization impacting society and the environment?

HEI: How could you change your practice to ensure a positive impact on the society and environment?

Stakeholder Engagement

Co-Design

Co-Design refers to the collaborative principles and practices that actively involve other people (stakeholders) in the process. Co-Design emphasizes inclusivity, transparency, and shared decision-making through participatory models that seek to reshape the traditional top-down approaches of the fashion industry.

VET: How can you involve your friends or family when making decisions about what to wear?

HEI: How would you make a system that allows all the stakeholders to be part of the Design process?

Stakeholder Engagement

Socioeconomic and Governmental Factors

New laws, regulations, socil beliefs and societal costs (like inflation) play a crucial role in influencing sustainability and technolpgy practices in the fashion industry. Systemic change influences who society works and causes our orcanization to change.

VET: Which new laws and regulations will impact sustainability and technology practices in fashion?

HEI: How do economic and legislative factors influence fashion consumption and use?

Stakeholder Engagement

Feedback Loops

Collecting and making sense of stakeholder feedback is critical for businesses that wish to make improvements based on what their stakeholders (such as users) need.

VET: What stakeholder feedback is essential to your organization?

HEI: How could digital technologies support and incentivize stakeholders to be willing to share feedback?

Stakeholder Engagement

Users As Stakeholders

Encouraging users to be active stakeholders in the fashion ecosyste empowers them and leads to more customer-centric, sustainable offerings.

VET: In what governance, design, production and use processes could you involve users?

HEI: What technologies could enable users to engage with your current processes? How would that change those processes?

Stakeholder Engagement

Figure 5 The Stakeholder Engagement strategy cards co-designed for the Loopholes Toolkit

4.2. Canvases

The Loopholes toolkit consists of six canvases that help the trainers and participants develop a multi- faceted, holistic view that is circular by design.

4.2.1. Central Canvas

Figure 6 The Central Canvas or Board of the Loopholes Toolkit, used to bring a circular understanding to projects, companies and organizations in the Fashion and Textile Sector.

The Toolkit centers around a central canvas or board, see Figure 6, that takes the stakeholders in the project and looks at a wholistic circular process needed to make project sustainable and include the multi-faceted aspects of the fashion and textile sectors.

4.2.2. Project Description Canvas

PROJECT DESCRIPTION
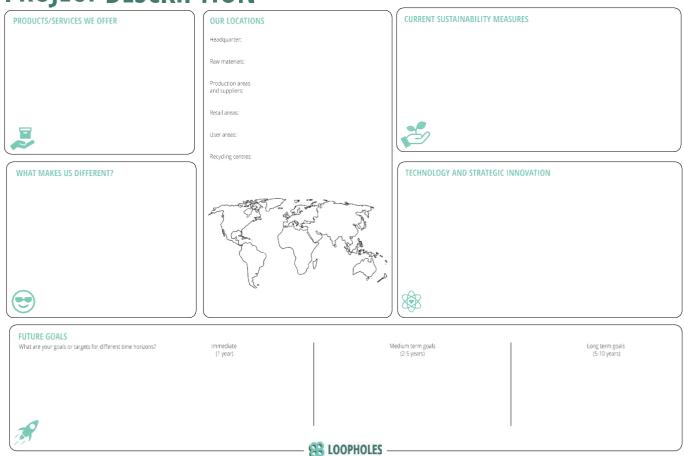
Figure 7 The Project Description Canvas helps students, companies and organization in Fashion and Textiles describe their product-service ecosystem

The Project Description Canvas, see Figure 7, is used to define the key aspects of a project by detailing what makes the company unique, outlining future goals, and listing current sustainability measures. It includes sections on technology and strategic innovation, as well as descriptions of the products and services offered. The canvas also captures the company's logistical information, such as headquarters, raw materials, production areas and suppliers, retail areas, user areas, and recycling centers. It allows the user to understand what strategies they already use and sets goals for different time horizons, including immediate (1 year), medium-term (2-5 years), and long-term (5-10 years) objectives.

4.2.3. Data Canvas
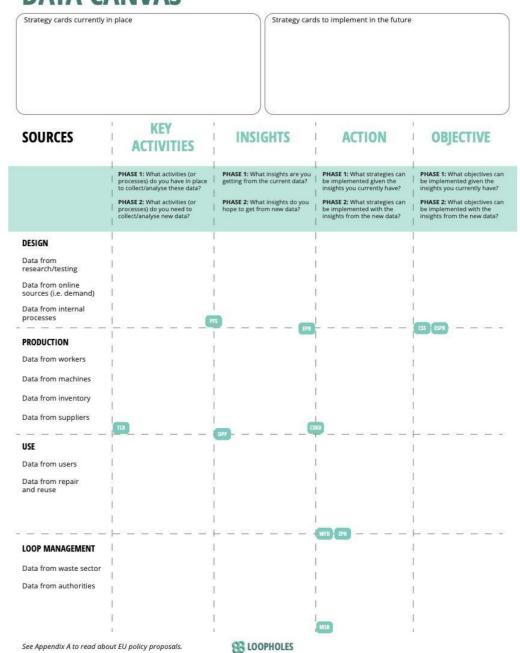
Figure 8 The Data Canvas helps students, companies, and organizations explain how data works in their product-service ecosystems.

The Data Canvas , see Figure 8, helps companies outline their current and future data collection and analysis activities. It captures the sources of data, key activities, insights, and action objectives. This canvas is divided into phases to differentiate between current practices and future strategies, addressing aspects such as design, production, use, and loop management. The aim is to leverage data from various sources, including users, suppliers, and internal processes, to drive informed decision-making and strategic implementation.

4.2.4. Stakeholder Canvas

STAKEHOLDER CANVAS

Strategy cards currently in place

Strategy cards to implement in the future

STAKEHOLDER CLASSES	PARTNERSHIP IDEATION	GENERAL AGREEMENT	ACTION	OBJECTIVE
	PHASE 1: What conversation is in place with the current stakeholders? **PHASE 2:** What conversations would you like to initiate with new or existing stakeholders to innovate processes?	**PHASE 1:** What agreements are currently in place with the stakeholders? **PHASE 2:** What agreements are required to define new processes?	**PHASE 1:** What actions are taken as a result of the partnership or agreement? **PHASE 2:** Which actions will be taken as a result of new agreement?	**PHASE 1:** What is the objective of the current partnerships and agreements? **PHASE 2:** What is the objective of the future partnership and agreements?
WORKERS Employees C-suit Freelancers		PFS		ESPR
SUPPLY CHAINS (UPSTREAM) Suppliers	CSS	TLR	EPR	DPP
SUPPLY CHAINS (DOWNSTREAM) Reuse, repair, refresh, recycle…			WFD	
(END) USERS	DPP		EPR	
GOVERNMENTS		CSRD	MSR	

See Appendix A to read about EU policy proposals.

✿ LOOPHOLES

Figure 9 The Stakeholder Canvas helps students, companies, and organizations explain how people and partners work in their product-service ecosystems.

The Stakeholder Canvas, see Figure 9, helps map out relationships and partnerships with different stakeholders. It covers stakeholder categories, partnership ideas, general agreements, and action objectives. The canvas is divided into phases to identify present discussions and agreements with stakeholders, as well as future dialogues and collaborations required to innovate processes. Key stakeholders include workers, suppliers, governments, and end-users, ensuring a comprehensive understanding of stakeholder dynamics.

4.2.5. Material Canvas

MATERIAL CANVAS

Strategy cards currently in place

Strategy cards to implement in the future

What is the aesthetic and functional features of current materials?

How much resources are needed to produce the current material?

CURRENT MATERIALS

CSS

CSRD

What is the aesthetic and functional features of new materials?

How much resources are needed to produce the new materials?

ESPR

MSR

DESIGN

NEW MATERIALS

PRODUCTION

EPR

DPP

LOOP MANAGEMENT

USE

How much of the new product can you recycle?

How durable is the product with new materials?

WFD

EPR

How much can you recycle of the current product?

How durable are your current products?

See Appendix A to read about EU policy proposals.

LOOPHOLES

Figure 10 The Materials Canvas helps students, companies, and organizations explain how physical materials works in their product-service ecosystems.

The Material Canvas, see Figure 10, focuses on the use of materials in the company's operations. It takes into account current and new materials, design, production, use, and loop management. The canvas raises questions about material recycling, durability, resource requirements, as well as aesthetic and functional features. It assists companies in assessing their existing materials and preparing for the adoption of new, more sustainable materials in line with strategies such as eco- design and extended producer responsibility.

