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Circular Design Strategies in Textiles: methods to increase the longevity of products and their impacts

Alessandro Pierattini

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Circular Design Strategies in Textiles:
methods to increase the longevity of products and their impacts

A CURRENT MODEL TO BE REVIEWED

The current design model in the textile industry is unsustainable and harmful in many respects.

It requires a radical rethinking towards circular design practices that privilege

sustainability, social equity and environmental responsibility.

Adopting circular design not only mitigates these negative impacts, but also provides opportunities for innovation, sustainable growth, and improved global working conditions.

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A CURRENT MODEL TO BE REVIEWED

Overproduction and Overconsumption

Fast Fashion: current model is dominated by fast fashion, which pushes for fast, low-cost production of clothing, often at the expense of quality. This leads to excessive wear and rapid obsolescence of garments.

Short Life Cycles: products are designed to be used for short periods and then discarded, which leads to a huge waste of resources and a significant amount of textile waste.

- **Take**
- **Produce**
- **Consumes**
- **Throws**

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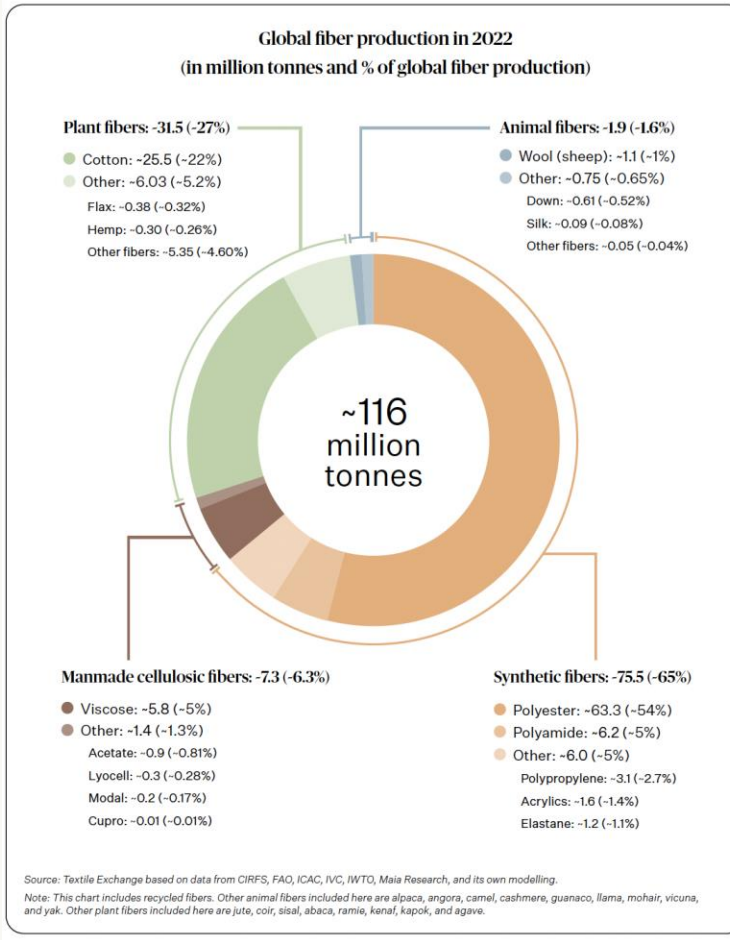
A CURRENT MODEL TO BE REVIEWED

Use of Unsustainable Materials

Virgin synthetic fibres: The massive use of synthetic fibers such as **polyester** and nylon, which are produced from fossil resources, contributes to increased carbon emissions and dependence on fossil fuels. These materials are not biodegradable and are a source of pollution.

Intensive Cotton Cultivation: Conventional cotton production requires **large amounts of water and pesticides,** causing environmental damage and **health problems for agricultural workers**.



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A CURRENT MODEL TO BE REVIEWED

Water Pollution

Dyeing and Finishing Processes: The chemical processes used in the dyeing and finishing of textiles release toxic substances into the water, contributing to water pollution and the destruction of aquatic ecosystems.

Microplastics: Synthetic fibers release microplastics during washing, which end up in oceans and water bodies, entering the food chain and causing harm to marine organisms and, potentially, humans.

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A CURRENT MODEL TO BE REVIEWED

Product End-of-Life Issues

Difficulty of Recycling: Many clothing items are made from fiber blends that are difficult to separate and recycle. In addition, **non-biodegradable coatings and finishes** prevent the efficient recycling of fabrics.

Landfills and Incineration: Much of the discarded clothes ends up in landfills or is incinerated, contributing to the accumulation of waste and air pollution.

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A CURRENT MODEL TO BE REVIEWED

Unethical Working Conditions

Exploitation of Workers: The current model often relies on cheap labor in developing countries, where workers are underpaid and work in dangerous conditions.

Gaps in Regulations: Weak regulations and a lack of transparency in the supply chain make it difficult to monitor and improve working conditions.

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What is Circular Design in Fashion Textiles?

Circular design in fashion textiles 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 minimizing waste and environmental impact. This approach is based on a few key principles:

Product Longevity: Designing **fibers, fabrics, clothes and accessories** that last longer, through the use of resistant materials and high-quality construction techniques.

Repairability and Disassembly: Create products that **can be easily repaired and disassembled, facilitating the reuse of components and the recycling of materials**.

Modularity and Adaptability: Design garments that can be **modified or updated** with new parts, allowing you to adapt to different styles and trends without the need to buy new products.

Recycling and Reuse of Materials: Use **recycled, recyclable and biodegradable materials**, reducing the need for new resources and minimizing waste.

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What is Circular Design in Fashion Textiles?

In the circular economy, products do not have a definitive life cycle with a beginning and an end.

Everything comes back into a circle: When materials stop being used, they return to a virtuous cycle, hence the circular economy. Everything is designed to be regenerative.

Since 2010, Ellen MacArthur has been committed to demonstrating how the circular economy is not only a system capable of responding to environmental limits, but there are also enormous opportunities for business.

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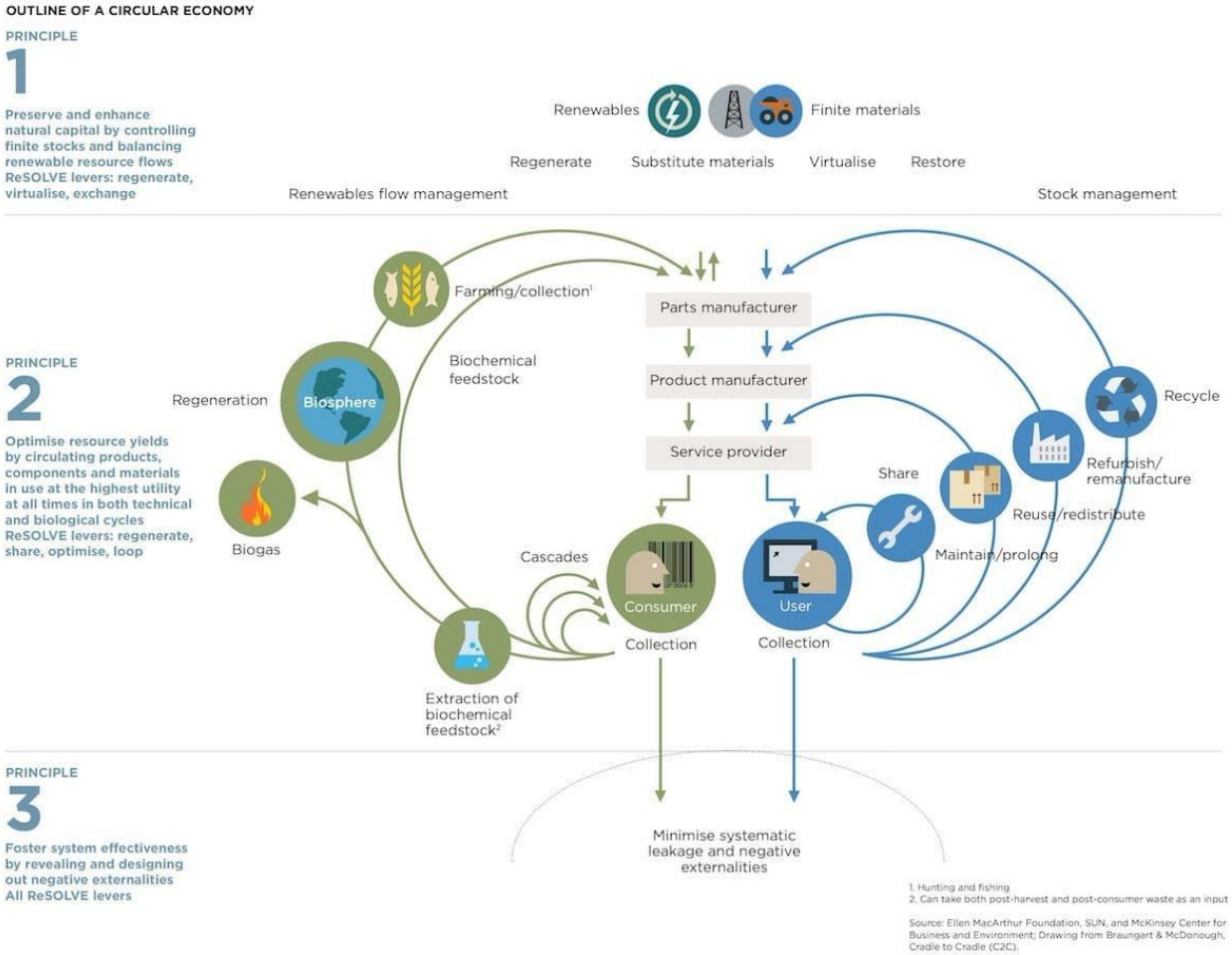
What is Circular Design in Fashion Textiles?