4.2.6. Business Canvas

BUSINESS CANVAS

| KEY STAKEHOLDERS & PARTNERSHIPS
strategic collaborations | KEY ACTIVITIES
processes | VALUE PROPOSITION
the core strategic benefit | USER RELATIONSHIPS & CHANNELS
creating containment | USER SEGMENTS
understanding needs, problems and opportunities |
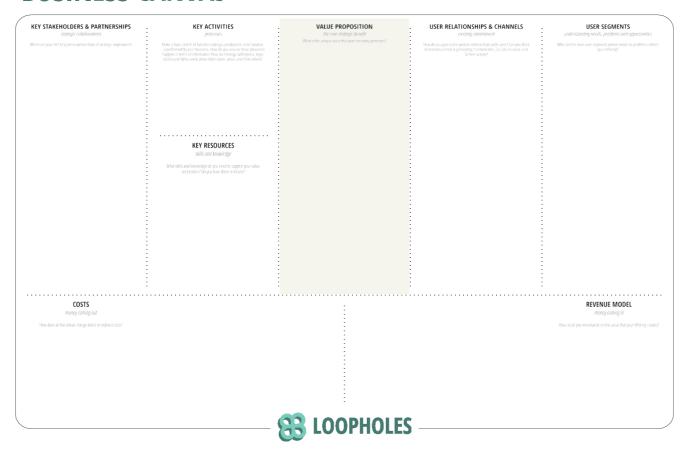
Figure 11 The Business Canvas helps students, companies, and organizations explain how finance works in their product-service ecosystems.

The Business Canvas, see Figure 11,provides a detailed overview of the company's business model, focusing on the value proposition, user relationships and channels, key activities, stakeholders and partnerships, costs, and revenue model. It aims to define the unique value the company generates, how it maintains relationships with users, and the strategic collaborations and processes required. The canvas also addresses the skills and knowledge needed, cost implications, and revenue strategies, ensuring a holistic view of the business's operational and strategic framework.

4.3. Instruction Manual

Through our participatory co-design process, we discovered new and different modes of play are needed to make the toolkit relevant to Vocational Students, Higher Education Students, Entrepreneurs, Companies and other institutions. We developed Modes of Play that are Descriptive, Explorative, Generative and Evaluative. When matched together, they offer new double diamonds.

Through our participatory co-design process, we identified the need for diverse modes of play to make the toolkit relevant to vocational students, higher education students, entrepreneurs, companies, and other institutions. We developed modes of play that are descriptive, explorative, generative, and evaluative. When combined, they create new double diamond frameworks.

LOOPHOLES

A User Manual

NEXT TECHNOLOGY TECNOTESSILE

Ʊ ELISAVA

Modacc

Iaac — institute for advanced architecture of Catalonia

BORÅS STAD

Hogeschool van Amsterdam

Nordiska Textilakademin

Città Studi BIELLA

N&F

Co-funded by the European Union

Figure 12 The User Manual, found on our websites, has multiple modes of play that allow the toolkit to be used in different ways depending upon the audience and situation.
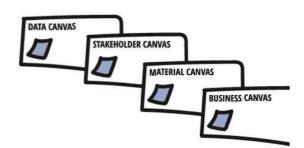
4.4. Modes of Play

During testing, we encountered four modes of Play, and we added instructions to the manual to enable trainers and participants with different goals to use the toolkit effectively.

4.4.1. Generative

DEVELOP ON IDEAS
(GENERATIVE PHASE)

30-40 min

DATA CANVAS
STAKEHOLDER CANVAS
MATERIAL CANVAS
BUSINESS CANVAS

Use each card as a new strategy on the canvases. N
canvas to describe the steps that can help realize th
perspectives.

It is recommended to use the following sequence:
1. Data canvas to understand the overall informatior
2. Stakeholder canvas to look at the service ecosyst
3. Material canvas to ensure the product lifecycle is

GENERATE NEW IDEAS
(IDEATE ON A NEW PROJECT FR

30-40 min

Place the board at the
centre of a wide table.
Keep 2 colour post-its at
hand

Comments

Mapping cards to
canvases
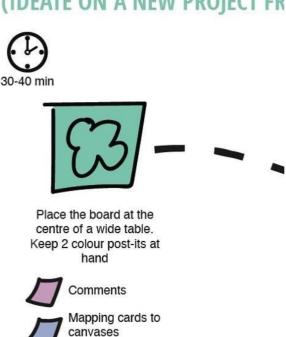
Figure 13 The Generative mode of play helps students, companies, and organizations generate new product-service ecosystems

In the generative phase, see Figure 13, each card is used as a new strategy on various canvases to realize the strategy from different perspectives. The recommended sequence starts with the data canvas, followed by the stakeholder, material, and business canvases. This effort is repeated for each card, with any uncertainties or disagreements noted. Finally, a roadmap is created using the canvases to plan the next steps for immediate, short-term, and long-term goals, revisiting the canvases to evaluate progress.

The process for generating new ideas involves placing the board at the center of a wide table with two colored post-its for comments and mapping cards. Players specialize in a domain or hold general knowledge, distributing and reading through the cards before placing them face-up. They collectively choose four strategy cards that inspire the team, placing them on the main board in the corresponding quadrants, and then describe a project based by these cards.

4.4.2. Explorative

EXPLORE NEW STRATEGIES
(EXPLORATIVE PHASE)

45-60 min

Each participant chooses some cards to propose strategies that the company could implement.
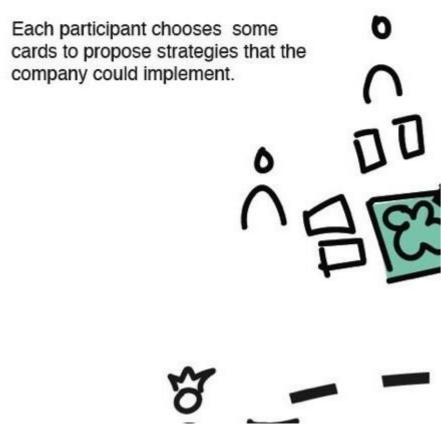
Figure 14 The Explorative mode of play helps students, companies, and organizations understand how specific strategies affect their product-service ecosystems

In the explorative phase, see Figure 14, each participant selects cards to propose strategies that the company could implement, placing them on the board in the most relevant quadrant. Over three rounds, strategies are proposed for short, medium, and long-term goals, aligning with the project's objectives. After each round, the cards are moved from the board to the canvases, with post-its used to answer relevant questions and map out strategies. This process helps create a roadmap for the company's progress in data, stakeholder, material, and business journeys, ensuring a comprehensive approach to strategy development.

4.4.3. Evaluative

EVALUATE PROGRESS
(REVISITNG THE TOOLKIT)

60 min

Revisit the project to evaluate the progress and modify the actions.

Refer the roamap that you used to implement your strategies and repopulate the canvases. You can also just use the previously filled canvas if you still have it handy.

STRATEGY	PLANNED ACTIONS	PROGRESS	
		Year 1	Year 2...

Roadmap

7

Assign a facilitator among the players who is in-charge of moderating the discussion.

Based on progress, repopulate each canvas using colour coded post-its.

Actions completed

Actions not proceeding as planned

Actions in the upcoming future

For every action that is not proceeding as planned:

a) Modify the task

b) Add supporting actions to enable the transition

c) Discard the task and repeat explorative phase for the corresponding card

STRATEGY	PLANNED ACTIONS	PROGRESS	
		Year 1	Year 2...

Roadmap

Update the road-map using the canvases to plan the next steps you would want to take in the immediate, short and long term and plan the next revisit and evaluation.

Figure 15 The Evaluative mode of play helps students, companies, and organizations strategically understand their product-service ecosystems over time.

In the evaluative phase, see Figure 15, the project is revisited to assess progress and adjust actions accordingly. Participants refer to the roadmap used for implementing strategies and repopulate the canvases based on the progress achieved, using color-coded post-its to indicate completed actions, actions not proceeding as planned, and future actions. For actions not proceeding as planned, tasks can be modified, supporting actions added, or the task discarded, and the explorative phase repeated for the corresponding card. The updated roadmap helps plan the next steps for immediate, short-term, and long-term goals, ensuring continuous improvement and alignment with project objectives.

4.4.4. Descriptive

SETUP AND PROJECT DESCRIPTI
(IMPROVE ON EXISTING EFFORT

15-30 min

Place the board at the
centre of a wide table.
Keep 3 colour post-its at
hand

DESCRIBE CURRENT STATE
(DESCRIPTIVE PHASE)

30-40 min

Each participant chooses some
cards to describe the current
state of the company.
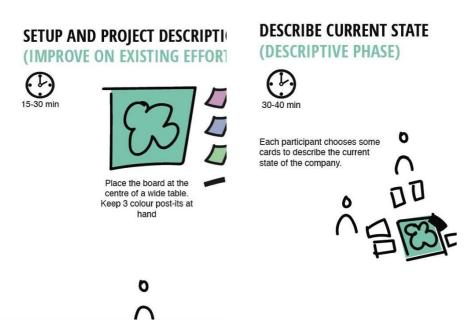
Figure 16 The Descriptive mode of play helps students, companies, and organizations describe their current product-service ecosystems so they can make it better.

In the descriptive phase, see , each participant selects cards to describe the company's or organization's current state, starting from the design quadrant and moving clockwise. They briefly explain their choices and then move the cards from the board to the canvases, using post-its to comprehensively answer questions and map out the current state.