The diagram has a mirror pattern that starts from the top on both sides and returns to it in a sort of loop pattern.

On the left, the **biological cycle** and, on the right, the **technical cycle** of materials. The circular economy aims to optimize the flow of materials in both cycles. It concerns the exploitation, extraction and transformation of products that must be part of a careful system.
In the **technical cycle**, on the left, the life of materials is prolonged, by subjecting them to maintenance, reusing them, redistributing them, reconditioning them, remanufacturing them and, only as a last resort, recycling them as secondary raw materials



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What is Circular Design in Fashion Textiles?

Introduction to the Circular Economy by Ellen MacArthur

The circular economy, as promoted by the *Ellen MacArthur Foundation*, is a regenerative industrial system by intention and design. In contrast to the traditional linear economy ("take-make-dispose"), the circular economy is based on three fundamental principles:

Eliminate and reduce waste and pollution: Design products in a way that minimizes waste generation and pollution.

Keep products and materials in use: Extend the useful life of products through **repair, reuse and recycling.**

Regenerating natural systems: Giving resources back to nature rather than extracting them without limits.

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What is Circular Design in Fashion Textiles?

Working together with companies on a new radical, restorative, regenerative model means starting to think much bigger:

- **Who will satisfy what I am planning?**
- **Who will he put in difficulty?**
- **What positive actions, what effects, what values will what I am planning be able to generate?**

It means thinking beyond the product and its characteristics, beyond the people for whom it is intended.

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What is Circular Design in Fashion Textiles?

When we design according to a circular approach, we imagine products/services/systems that if:

- Reused, they will return to their customers again
- Refurbished they will return to those who produced them for new uses
- Remanufactured will go through a new manufacturing process
- Recyclates will go up the process of materials

TEXTILE DEPARTMENT

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Circular Production Process in Fashion Textiles

Selection of Raw Materials

Regenerable Natural Fibers: Use of organic cotton, linen, hemp etc.

Recycled fibers : are often more polluting than virgin fibers in the production phases, but limit the need to produce new plastic.

Biodegradable Materials: Preference for materials that can decompose naturally.

NATURAL FIBERS
Organic
Vegetable <
Animals

ARTIFICIAL FIBERS
Cellulose
Protein

SYNTHETIC FIBERS Recycled <
Biopolymers?

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BIOPOLYMERS

What is a Biopolymer?

A biopolymer is a polymer derived from renewable biological sources, such as plants, algae, or bacteria.

These materials offer sustainable alternatives to synthetic petroleum-derived polymers and can be used in textile production.

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Biodegradable Biopolymers

Biodegradable biopolymers are materials that can decompose naturally in the environment, thanks to the action of microorganisms, thus reducing the environmental impact.

PLA (Polylactic Acid)

Origin: **Derived from the fermentation of sugars found in corn, sugar cane or other biomass.**

Properties: **Biodegradable, compostable in industrial conditions, transparent, resistant and usable for fabrics and packaging.**

Textile Applications: **Used to produce textile fibers that can be used in clothing, home textiles, and upholstery.**

PHA (Polyhydroxyalkanoates)

Origin: Produced by bacteria through the fermentation of sugars or lipids.

Properties: **Biodegradable in natural environment**, good mechanical and thermal properties.

Textile Applications: Mainly used in specialist applications, such as medical and technical textiles.

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Non-biodegradable Biopolymers

Some biopolymers, although derived from renewable sources, are not biodegradable. However, they offer sustainability advantages over traditional polymers.

Bio-PE (Polietilene Biobased)

Origin: Derived from ethanol produced from sugar cane.

Properties: **Not biodegradable**, but recyclable. It has similar properties to traditional petroleum-derived polyethylene.

Textile Applications: Used to produce strong and durable textile fibers, used in technical clothing, sportswear and textile packaging.

Bio-PET (Polyethylene Terephthalate Biobased)

Origin: Produced partially from renewable materials such as sugar cane.

Properties: **Not biodegradable**, but recyclable. It retains the same properties as traditional PET, such as strength and transparency.

Textile Applications: Used to produce textile fibers for clothing, home textiles, and beverage bottles.

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Non-biodegradable Biopolymers

Some biopolymers, although derived from renewable sources, are not biodegradable. However, they offer sustainability advantages over traditional polymers.

PA 11 (Poliammide 11 Bio-based)

Origin: Produced from: Castor oil, a renewable resource.

Properties: **Not biodegradable**, but recyclable. It maintains high strength, flexibility and durability properties.

Textile Applications:

Technical Clothing: Sports jackets, trousers.

Footwear: Soles and uppers of shoes.

Home Textiles: Curtains, upholstery.

Industrial Fabrics: Filtration, Protection.

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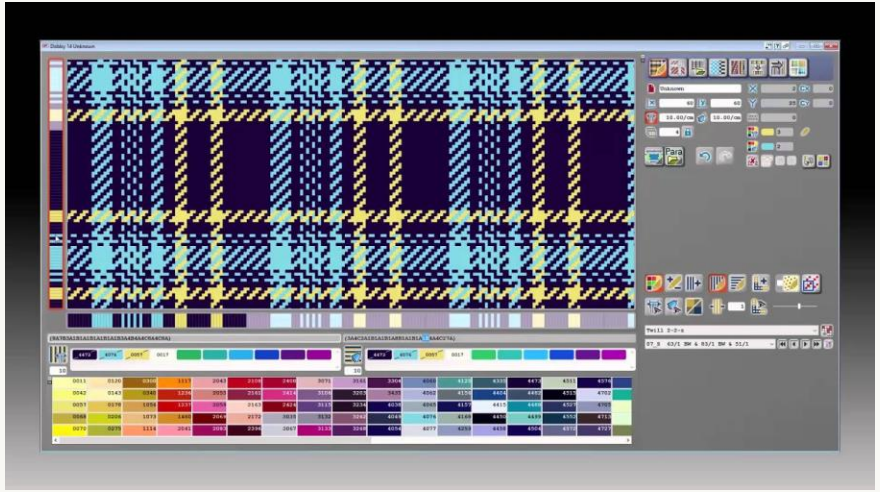
Design

Digitalization: use of CAD software etc. for visual prototyping and saving on the implementation of textile sample.



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Design

Developing: collections of fabrics made with pure materials or from the same family of origin.

Avoiding the mix of various compositions of different nature and not compatible for recycling and reuse processes.

Production waste will be easily manageable.