In the setup and project description phase, the board is placed at the center of a wide table with three colored post-its for comments and mapping cards. Participants either specialize in a domain or have general knowledge, reading through and placing the cards face-up. They define the project using the project description canvas and post-its, working simultaneously on different sections to ensure timely completion.

4.4.5. Additional Resources

All resources are available on the Loopholes support websites for trainers at https://transitionsproject.eu and https://circularloopholes.net, and as a collaborative code repository at https://github.com/troykyo/dssloopholes.github.io/. An example is see in Figure 17.

Figure 17 An example of the supporting Loopholes website where a strategy is detailed with supporting details and links to case studies and literature.

There are also instructional videos, see Figure 18, on YouTube https://youtu.be/rkMrLolHitU
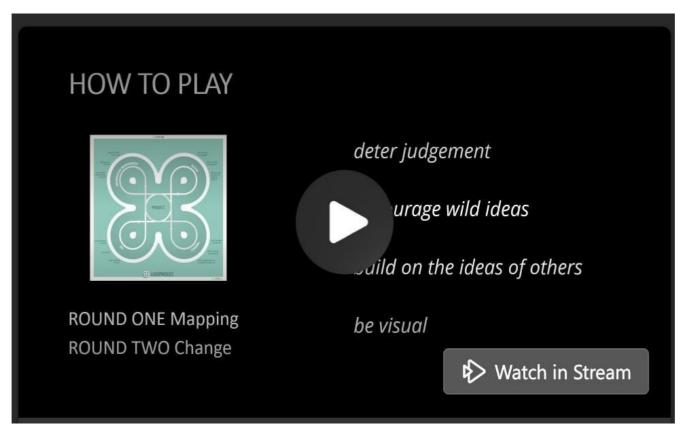
Figure 18 An instructional video on how to use the Loopholes toolkit on YouTube

Additionally, we created an AI ChatGPT, see Figure 19, assistant that can help trainers and participants question the created materials with specific questions https://chatgpt.com/g/g-nCIwIrJam-transitions-loopholes

Figure 19 The Loopholes GPT to help participants ask questions about the Loopholes Toolkit

5. Creating the Toolkit

A series of maps were created based on a combination of activities: a literature review, a survey, and co-creation sessions. The following section describes our process of creating the toolkit in the hope that others will adopt the toolkit in adjacent fields and grow the toolkit over time.

5.1. Literature Review

The mapping of technology and sustainability tools and methods for the T&F transformation into a circular economy departed from a literature review on education and pedagogical models in fashion and textiles, see Table 1. The focus on education as a starting point was deemed important by the team of researchers as a form of anchoring our mapping and future WP work through tools, methods and methodologies already researched in the context of fashion education. This review included articles published between the years 2000 and 2022 in the following journals:

- Clothing and Textiles Research Journal
- International Journal of Fashion Design, Technology and Education Journal of Textile Design Research and Practice
- Fashion Theory
- Fashion Practice
- The Design Journal

The scope of the search was narrowed down through the keywords "*fashion education*" and "*pedagogy*". "*Fashion pedagogy*" was used to search "The Design Journal" as it has a broader scope of design publications.

The selection process had two rounds. The first round selected papers with titles indicative of it focusing on curriculum, teaching, course development, learning experience and alike. The second round filtered these papers based on their abstracts. In this step, the results from the "pedagogy" search were crossed- checked with the first search to eliminate duplicates. 102 papers were selected through this process. Table 1 summarizes the number of papers selected in each round per publication. A full list of references is included as ANNEX A.

Table 1 A summary of found literature surrounding our topics of sustainability and digitalization for Fashion and Textiles.

CLOTHING AND TEXTILES RESEARCH JOURNAL		
	Fashion Education	Pedagogy
Results	251	36
Filtered (title)	24	18 (9 new)
Filtered (abstract)	16	8
INTERNATIONAL JOURNAL OF FASHION DESIGN, TECHNOLOGY AND EDUCATION		
	Fashion Education	Pedagogy
Results	459	54
Filtered (title)	68	29 (6 new)
Filtered (abstract)	53	6
JOURNAL OF TEXTILE DESIGN RESEARCH AND PRACTICE		
	Fashion Education	Pedagogy
Results	59	28
Filtered (title)	9	9 (3 new)
Filtered (abstract)	7	3
FASHION THEORY		
	Fashion Education	Pedagogy
Results	292	32
Filtered (title)	6	5 (1 new)
Filtered (abstract)	5	0
FASHION PRACTICE		
	Fashion Education	Pedagogy
Results	146	6
Filtered (title)	3	1 (0 new)
Filtered (abstract)	3	0

THE DESIGN JOURNAL		
	Fashion Education	Fashion Pedagogy
Results	164	35
Filtered (title)	2	0
Filtered (abstract)	1	0

Total results	1371	191
Total filtered results (title + abstract)	85	17

After selecting the papers, all PDF files were uploaded to a visual collaboration platform (Miro) to enable both their analysis and access by all partners of the content from the map, see Figure 20. Papers were each marked with notes highlighting their key concepts to facilitate clustering them into themes (Figure 1).
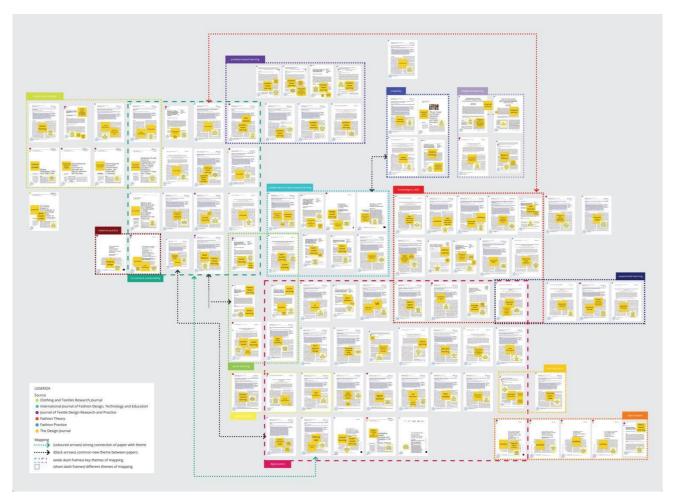
Figure 20 A visual literature review was made to facilitate clustering content

Clusters included social responsibility, problem-based learning, integrated learning, active learning, collaboration & team-based learning, experiential learning, knowledge & skills, creativity, learning styles, object-based, material practice, patternmaking, as well as the two most important ones for the goals of this deliverable: digitalization, and circularity & sustainability. The two latter clusters were included in the maps.

Like previous research, this review pointed to a lack of literature on methodologies used in Fashion (education). Berglin et al. [3] indicated that literature on teaching methods in fashion is not extensive, pointing to a lack of specific theoretical and methodological foundations in fashion education. Our review's specific finding was the lack of European-based literature and research. Of the 102 papers included in the review, 66 were from American institutions. Most of the European papers were from institutions in the UK (14). This presents a big issue in assessing the state of the art for the TRANSITIONS program. Although broader research on digital and sustainability from European researchers abound, the lack of research of pedagogical methods and such tools are applied in educational contexts is problematic. This finding motivated the approach for the activities of the work package to be guided through action research [7] as a strategy to overcome the lack of literature in this area. "Action research combines both action and research within the same process and aims at generating knowledge by improving practice, and improving practice by the application of knowledge" [7]. This kind of research enables researchers to consider different kinds of data, including first-person perspective.

25

5.2. Survey: "Pedagogical innovations in Fashion Education"

A survey was prepared and disseminated between the institutions represented in the TRANSITIONS consortium to collect insights from the pedagogical models used or known by educators in T&F active both in higher and vocational education (HE and VET, respectively). This survey did not aim to reach a specific number of respondents to provide quantitative significance. Rather, the aim was to give an opportunity for the teaching staff to contribute through rich information regarding the current practices, methods and tools they currently employ in education.

A pilot was conducted internally at the Amsterdam University of Applied Sciences (HvA) between the 1st and 8th of December 2022. This pilot survey, which had 20 responses, included questions that probed the "theoretical underpinnings" and "methods & tools" that inform their teaching practice of the educators in relation to sustainability and digitalization. Based on the participants' responses, we found three main insights:

5.2.1. Absence of Specific Methodologies

Overall, teachers did not relate their teaching practice with specific methodologies and pedagogical models. They describe their practice through the practical tools, methods and content they teach. This seems on par with observations from prior research by Berglin et al. [3] that indicates that literature on teaching methods in fashion is not extensive, pointing to a lack of specific theoretical and methodological foundations in fashion education.

5.2.2. Digitalization: New and Old Tools

Among tools mentioned, participants reported the use of design and simulation software tools (CLO 3D, Browzwear, Adobe Illustrator); PDM/PLM/ERP systems; as well as platforms such as Microsoft Teams for content delivery. The relationship between digital workflows and handicraft/physical work has been brought up as a way of teaching, as a form to support sustainable practices and a form of innovation that is currently being developed (digital sewing room for CLO and Browzwear).