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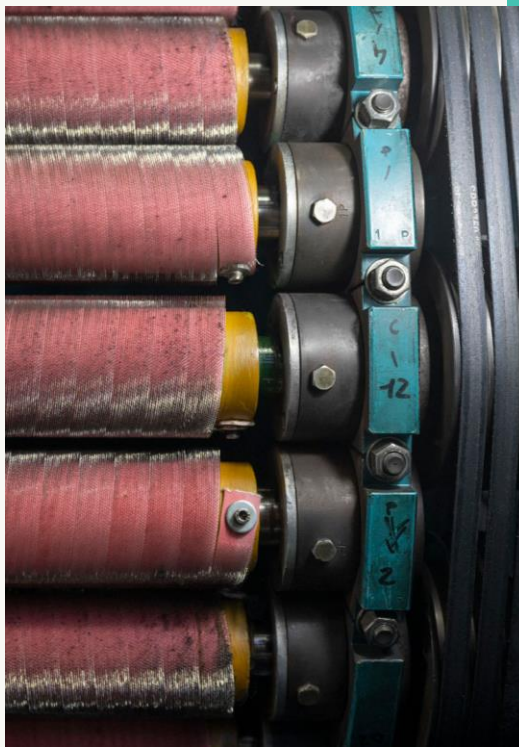
Production

- **Finishing:** use of finishes that have the lowest environmental impact.
- Recommended mechanical finishing (raising, grinding, calendering, etc.)
- Low consumption and use of chemicals
- Low water consumption and use
- Low power consumption



Ozone: Used to bleach and soften fabrics, ozone significantly reduces the use of water and chemicals. It is particularly effective in treating denim.

Plasma: An advanced technology that modifies the surface of tissues without the use of water or chemicals. It can be used to improve water resistance, stain resistance, and to impart other desired surface properties.

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Production

Dyeing and bleaching: use of natural products that have the lowest environmental impact.

- **Natural Dyes or Alternative Pigments**: Use of dyes derived from plants, minerals and other natural sources.
- **Enzyme Dyeing:**Enzymes can be used for eco-friendly dyeing and bleaching processes, reducing the use of dangerous chemicals.

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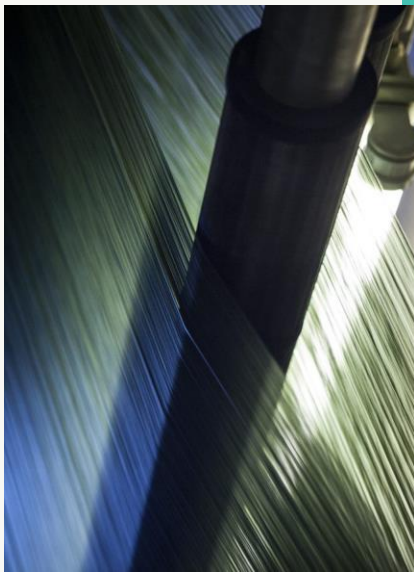
Production

Low Impact Dyeing:

- **Low Temperature Dyeing:** Reduce the temperature of dyeing processes to save energy. Technologies such as cold dyeing can be very effective.
- **Supercritical Dyeing:** Use of supercritical CO2 for the dyeing process, completely eliminating the use of water and reducing energy and chemical consumption. (**limited for polyester**)



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Circular Production Process in Fashion Textiles

Production

Biodegradable finishes:

- **Biopolymer-Based Coatings:** Using biopolymers derived from renewable resources, such as PLA (polylactic acid), to create coatings that improve fabric properties and are biodegradable.
- **Natural Seed Oil:** Impregnation of fabrics with natural oils such as linseed oil to improve resistance to water and stains without the use of synthetic chemicals.
- **Coating with natural bee wax**: Natural waterproofing processes

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Research

- **Life Cycle Analysis(LCA):** Assessment of the environmental impact of the entire product life cycle to identify areas for improvement.
- **Materials Research:** Identification and development of sustainable and recyclable materials, such as organic natural fibers and recycled and certified fibers.

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Circular Production Process in Fashion Textiles

Product Design and Development

Design for Durability: Creation of robust and long-lasting garments.

Design for Repairability: Design garments with accessible seams and interchangeable parts for easy repair.

Modularity and Adaptability: Creating garments that can be easily modified or updated, such as jackets with detachable sleeves or trousers that can be converted into shorts.

TO AVOID: Different material mix: avoid the use of fabrics of different kinds or with mixed compositions in the same product.