5.2.3. Sustainability is Content, Not a Guiding Principle

Regarding sustainability, participants mentioned several methods such as upcycling dead stock fabrics, social design, zero waste, slow approach, life cycle inventory analysis, life cycle assessment, Eco-design strategy wheel, and several design principles like a design for disassembly, design for recycling, C2C, purpose-driven design. Collaboration with industry, experts and other partners has been mentioned both as a current best practice and a desirable one for future innovation.

Continuous upskilling/training teachers is also mentioned as a best practice for bringing digitalization and sustainability into fashion education. Participants reported they considered

the alignment between curriculum and staff as well as other institutional barriers to be the main challenges in adopting new pedagogical models.

The questionnaire was then slightly adapted to be sent to the partners to be disseminated to their teaching staff and other contacts across Europe. The rate of response was low (19 responses by the time of the co-creation sessions). This was probably due to timing overlapping with the holiday season. Nonetheless, the answers given by educators spread across Europe were compatible with the ones received in the pilot study, particularly regarding to a gap between methods and tools taught in class and methodological underpinnings that inform teaching style. This could indicate a need to investigate and consider the implicit underpinnings of such tools or methods to fully understand the state of the art of F&T education.

The answers of both rounds of questionnaires were added to the mappings of digital technologies (digitalization) and sustainability.

5.2.4. Co-Creation Sessions and Finalized Maps

We conducted a workshop split into two co-creation sessions with project partners, a specialized group of engineers and designers, to include our joined expertise and knowledge into the mapping. The workshop lasted a total of 3 hours, divided equally between sessions. The first session was used to complete the map of digital technologies (digitalization) and the second focused on circularity & sustainability. These sessions were conducted online, using Microsoft Teams and a visual collaboration platform (Miro) as tools. A collaborative board was created including a frame with the template for each session.

Since the maps were created collaboratively using different kinds of data from many sources, including our own knowledge and experience, the templates had separate sections for information from different types of sources. To provide rigor to the map, it was important to ensure that all references had a traceable origin, which was done by a) adding them to the right section of the map, and b) adding tags and text to each of them with the source and some key notes about their relevance to the topic of the map.

The first section of the templates, entitled "what has been researched in education", were prefilled with the papers included in the clusters "digitalization" and "circularity and sustainability" of the Literature Review The second section, "what tools and methods are currently used by our teaching staff", was filled during the sessions with methods and tools used by people in the participants' institutions (1st person perspective). Findings from the survey "Pedagogical Innovations in Fashion Education," as well as partial results from the survey "Needs Analysis", conducted by work package 2, were also included in this section. The third section of each template, was filled during the sessions with others relevant references, including reports from other EU projects and scientific publications (secondary research).

5.2.5. Technology Map (digitalization)

Figure 21 Digitalization Map created in during partner co-creation sessions with literature, practice and partner experience.

A Technology map, see Figure 21, was created, and we highlight the following sections:

5.2.6.   Section 1 Literature review:

The paper "Fashion and toolkit design as hybrid practices: approaches in education to creating fashion-related experiences in digital worlds" [11] articulates the needs of teaching fashion designers (digital) tools and methods shared by digital-native disciplines to enable them to effectively design for digital fashion. Beyond a focus on digital worlds, the paper gives insights on a need of supporting an understanding of socio-technical systems, which is important for other kinds of functions in the F&T chain as a form of nurturing systemic thinking needed to address complex issues such as circularity. This paper also presents a design toolkit, which can contribute to the development of the toolkit itself.

The paper "Investigating Creative Processes and Pedagogy in the UK: Fashion Thinking" [9] which describes the repositioning of pedagogical model for the RCA Fashion Program though a transdisciplinary approach. Their proposed approach nurtures critical thinking, closer collaboration between professionals in the production chain, and social responsibility. Three perspectives are suggested as possible ways to look at the relationships between design, development and production: historic, economic and policy; designer led and culturally specific; machinery and tooling innovation. The paper offers rich insights on their reasoning for implementing such approach and can inform the development of the TRANSITIONS curriculum.

The paper "Exploration of Digital Competency Requirements within the Fashion Supply Chain with an Anticipation of Industry 4.0" [13] presents a very interesting break down of digital competencies between function in the supply chain and the complexity of learning goals. This combination can support our project in devising a self-directed learning system for the TRANSITIONS program that enables professionals to tailor their training to deepen their skills depending on the function they are interested in growing towards.

5.2.7.   Section 2: Partners

The knowledge and skills shown by the input of the partners demonstrates the competence of bringing reflective, critical and systemic thinking into the toolkit that will be developed by our work- package and future development of the curriculum. Specifically, we highlight the UPPSS toolkit presented in the paper "Designing ultra personalized product service systems" [8] which supports designers in building and negotiating design considerations of product-service-systems. This toolkit, which has been further developed since the publication, can be a point of departure for the toolkit and the workshops. The "She makes open toolkit" [10] is also an important reference to support this development.

5.2.8.   Section 3: Underpinning

The need of addressing the challenges of the transition towards circular economy and Industry 4.0 has motivated other EU projects and initiatives with similar mission than the TRANSITIONS project in the recent years. Reports such as "Education for Fashion Tech" [4], a result from the Erasmus + "EDU4Fashion-Tech" project, offer us rich insights that need to be considered for the future of our project, especially given the lack of literature regarding F&T education from European researchers.

5.3. Sustainability and Circularity map
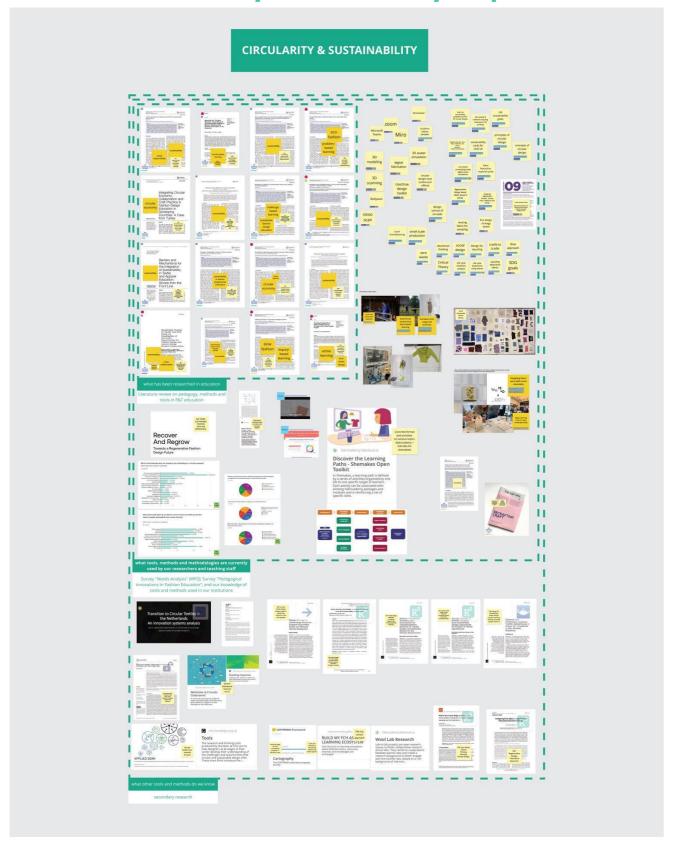
Figure 22 Sustainability map of Literature, Practice, and partner experience

A Sustainability map, see Figure 22, was created, and we highlight the following sections:

5.3.1.   Section 1 Literature Review

The paper **"Developing textile sustainability education in the curriculum: pedagogical approaches to material innovation in fashion"** [14] investigated pedagogical approaches to develop sustainable textiles for the fashion design curriculum. For our project, it is interesting that this paper discusses educational strategies to convey principles of sustainability in fashion to different audiences, which is also one of the challenges we will need to address to build a curriculum fora variety of professional profiles.

5.3.2.   Section 2 Partners

There was overlap between the two maps, having some references appear in both. Among these, we highlight again the UPPSS toolkit presented in the paper **"Designing ultra-personalized product service systems"** [8]. As a point of departure, the toolkit and insights from its use in workshops are relevant to help us in developing tools that provide designers ways to negotiating design considerations considering circularity.

5.3.3.   Section 3 Underpinning

The paper **"Fashion Design for Sustainability. A transformative challenge across the European fashion education system"** [5] addresses the digital and sustainable transitions in the context of European fashion education. The paper offers insights on the state of the art and the possible best practices towards the transition. Particularly for our project, the paper proposes a look into the sustainable transition that is supported by the digital transformation. This synergy between the two transitions is highly important for an effective sustainable transition. To our project, this of synergy between the two can inform our development of the toolkit.

Other references, such as **"The Circular Classroom"** [12] (an interactive educational toolkit for upper high school educators) and the **Fab City** [15] approach, offer important references for both content and frameworks that can inform our approach to the toolkit and workshops.

5.4. Findings and Conclusions from the Design Phase

The most significant finding of the process of building the map was that fashion seems to be designed in different places where the literature is being articulated. While the lack of literature on methodologies and pedagogical methods in generalis problematic, it is particularly concerning the lack of documentation of the those used within European educational systems. We see efforts in the direction of closing this gap by borrowing methods and frameworks from HCI and other design fields. The Marie Curie PhD program is an example of such efforts. However, the results have remained in HCI and still need to be translated to fashion.