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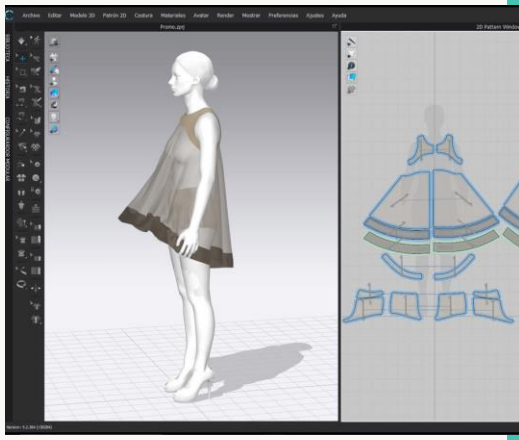
Computer Aided Design(CAD)

Virtual Prototyping: Create digital prototypes of clothing to evaluate design, fit, and aesthetics before physical production. **This reduces the need to create physical samples, saving materials and reducing waste.**

Digital Pattern Making : Use CAD software to develop precise and efficient cutting patterns, **minimizing fabric waste.**



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Circular Production Process in Fashion Textiles

Production

Low Impact Cutting and Sewing Techniques: Implementation of cutting and sewing techniques that minimize waste, such as ***zero-waste*** pattern making.

Sustainable Production Methods: Use of renewable energy (solar, wind, etc.) in production processes.

Local Production: Localization of production to reduce the environmental impact of transport and support local economies.

Respect for workers' rights: verification of social sustainability in the supply/production chain.

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Distribution and Logistics

Sustainable Packaging: Use of recycled and recyclable packaging materials. (possibility to recycle your waste as packaging etc.)

Low-impact logistics: Optimisation of supply chains to reduce carbon emissions, use of low-impact transport vehicles**. (local production)**

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Use and Maintenance

CLEAR care labels: inform the customer with labels that demonstrate the correct maintenance of the product for a long life.

Consumer Information: Providing detailed information on how to maintain and repair garments.(**repair kits and tutorials**)

Repair Services: Offering **repair and maintenance services** to extend the life of your products, such as repair shops and take-back programs.

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Recovery and Recycling

Take-back and Recycling Programs: Implementation of programs for the collection of used garments, which can be repaired, recycled or disassembled to recover parts or materials. **UPCYCLING**

Second Life of Products: Promotion of the reuse of garments through the sale of used clothing and exchange platforms organized by the company itself.

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Circular Production Process in Fashion Textiles

Transparency Systems

- Certifications
- Blockchain and Web3 Technologies
- EU Digital Passport - DPP

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Circular Production Process in Fashion Textiles

Transparency Systems

Certifications

Certifications are awards issued by independent third parties that certify that a **product or production process meets certain standards of sustainability and ethics.**

Impact

Sustainability Standards: Certifications such as GOTS (Global Organic Textile Standard), OEKO-TEX, etc. guarantee that materials and production processes comply with strict environmental and social standards.

Credibility and Trust: Consumers can rely on these certifications to make informed purchasing decisions, knowing that the products have been verified for their sustainability.

Regulatory Support: Certifications help standardize sustainable practices in industry, facilitating the regulation and adoption of circular practices globally as well as the management of recycled materials.

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Transparency Systems

Blockchain and Web3 Technologies

Blockchain is a distributed ledger technology that allows transactions to be recorded in a secure, transparent, and immutable way. Each transaction is recorded in a "block" and linked chronologically to previous blocks, creating a chain of information. These methods are often associated with certification processes.

Impact

Immutable traceability: Each step of a product's production and distribution can be recorded on the blockchain, ensuring complete and unalterable traceability. This helps prevent fraud and ensure the authenticity of the products.

Authenticity and Certifications: Using Web3 technologies, manufacturers can issue digital certificates of authenticity and sustainability, which are verifiable by consumers and independent third parties.

Transparency of the Supply Chain: Blockchain can record information about suppliers, labor practices, environmental conditions, and more, giving you a clear and transparent view of your supply chain.

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Circular Production Process in Fashion Textiles

Transparency Systems

What is the Digital Passport? (DPP) March 2024

A digital passport is a document that accompanies a product throughout its life cycle, providing detailed information on every step of the process, from the materials used to production, distribution, use and end of life. (From 2027 to 2033 final)

Impact

Material Traceability: Each component of the product can be traced back to its origin, ensuring that it comes from sustainable and ethical sources.