Based on the activities carried out to build the maps, we also see an important disconnect between the many tools used and taught by educators in T&F and methodological underpinnings. Apart from educators teaching theoretical classes, most educators seem describe their practice through the practical tools, methods and content they teach see Figure 23.
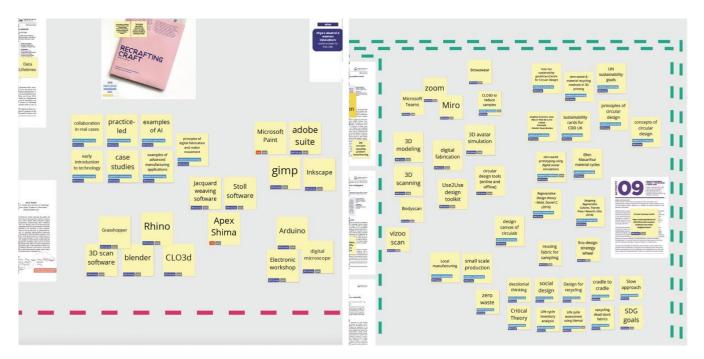
Figure 23 Detail of Digitalization (left) and Sustainability & Circularity (right) maps showing tools and methods mentioned by the "Pedagogical innovations in Fashion Education" survey respondents. In Digitalization, we see a predominance of tools geared towards.

Tools are designed with intentionality and such intentionality can and does contribute to specific ways of working that privilege certain kinds of goals over others. Like tools created for other design and engineering fields, most digital tools employed in fashion were designed with an intent of optimizing and maximizing production. This makes such tools incompatible with the aims of sustainability and even with the opportunities envisioned by Industry 4.0, such as local and on- demand production, that require a higher level of flexibility of the systems, among other things. As such, more than choosing the right tools for the future development of the project, the aim of our future work is to define a strategy to support systemic, critical and reflective thinking. In turn, this should facilitate (future) professionals in comprehending tools and the practices they foster, and consequently facilitating a critical selection of tools to support one's practice and goals.

6. Testing Phase

We verified each iteration of the toolkit to make sure it was accomplishing our aims as we designed it.

6.1. Testing the First Version of the Toolkit

The revisions that led to a final version of the toolkit are based on a series of iterations of the toolkit, briefly described below. Further on, in this section we build upon the results from all events, iterations and discussions held, with the aim of creating a final version of the toolkit.

At first, two "Fashion Meets Design" experimental workshops have been held, co-designed by Transitions WP3 partners. Workshop one (WS1) of "Fashion meets Design" was held in all the partner countries and hosted online through the Zoom and Miro virtual platforms on the 29th and 30th of March 2023. The workshop aimed to promote systemic thinking by unpacking systems, understanding specific sustainability and technology from the stakeholders' perspective, and reflecting on how different strategies can impact their transition processes. Feedback from facilitators and participants was collected and analyzed further to refine the toolkit's application in real-world scenarios.

A series of iterations of the toolkit were then made, that were evaluated with all partners at a second Workshop (WS2). WS2 was hosted in the Netherlands from June 6th to 8th 2023 with partners from all the work packages and six young fashion companies, see Figure 24, from around Europe. This workshop tested the design process for fashion and the validity of the designedly toolkit created to support a business case and the transition towards digitalization and circularity through analyzing and re-imagining linear, simplistic production processes and supply chains into complex systems.

6.1.1. From Loopholes to Business Plan

An important aspect of the latter workshop was experimenting how Loopholes can support entrepreneurs in building their business models through a systemic thinking approach. For this, the standard canvas model (as developed by Osterwalder and Pigneur 2010, [12]) was adapted as a complimentary tool to the Loopholes toolkit. This development was led by Dr. Marco Mossinkoff, a researcher and senior lecturer at the AUAS with a background in economics and a Ph.D. in economics and sociology.

Different existing business canvases were considered for the toolkit, such as the Ecocanvas [2] which focuses on a holistic approach by including three additional blocks for considering economic and legal, environmental, and social forces. The traditional model was preferred as it would have been more familiar to participants. Taking a similar approach to the one taken by the canvas proposed by Circular Design Guide [2], the small adaptations made to the model, consisting of textual prompts included in each of the blocks of the canvas, allowed us to create a link between the tool and the Loopholes toolkit.

By asking participants to fill in the business canvas after playing Loopholes, we aimed to inquire whether participants could leverage the mapping process of the toolkit to identify the building blocks of the business model.

Figure 24 Young entrepreneurs at WS2. During the Material Engagement session, participants used materials they brought or were available in the lab to create a sample that embodied important aspects of their work.

On the second day of WS 2, an extended session with all the partners and participants was crucial to generating insights regarding the cards, the modes of play, and the overall toolkit procedure. Below is an excerpt of comments that mention actions taken.

"In a game there should be winners and losers.": we now only try calling it a Toolkit.

"Not clear what the aim is to a young company" and further "We can have different versions of the game, each of which is more suitable for any type of business." : we have contextualized the board's focus project.

"Exploring local networks and connections with the industry is mostly interesting for the participants": we have added cards in the Business & Economics section to further explore instead of organize.

"No, I think the game is well structured and the cards cover the most important topics. It was not easy to decide only 3 cards, but I think 'the bonus strategy' can be a solution" : we have allowed for a pre- selection of cards.

Mostly these comments regarded the structure and process of the game. Changes leading to more structure but also more contextualization (allowing the structure to change according to the setting) have been made, next to changes to the card's contents.

34

Comments from the preliminary sessions held with practitioners have been incorporated and further tested during more iterations and feedback sessions in a second tasting phase.

6.2. Testing the Second Version of the Toolkit

To further test the toolkit set-up and contents several workshops have been held with students at both bachelor and master level attending courses at the Amsterdam University of Applied Sciences and in a session held with practitioners in Boras, Sweden, during a partner meeting.

Further activities undertaken to generate feedback on the toolkit's set-up and card contents were:

1) A workshop held at an international conference on fashion research and education (IFFTI New Zeeland, 2023, see Annex C for an overview of main comments and pictures of the session),

2) Feedback obtained on proposed changes by consortium partners during a series of 4 WP3 partner meetings that took place on April 9, April 22, May 27, and throughout June 2024 respectively (please see the Miro page for a comprehensive list of comments)

3) A final critical review in a day-long sprint at HvA held on May 30. Participants are lecturers and researchers of the Amsterdam Fashion Institute (Troy Nachtigall, Marco Mossinkoff, Francesco Sollitto, Ineke Siersema, Merunisha Moonilal, Ellis Droog, Shannon Riegstra) and trainees/students at the AUAS Digital Society School.

6.2.1. DSS Testing

Between February and June 2024, we conducted testing sessions with the Digital Society School (DSS) at AUAS. The DSS was founded to research the impact of technology on society, develop the skills necessary to guide the transformation and pass on this knowledge and these skills to a new generation of professionals. Its trainees are enrolled in an intensive 20-week-programme, and a group of them have been working on testing the Transitions Loopholes toolkit in an extensive series of 3-hour sprints. The "Modes of Play", meaning the most suitable ways to utilize the board game, were the focus of these sessions. Moreover, a continuous process of partners interaction which has taken place during the pilots of WP4 has provided rich feedback from the trainers.

The trainees at DSS working on the development of Loopholes version 3 were: Tejaswini Nagesh, Samila Alamdar, Abdul-Mubarik Sumani, Patience Musemakweri.

6.2.2. Student Testing

Five workshops were held between the 29th of February and the 5th of March, with classes of 20-25 students divided into groups of 4-5 people (please see Annex C for an overview of student names and comments). The population consisted of fashion management students in

their 2nd year of studies. During this semester they have been assigned case studies of brands, for which they have to design a new and improved strategy. Within this context the toolkit has helped students mapping and developing these strategies. Each workshop lasted 2 hours.

Students have been given instructions how to use the toolkit to analyze the strategy of a major fashion company, and about how to use the cards to develop a new strategy for the brand and to report on the consequences of their decisions for the existing business model. It was interesting to see how different groups have used the cards differently. That has been a good source of suggestions for restructuring the toolkits process.

Figure 25 Loopholes with Fashion students

Figure 25 shows the workshops the trainer. These have been summarized and further elaborated upon. Overall students were enthusiastic about the toolkit, as it allowed them to reflect on the strategy using non-digital means (!) and also because it would give them information about technologies and strategies they would not have thought of otherwise. Many comments have been given which can be summarized in the following.

1) Language and text formulation issues (needs to be clear and specific).

2) Questions on the board should be clearer and more specific.

3) There are too many cards that need to be selected; all interesting, but difficult to handle in a short time. A pre-selection would be better.

4) The relationship between the two phases of the toolkit should be more clearly separated.

5) The instructions should be revised, verbally it was clear, written less so.

6) Some cards do not ask for new possibilities and changes but are merely instructive (especially the B&F ones, e.g. the roles and functions related card). Those should be more challenging. Also, several cards (e.g. sustainability) are repetitive, they do not mutually exclude each other.

All these comments were taken into consideration in the toolkit revision sessions.

6.2.3. Tests with practitioners

Another session with mostly start-up companies has been held in Borason the 15th of

November on the occasion of a partner's meeting, see Figure 26. Pictures of that workshop are given below, after the list of participants and partner trainers.

Organization	Name	Facilitator
Wernerfelt	Jari Achrenius	Troy Nachtigall
Design by MaLo of Sweden ek.för	Lovisa Källén	Anastasia Pistofidou
Borås ink	Annelie Rådhall	Giulia Francioni
Ameneh Hajabootalebi	Ameneh Hajabootalebi	Marion Real
Koldbath Craft Kollektiv	Cara Boccieri	Helen Milne
Material Guidance Sweden AB	Caroline Connor	Ingrid Grankvist
University of Borås	Sweta Iyer	Marina Castan
Tobex AB	Anne-Lie Hummel Högblom	Marco Mossinkoff

Figure 26 Workshops held in Boras, Sweden

Overall, practitioners have appreciated the toolkit mostly because it makes them think of how to contribute to their value proposition. So the cards mostly made them aware of possibilities. Feedback was mostly about language. Also, the time frame did not allow for the plenary discussions of the findings to be fulfilled. Each participant shared that at the end of the session with the rest of the group for discussions and (dis)confirmation.

In the next section, we give a more specific overview of the changes that have been proposed, discussed and introduced because of these sessions.

7. Revisions of the Toolkit

Several changes to the toolkit were proposed, discussed and executed. These apply first and foremost to the card's contents. Further, comments also apply to the toolkit board, the process or 'modes of play', and finally the outcomes, which we have labelled as journey canvas(es). We elaborate on each of these elements below.

7.1. Strategy Cards

During the sessions we observed how participants used the cards, which cards were discarded, and which ones held or commented upon. Further on, in Transitions WP4, some learning units were merged based on the card's content. This, combined with the toolkit's continuous feedback loop, resulted first in reviewing the language on all the individual cards. Feedback on this was given by all partners during partner sessions and on the shared TRANSITIONS Miro board to make them as comprehensible and accessible as possible for all participants who are going to utilize the toolkit, see Figure 27.
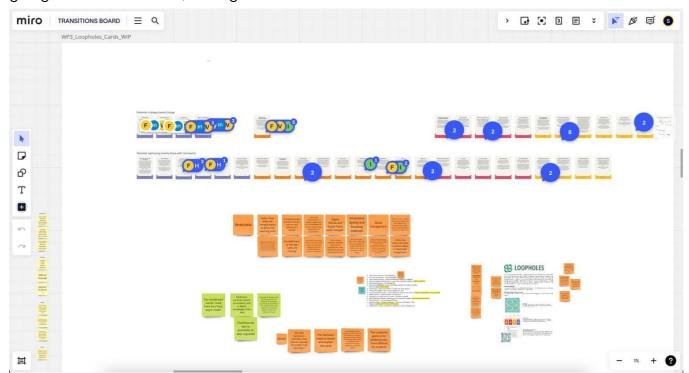
Figure 27 Miro capture showing the collection of feedback from WP3 partners.

The result of the input given by the consortium partners, and of the critical review sessions have led to a definitive set of fifty cards. Some have now changed their title, others have changed concept (moving from a generic strategy to a more specific one), and in some cases only a correction in the description has been suggested to make the strategy clearer.

The final version and validation of the final set is the result of all the abovementioned input plus a plenary discussion amongst trainers, specialists in each of the fields and researchers, see Figure 28.

In the following Table 2 an overview can be found of comments given that have been further processed during the validation session. The changes have been discussed and partly accepted. A final version has been produced of 50 cards, each containing a question (formulated twice, for the HEI and VET levels of understanding), a short description and a more elaborate virtual description.

Table 2 Summary of strategy card changes

Old card name	Change proposed	Reason for the change
Technological Resilience	Should be Tech dependency	That is more specific and clear
Economic resilience	Should be economic debt	Somehow it should be clear that it is about debt structure here
Ecosystems	Competencies change by making it conditional	It is about possible changes in the business

Task Allocation	Becomes alternative financing	Change the card, as that is about heh business model. Ask for alternatives in general, also for economics.
Means of Communication	Loyalty Loops	Should be stimulating to think about new marketing means, instead of the necessary ones.
Reposition	Should be Rebranding?	As positioning only refers to price points.
Blockchain web.3	Should be more specifically about NFC's	As the formulation is too general and has too broad applications
Digital Worlds	We should look at how to make these more sustainable (use them for -).	These are not really sustainable.
Strategic Partnerships	Trust should be included	That is really the core.
Refreshing roles	Use People instead of Employees	We refer to the ecosystem, not the traditional company.
User as stakeholder	Becomes New stakeholders	As these can change roles, and can come from everywhere.
More than Human	Think of sustainability accountancy	That formulation is vague and partial (also ideologically loaden).
Reverse ---	Think of Sustainable to Circular	Overall there are too many cards in this vain. let's be more specific and eliminate a few.
Waste reduction	Energetic Efficiency	That is really what this is about. Waste is too general.
many similar cards (on re-use) in the sustainability category.	Bio- Materials, Chemistry, Reduced Packaging should be introduced.	There are some topics that need to be included instead of only looking at re-use materials.

7.2. Modes of Play

Following the "Fashion meets Design" workshop two (WS2) hosted at the Amsterdam University of Applied Sciences in Amsterdam and at New Order of Fashion in Eindhoven between the 6th and 8th of June 2023 a recommendation was made to implement modes of play into the Loopholes Toolkit.

Initially, three modes were suggested: Informative, transformational, and generative. Informative would be an educational discovery mode aimed at promoting system thinking. The transformational mode would disrupt established businesses and transform them with new strategies. Generative would be a mode played by entrepreneurs ideating their new business. The toolkit could support them in finding new opportunities, identifying gaps in their plan, and recognizing which stakeholders they might need to seek to execute this plan. Each mode of play might require slightly different rules and ways to engage with the strategy cards to fulfill its purpose (see more in "selecting strategy cards").

After collecting feedback from the aforementioned groups over the course of 2024, including students, academic experts, businesses, and more, we realized that the toolkit needed to 1) start from the distinct and specific needs of the user and 2) that it needs to embed a time component in the modes of play, as well as a clear connection between the board, the card themes, and the canvases (initially only Business canvas).

Therefore, we recommend to use the toolkit in two phases: the first is focusing on the description of the present state, that is, using a Project Description canvas and cards to map the strategies that are currently in place or under implementation; the second is an explorative phase of strategies that could support the company transition towards a more sustainable future, while providing suggestions for compliance with upcoming EU legislation. This phase can also occur in 3 rounds, respectively to map out strategies to be implemented in the short (within one year), medium (2-5 years), and long term (5-10 years).

The company goals for the 3 different time "horizons" can also be specified in the Project Description canvas, which was specifically designed to support the specification of the company's activities and strategic positioning.

Other suggestions we make in the manual pertain to:

- The distribution of cards (placed face up) and instructions regarding their moment of use
- the role of facilitators, in charge of time-keeping and neat write up of comments on post its and their placement on the canvases
- the use of the board to initially map strategies with their relevant life-cycle stage (the 4 quadrants: Design, Produce, Use, Information Management).

7.2.1.   Journey Canvases

As the context in which the toolkit is played is different according to the type of business one is referring to, different canvasses have been developed to portray the results of the cards – pick process. The strategies chosen are used to analyze three types of flows, depending on which aspects of the business process are changing. For a B2B context for instance a stakeholder canvas will probably be most affected, whereas for a pure virtual offering the materials canvas is not relevant.

For some companies of course all three are relevant.

To accommodate that, in addition to the Business Canvas, the DSS group has worked on the design of 3 new canvases corresponding to the other themes of the strategy cards: Data Canvas (Digitalization), Stakeholder Canvas (Engagement), and Material Canvas (Sustainability). Despite the matching of the 4 canvases with the card themes, we point out in the manual that cards can also generate insights for different canvases.

Moreover, two-color post-its allow the participants to map out strategies currently in place/under implementation (Phase 1), and new ideas for future implementation (Phase 2). We also include a series of icons with policy proposals in the 3 new canvases to guide participants toward EU legislation compliance; added to the manual to help familiarize its users with the policy proposals.