Product History: Consumers can access the full history of the product, including details on repairs and maintenance carried out, promoting more conscious and prolonged use.

Facilitation of Recycling: Detailed information on materials and product construction techniques facilitates the end-of-life recycling process, making it easier to separate and recover materials.

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Circular Production Process in Fashion Textiles

Transparency Systems

What is the Digital Passport?

Main Objectives of the DPP

Transparency: Provide detailed and verifiable information on every stage of the product lifecycle, increasing transparency for consumers and businesses.

Traceability: Improve the traceability of materials and production processes, facilitating the sustainable management of resources.

Sustainability: Promote circular economy practices, such as the reuse, repair and recycling of products, reducing waste and environmental impact.

Compliance: Ensure that products comply with European regulations on sustainability and social responsibility.

Competitiveness: Differentiate products based on quality and sustainability, facilitating competition against fast fashion.

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Circular Production Process in Fashion Textiles

Transparency Systems

What is the Digital Passport?

Main Components of DPP

Product Description: Detailed product information, including dimensions, materials, and technical characteristics.

Composition: Details of the materials used, including the percentage of fibers and the presence of animal components.

Supply Chain: Traceability of production steps, from raw material to finished product, including supplier information.

Transport: Data on the methods and distances of transport of materials and products.

Environmental and Social Impact: Information on the environmental and social impact of the product, including certifications and audits.

Circularity: Data that promotes reuse, repair and recycling, and informs consumers on how to properly dispose of products at the end of their life.

NEW EU REGULATIONS

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LAST NEW Ecodesign for Sustainable Products Regulation (ESPR)

On 27 May 2024, the EU Council adopted the Ecodesign Regulation, which sets out sustainable product requirements for almost all types of goods placed on the EU market.Tali requisiti includono:

- durability, reusability, upgradability, and repairability of the product
- rules on the presence of substances that inhibit circularity
- Remanufacturing and recycling options
- Carbon and environmental footprint
- Energy and resource efficiency

The new regulation also introduces a ban on the destruction of unsold textiles and footwear.

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LAST NEW Ecodesign for Sustainable Products Regulation (ESPR)

The Council of the European Union has adopted the new Ecodesign Regulation, which sets requirements for sustainable products. This regulation replaces the previous Ecodesign Directive and broadens its scope to include with a few exceptions (e.g. cars or products related to defence and security). all types of goods placed on the EU market,

Requirements for Sustainable Products

The regulation introduces new requirements for the durability, reusability, upgradability and repairability of products, rules on the presence of substances that inhibit circularity, energy and resource efficiency, recycled content, regeneration and recycling, carbon and environmental footprint, and information requirements, including a ***Digital Product Passport.***

The Commission will be empowered to set specific requirements through delegated acts, and industry will have 18 months to comply.

LAST NEW Ecodesign for Sustainable Products Regulation (ESPR)

Application in Public Contracts

Ecodesign criteria will be applicable in public procurement to incentivise the public purchase of environmentally friendly products. The new regulation introduces a direct ban on the destruction of unsold textiles and footwear (SMEs will be temporarily excluded) and authorises the Commission to introduce similar bans for other products in the future.

The regulation will be aligned with the ***Digital Services Act*** with regard to products sold online.

*In the context of the Ecodesign Regulation, the **Digital Services Act** aligns with the new sustainability requirements. Online platforms will have to ensure that the products sold comply with ecodesign standards, including durability, reusability, upgradability and repairability requirements. This means that platforms will have greater responsibility for verifying product compliance with environmental regulations.

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LAST NEW Ecodesign for Sustainable Products Regulation (ESPR)

Next Steps

Following the Council's approval, the legislative act was adopted.

After signature by the President of the European Parliament and the President of the Council, the regulation will be published in the Official Journal of the European Union and will enter into force on the 20th day following its publication.

It will apply from **24 months after its entry into force**.

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LAST NEW Ecodesign for Sustainable Products Regulation (ESPR)

Context

The current Ecodesign Directive (2009/125/EC) set energy efficiency requirements for 31 product groups, saving €120 billion in energy costs and reducing the annual energy consumption of covered products by 10%.