Figure 29 Users and Partners testing the new canvases

7.2.2. Board (Central) Canvas

In the first version of the board, see Figure 30, several questions were included to offer this guidance, with nine prompts grouped into 'information management', 'design', 'use' and 'produce'.
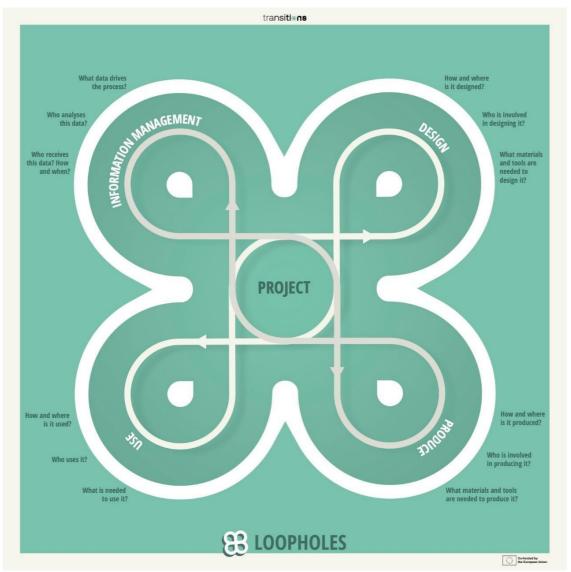
Figure 30 The first version of the board with the questions included. These were removed following the development of the modes of play.

In the final version, after introducing the various modes of play following the feedback received during the extensive testing sessions, the board was evaluated. The canvases allow the user to start their journey by answering more specific questions on the various canvases (including the Project Description canvas), which allow for a tailored point of departure. This has rendered the original, more general questions on the board redundant. In the final version, the questions were removed. This decision was validated in the WP3 partner meeting on 27 May, 2024.

7.3. Loopholes Toolkit Website

Enhancing the Loopholes Toolkit website was also discussed during partner meetings and on the TRANSITIONS Miro board in order to come up with the best ideas for improving the website's accessibility (see Figure 31 below with feedback from partners on TRANSITIONS Miro board):
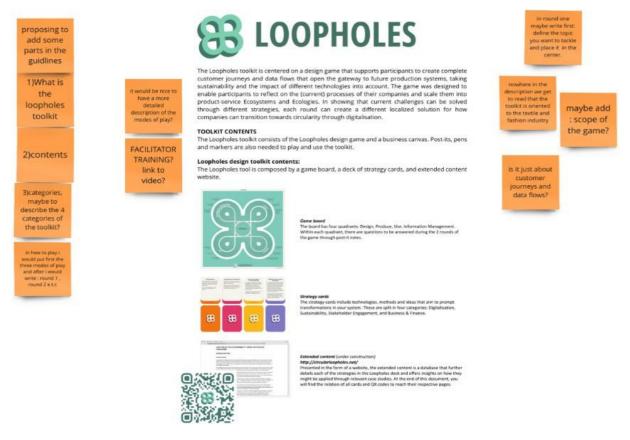
Figure 31 Miro board concerning website adaptations

8. Findings and Future Work

The toolkit like tool has been defined both in terms of contents and process. The cards set to be used contain several possible strategies a company can adopt to develop a fully circular business and production model; the cards have therefore been assigned using the Transition Pathways for European Industrial Ecosystems principles[1]. In a partner meeting on the 27th of June 2024, a workshop was held to group cards into topics suitable for further developing and using the toolkit in the learning unit training sessions of the curricula. Also, the cards have been used to inform the creation of learning modules for the curriculum.

Once the first version of the toolkit had been defined, several iterations of the toolkit have been done, and much feedback collected. Changes have been made and tested in a second version of the toolkit. The main findings in the testing phase – which have led to changes in the toolkit contents and procedures – can be summarized as follows:

- The context in which the toolkit is used depends on the educational level as well as on the initial conditions which are represented by the project, or case, under scrutiny. This meant changing the formulation of the cards (for instance mentioning two questions instead of one) and creating more detailed 'journey canvasses.

- The contents of the cards have been frequently revised. Apart from language and clarity issues, doublings have been eliminated, and topics added.

- The toolkit is flexible, as it can be applied in different business contexts and eventually integrated with a business model canvas to provide longer, business-oriented training.

- The trainer can select the cards beforehand to focus on the topics of interest for the training. The toolkit can then be most effectively integrated into a specific learning module.

- The toolkit is most effective when played amongst 3-5 people.

We have experienced that the physical nature of the toolkit is particularly appreciated by participants (players) as it enhances the engagement and interaction. This adds to the effectiveness of the sessions. Another aspect that makes this toolkit particularly valuable is that it gives participants the possibility to think of radical new possibilities, as well as of strategies that can be immediately implemented. All that in a short period of time. In other words, it constitutes a valuable source of information, but also allows for translating strategies and possibilities into viable business opportunities. The flexibility of the toolkit is of particular importance in terms of 1. variation in the project, or value proposition, it is used for 2. the adaptability to different learning goals and 3. The fact that teachers and lecturers can adapt it to the specific content aims of a training or teaching session.

---

[1] see also: https://single-market-economy.ec.europa.eu/industry/transition-pathways_en (7th July 2024)

9. References

1. Centobelli, P., Cerchione, R., Chiaroni, D., Del Vecchio, P., & Urbinati, A. (2020). Designing business models in circular economy: A systematic literature review and research agenda. Business Strategy and the Environment, 29(4), 1734–1749. https://doi.org/10.1002/BSE.2466

2. Daou, A., Mallat, C., Chammas, G., Cerantola, N., Kayed, S., & Aoun Saliba, N. (2020). The Ecocanvas as a business model canvas for a circular economy. Journal of Cleaner Production, 258, 120938. https://doi.org/10.1016/J.JCLEPRO.2020.120938

3. Ellen MacArthur Foundation & IDEO. (2016). Circular Business Model. Circular Design Guide. Retrieved June 13, 2023, from https://www.circulardesignguide.com/post/circular-business- model-canvas

4. Fehrer, J. A., & Wieland, H. (2021). A systemic logic for circular business models. Journal of Business Research, 125, 609–620. https://doi.org/10.1016/j.jbusres.2020.02.010

5. Forlizzi, J. (2013). The Product Service Ecology: Using a Systems Approach in Design. In Proceedings of the 2nd conference on Relating Systems Thinking and Design (RSD2).

6. Forlizzi, J., Keywords Design Theory, Interaction Design, Product Ecology, & Social Products. (2007). The Product Ecology: Understanding Social Product Use and Supporting Design Culture. International Journal of Design, 2(1), 11–20.

7. Gjerdrum Pedersen, E. R., Earley, R., & Andersen, K. R. (2019). From singular to plural: exploring organizational complexities and circular business model design. Journal of Fashion Marketing and Management, 23(3), 308–326. https://doi.org/10.1108/JFMM-04-2018-0062

8. Hummels, C., & van Dijk, J. (2015). Seven Principles to Design for Embodied Sensemaking. In Proceedings of the Ninth International Conference on Tangible, Embedded, and Embodied Interaction - TEI '14. https://doi.org/10.1145/2677199.2680577

9. Mugge, R., Schoormans, J. P. L., & Schifferstein, H. N. J. (2009). Incorporating consumers in the design of their own products. The dimensions of product personalization. International Journal of CoCreation in Design and the Arts, 5(2), 79–97. https://doi.org/10.1080/15710880802666416

10. Nachtigall, T., Mironcika, S., Tomico, O., & Feijs, L. (2020). Designing ultra-personalized product service systems. CoDesign, 16(4), 274–292. https://doi.org/10.1080/15710882.2020.1842454

11. Nachtigall, T., Tetteroo, D., & Markopoulos, P. (2018). A five-year review of methods, purposes and domains of the international symposium on wearable computing. In Proceedings of the 2018 ACM International Symposium on Wearable Computers - ISWC '18 (pp. 48–55). https://doi.org/10.1145/3267242.3267272

12. Osterwalder, A., Pigneur, Y., & Tim, T. A. - T. T. - C. (2010). Business model generation: A handbook for visionaries, game changers, and challengers. Wiley, Hoboken, NJ.

13. Read, S., Dew, N., Sarasvathy, S. D., Song, M., & Wiltbank, R. (2009). Marketing under Uncertainty: The Logic of an Effectual Approach. Journal of Marketing, 73(3), 1–18. Retrieved from http://www.jstor.org/stable/20619019

14. Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning. Policy Sciences, 4(2), 155–169. https://doi.org/10.1007/BF01405730

15. Smit, D., Oogjes, D., Goveia da Rocha, B., Trotto, A., Hur, Y., & Hummels, C. (2016). Ideating in Skills. In Proceedings of the TEI '16: Tenth International Conference on Tangible, Embedded, and Embodied Interaction - TEI '16 (pp. 78–85). https://doi.org/10.1145/2839462.2839497

16. Sosna, M., Trevinyo-Rodríguez, R. N., & Velamuri, S. R. (2010). Business model innovation through trial-and-error learning: The naturhouse case. Long Range Planning, 43(2–3), 383–407. https://doi.org/10.1016/j.lrp.2010.02.003

17. Tukker, A. (2004). Eight types of product–service system: Eight ways to sustainability? Experiences from SusProNet. Business Strategy and the Environment, 13(4), 246–260. https://doi.org/10.1002/BSE.414

10. Annex A: Comments on the first loopholes session(s)

Did the **Material Engagement** phase and having your samples around you while playing affect your process throughout the workshop? How?
Helps to get into the mindset
Less Restrictions
helpful to reflect on the tools, materials normally used
helpful to explore an experimental, fun aspect of the process
warming up
good duration: short enough to activate difficult to service design at first, made more sense after phrased as "representing the system"
"blurting it out" in writing could also be a way of warming up

Could you describe **what worked well** during the Loopholes Toolkit?
Strategy cards at end of round 1
Acknowledge what is already in the system or what is missing
Acknowledge to what extent that we do something
"The cards were good prompts to get us to think from new perspectives"
Cards worked well because gave new ideas to consider (prompts)
The business prompts might be new to a lot of creatives
"We found we job roles we did not know we needed"
Order of tasks
Exchange ideas with others
Helped breaking down complexity
The pitch at the end of the day
Exchange ideas with others
"The mix of sitting working with it and bouncing thoughts and ideas. Also see what cards which didn't get chosen and see what that would mean for us!"
Description on the cards is good

Could you describe **what did not work well** during the Loopholes Toolkit?
Difficult to go through 40 cards in one session
Needed to spend more time with the cards
Shine finish of the cards makes it hard to photograph
"Information management" could be difficult for some
We need a glossary
Bigger Board would be better
Accessibility (font size and spacing could be improved)
Text on the cards could be larger
Color of the card background – if the bottom of the card is covered, it is not possible to easily identify which category it belongs to
No easy identifiers in the cards: Card Numbers By Category
Calling it a toolkit gave a feeling that there was a right way to play
"it would be good to simplify some [cards] or make them less prescriptive and simpler so that it is easier to apply to your business in the way that you want to rather than describing traditional structures that might not apply to your business"
Based on your knowledge about circularity and industry 5.0 as well as your experience playing it, is there **something that we are missing** in the Loopholes Toolkit?
Way to see the level/stage a strategy is implemented
How about "Onboard" the user?
"Elements of ethics in relation to humans rather than materials. Fair labor practices and structuring a business in terms of paying people well for what they are good at."
The social sustainability as a one of the categories
Communication Styles and Channels
How do the stakeholders relate to each other? (Channels, Platforms, Segments)
Place in the board for the cards in round 2
Recommendations for time or phases of development
Customer and demographic - how to communicate the value to the customer/ sustainable marketing strategies
Could we include a card relating to influence? Considering wider industry and planet with relation to social, cultural and economic perspectives. "How does your business/loophole contribute to the wider loop?"

Numbering / code of the cards
link to how to put ideas/plans into action (e.g. how to write the job role descriptions for the functions identified during the toolkit)
Vertical position of the board to help teamwork & overview
How did the data generated during the Loopholes toolkit feed into your business model?
Helped fund USPs and UBR's
helped understand terrible it would be if Mathew died :(
helped understand how to be more vulnerable and resilient
it would have been useful to recap the Loopholes before filling in the canvas
cards helped giving vocabulary to describe what they do
questions on the business canvas related to the toolkit, which helped filling in the canvas
the combination of the toolkit and the canvas supported exposing vulnerabilities of the business
Also see all aspects as being equally important - your focus may be more on specific areas before playing the toolkit
"The cards we picked out from the toolkit were good to bounce from while we were filling this in."
As mostly designers the business model can be difficult to approach
"We used it [Loopholes toolkit] to help us focus on the element that we wanted to talk about. They helped us to verbalize what we are doing too."
Seeing: Who Does What?
Seeing: How do we do "this"
Cards helped giving vocabulary to describe what they do
How does the business model canvas need to be changed to address circularity?
User as stakeholder is not well represented by the BMC
Every project and concept is different with loopholes
Terminology like Revenue Model and Costs were jarring. Unify the phrases
Conceptually the circularity is difficult to find in the square model
How to show relationships between elements of the canvas
The overlap between the two extremities of the canvas should be explicit
Glossary: Stakeholder

| Glossary: Data |
| the canvas could visually support creatives to understand the relationships and concepts |
| Movable joining arrows would help! |

11. Annex B: Report of the IFFTI session

On April 4, an online workshop was held during the 23rd IFFTI (International Federation of Textile and Technology Institutes) conference, in Dunedin, New Zeeland. Aim of the workshop – called Fluid Ownership and Shared Rewards – was to discuss the loophole toolkit set-up, and in specific some engagement cards of the toolkit. Despite the time difference, some 10 textile academics from all over the world attended the workshop. Summarizing the results, a few points were brought up that helped us refine the toolkit. These points were the following:
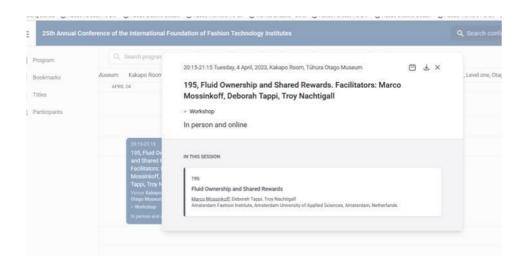
Complexity of the product: the very value proposition of the company in terms of product complexity has consequences for e.g. the amount and role of the partners involved, that should be taken into consideration when designing the toolkit.

Cross boundary communities: local communities to address should cross company boundaries. It is important to think of forms of (imagined) communities that are thematic, and transcend the specific characteristics of the public involved in the process.

Traditional rewards systems in loyalty: looking at the literature about rewards – emotional, hedonic vs functional or utilitarian, helps to understand the incentives that are necessary for

e.g. consumer to input data in the process, during the design but mostly during the post-purchase phase.

Indian forms of collaboration: there are similar forms of co-design design processes, that have existed for centuries in pre-modern socio-economic systems. Examples of these are present in India, not only to create a garment but also in textiles (cfr also Keiretsu's in Japan or even industrial districts theory of A. Marshall).

A recording of the event has been made and shared by the conference organizers.

Source: Author's screen shot.

Source:
https://virtual.oxfordabstracts.com/#/event/3393/program?session=70475&s=15328
Retrieved on 14th April 2023.

12. Annex C: Literature on the business model canvas

Literature on the transition from a linear to a circular business model.

1) Kant Hvass, K., & Pedersen, E. R. G. (2019). Toward circular economy of fashion: Experiences from a brand's product take-back initiative. Journal of Fashion Marketing and Management: An International Journal, 23(3), 345-365.

"…fashion brands need to cope with multiple challenges in the process of developing circular business models in the organization, including: diverging perspectives of value and unclear success criteria, poor alignment with existing strategy, limited internal skills and competences, and limited consumer interest.".

Good if you want to use a quote.

General business model adoption from linear to circular:

2) Centobelli, P., Cerchione, R., Chiaroni, D., Del Vecchio, P., & Urbinati, A. (2020). Designing business models in circular economy: A systematic literature review and research agenda. Business Strategy and the Environment, 29(4), 1734-1749.

A relatively recent literature review on the topic of circular business models.

3) Fehrer, J. A., & Wieland, H. (2021). A systemic logic for circular business models. Journal of Business Research, 125, 609-620.

Explains innovation failure arguing that traditional 'porterian' logic (a.o. the business Model Canvas) fails to explain new circular business models. Adds the need for a complex, institutional perspective (cross-sectorial).

Focus on fashion.

4) Pedersen, E. R. G., Earley, R., & Andersen, K. R. (2019). From singular to plural: Exploring organizational complexities and circular business model design. Journal of Fashion Marketing and Management: An International Journal, 23(3), 308-326.

The case of a service system to design a new shirt.

(Note, also from a prolific author in this field: E.R. Pedersen, from the Copenhagen Business School, CBS Sustainability Centre).

5) Arribas, M., Nylund, P. A., & Brem, A. (2022). Circular business models in the luxury fashion industry: Toward an ecosystemic dominant design?. Current Opinion in Green and Sustainable Chemistry, 100673.

Redesign business models -standardization- towards a circular model. The case of luxury fashion resale.

6) Jacobs, D. (2006). The promise of demand chain management in fashion. Journal of Fashion Marketing and Management: An International Journal, 10(1), 84-96.

Argues that the application of the demand chain management concept – specifically in the realm of fashion – asks for a new understanding of the marketing function within the business model of a firm.

Literature on adaptive planning.

7) Read, S., Dew, N., Sarasvathy, S. D., Song, M., & Wiltbank, R. (2009). Marketing under uncertainty: The logic of an effectual approach. Journal of marketing, 73(3), 1-18.

Extended empirical work on how entrepreneurs use a set of 'effectual' heuristics in tackling with uncertainty and unpredictability, as opposed to managers in larger, longer existing firms.

8) Sosna, M., Trevinyo-Rodríguez, R. N., & Velamuri, S. R. (2010). Business model innovation through trial-and-error learning: The Naturhouse case. Long range planning, 43(2-3), 383-407.

How rapid growth is managed. Explained using concepts from adaptation and organization learning.

9) Svensson, N., & Funck, E. K. (2019). Management control in circular economy. Exploring and theorizing the adaptation of management control to circular business models. Journal of Cleaner Production, 233, 390-398.

Criticism of management control models in the context of a circular economy. How the focus should be on the (pre)development stages, and long-term.