The new regulation was proposed by the Commission on 30 March 2022, the Council adopted its general approach on 23 May 2023 and reached a provisional agreement with Parliament on 4 December 2023.

STRATEGIES & BENEFITS

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Circular Production Process in Fashion Textiles

Strategy Summary

Design for Durability

Design for Repairability

Modularity and Adaptability

Use of Sustainable Materials

Eco-Sustainable Production Technologies

Circular Business Models

Traceability and Transparency

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Circular Production Process in Fashion Textiles

Summary of the benefits of circular design.

Waste Reduction

Minimization of waste through the reuse, repair and recycling of products - Reduction of production waste and post-consumer waste.

Resource Efficiency

Ottimizzause of natural and material resources - Promotion of the reuse of materials and the closure of the cycle.

Reduced environmental impact

Decrease CO_2 emissions through more efficient and sustainable production processes - Reduce water and soil pollution through the use of environmentally friendly chemicals or bio-based products.

Economic benefits

Creazion of new business opportunities through circular economy models - Reduction of waste production and management costs.

Added Value for Consumers

Offering superior quality and long-lasting products - Greater transparency and information for consumers, promoting informed purchasing choices.

Social Benefits

Job creation related to repair and recycling services. - Improvement of working conditions and promotion of ethical practices along the production chain.

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Current critical issues of circular design.

High Implementation Costs

Initial investments: Implementing circular design practices can require significant upfront investment in research, development, and advanced technologies.

Cost of Sustainable Materials: Sustainable and recycled materials can be more expensive than conventional alternatives, making it difficult to compete on price.

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Current critical issues of circular design.

Supply Chain Complexity

Traceability: Ensuring complete traceability of materials along a global supply chain can be complex and costly.

Transparency: Ensuring transparency at all levels of the supply chain, from raw materials to production, requires advanced monitoring and certification systems.

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Current critical issues of circular design.

Resistance to Change

Consumer Mindset: Consumers may be reluctant to change their shopping habits and pay a premium for sustainable products.

Inertia of Companies: Established companies may be reluctant to adopt new business models and circular design practices due to perceived costs and risks.

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Current critical issues of circular design.

Technologies and Infrastructures

Availability of Advanced Technologies: Not all regions have access to advanced technologies needed to support circular design, such as advanced recycling and on-demand manufacturing.

Recycling Infrastructures: The lack of adequate recycling and waste management infrastructure can hinder the closure of the material cycle.

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Current critical issues of circular design.

Regulations and Standards

Lack of Clear Regulations: The absence of clear and uniform regulations and standards globally can create uncertainties and obstacles for companies looking to implement circular design practices.

Regulatory compliance: Staying compliant with an ever-changing regulatory framework can be challenging and costly.

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Current critical issues of circular design.

Education and Awareness

Limited Awareness: Lack of awareness and knowledge about the benefits and practices of circular design can limit its adoption by consumers and businesses.

Formation: The need for continuous training for designers and workers on new sustainable techniques and practices.

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Current critical issues of circular design.

Scalability

Large-Scale Production: Moving from small-scale to large-scale circular manufacturing can be complex and costly, requiring new business models and manufacturing processes.

Economic efficiency: Ensuring that circular design practices are economically viable at scale is a significant challenge.

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CONCLUSIONS

Despite its many benefits, circular design in the textile/fashion industry faces several critical issues that limit its adoption on a large scale.

Addressing these obstacles requires a shared commitment from all stakeholders, including governments, businesses, and consumers.

Innovative solutions, investments in technology and infrastructure, and increased awareness and education can help overcome these challenges and promote a more sustainable future for the fashion industry.

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CONCLUSIONS

How can we think of being sustainable without considering the entire life cycle of our products?

How can we justify the use of non-recyclable materials at a time when natural resources are increasingly scarce?

How can we guarantee the quality of our products and expect consumer trust without full traceability throughout the supply chain?

How can we promote sustainability if our employees and customers are not properly informed?

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Circular Production Process in Fashion Textiles

CONCLUSIONS

Is it possible to remain competitive without investing in innovations that reduce our environmental impact?

How can we talk about social responsibility without adhering to recognized certifications?

How can we be prepared for the future without complying with emerging environmental regulations?

How can we look at the upfront costs without assessing the long-term benefits of sustainability?

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