SUSTAIN TEXT

Co-funded by the European Union

Guideline on how to use the identified methods practically and how they can reduce the negative impact of the industry on the climate

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Introduction

In a world increasingly aware of the environmental challenges we face, the urgency to reshape industries and practices towards sustainability has never been more pressing. The textile industry, a cornerstone of modern life, stands at the forefront of this transformative journey. The Guideline from the European project “Sustainable Textile” is a pivotal document that emerges from a resolute commitment to catalyze change and embrace a regenerative growth model—one that seeks to give back to the planet more than it takes.

The overarching objective of this project is to act as a catalyst in accelerating the transition towards a regenerative growth model within the textile industry. This transition, essential to meet the imperatives set forth by the European Green Deal, not only aims to mitigate environmental harm but also endeavors to create value, reduce waste, and curtail the 'fast-fashion' phenomenon. It is a call to action that resonates with the ideals of a circular economy, sustainable investment, and responsible production processes.

At its core, this initiative seeks to address several specific objectives, each playing a vital role in the broader mission:

- Accelerating Transformational Change
- Mitigating Greenhouse Gas Emissions.
- Enhancing Value and Reducing Waste
- Curbing the 'Fast-Fashion' Phenomenon
- Coherence with Existing Initiatives
- Optimal Utilization of Recovery Plans
- Promoting Reuse and Recycling

To achieve these ambitious objectives, the guideline is rooted in comprehensive research encompassing various sustainable design approaches. Within these pages, we delve into the intricacies of three key approaches:

Fashion Zero Waste

Traditional Dipping "from India”

Collaboration between Cutting and Packing

This research spans the globe, drawing insights from both European and international best practices. It stands as a testament to our commitment to understanding and implementing the most sustainable strategies within the textile industry.

As we embark on this transformative journey, guided by these principles and research findings, we invite all stakeholders within the textile industry to join us in advancing sustainable design

practices. Together, we can create a future where textiles not only adorn our lives but also enrich our planet.

This guideline serves as a roadmap—a collective vision—to guide the textile industry towards a sustainable, regenerative, and responsible future.

1. EUROPEAN POLICIES

There are now many policies and strategies that the European Union has adopted to tackle climate change and make all industrial sectors more sustainable.

In particular, several policies are aimed at the textile sector with the aim of promoting more sustainable production processes.

Let's take a look at some of these and in particular the new EU strategy on textiles.

European Green Deal

The main features of the European Green Deal will be analysed point by point below.

Shared objectives: The European Green Pact aims to achieve climate neutrality by 2050 and to transform the EU economy towards a sustainable model.

Waste reduction: The European Green Pact aims to reduce waste generation and promote the circular economy. The module focusing on waste in the fashion industry highlights how the fashion industry is a significant source of waste, either through discarded garments or waste generated during production. By highlighting the importance of reducing this waste and promoting the reuse, recycling and repair of garments, the module aligns with the circular economy principles promoted by the Green Pact.

Natural fibres as sustainable alternatives: The module also highlights examples of natural fibres, such as organic cotton, linen and wool, which are more sustainable options compared to synthetic fibres. This relates directly to the objectives of the European Green Pact, which seeks to reduce the use of toxic materials and chemicals, as well as promote biodiversity and environmental protection. By encouraging the use of natural fibres, the module contributes to reducing the environmental impact of the fashion industry and aligns with the principles of the pact.

Policies and regulations: The European Green Pact includes measures to promote sustainability in fashion, such as stricter regulations in terms of the use of hazardous chemicals and the promotion of more sustainable production practices. The module can highlight how natural fibres meet these stricter standards and how the policies and regulations proposed by the pact can further support the adoption of these sustainable alternatives in the fashion industry.

Education and awareness: The European Green Pact also seeks to promote education and awareness on sustainability and the environment. The module in question, by providing information on waste in the fashion industry and promoting more sustainable alternatives such as natural fibres, contributes directly to the education and awareness of students or participants. This can help to promote a change in mindset and drive demand for more sustainable practices in the industry.

Circular Economy Action Plan

Shared objectives: The EU Circular Economy Action Plan aims to transform the linear model of production and consumption into a circular model, where products and resources are used more efficiently and waste generation is reduced. The module on waste from the fashion industry and natural fibres aligns with these objectives by directly addressing the issue of waste in fashion and promoting the adoption of more sustainable and circular practices.

Circular economy in fashion: Fashion is one of the industries that generates a large amount of waste, from the production stage to the consumption and discarding of garments. The module highlights how adopting circular economy practices in fashion, such as reusing, recycling and repairing garments, can significantly reduce the waste generated. In addition, promoting the use of natural fibres instead of synthetic fibres also aligns with circular economy principles, as natural fibres are renewable and biodegradable.

Sustainable design and production: The EU Circular Economy Action Plan seeks to promote sustainable design and production in all industries, including fashion. The module can address how designing durable products, choosing sustainable materials such as natural fibres and implementing more efficient production practices can reduce waste and promote circularity in the fashion industry.

Innovation and collaboration: The Circular Economy Action Plan also highlights the importance of innovation and collaboration between different actors to achieve a circular economy. The module can mention examples of collaboration between designers, manufacturers, brands and consumers to implement more sustainable practices in fashion, such as the use of advanced textile recycling technologies and the promotion of consumer awareness of the importance of circular fashion.

Policies and regulations: The EU Circular Economy Action Plan includes policies and regulations to promote the circular economy in different sectors, including fashion. The module can highlight how these policies and regulations, such as those related to the use of hazardous

chemicals, textile waste management and the promotion of reuse, support and reinforce the importance of addressing waste in the fashion industry.

EU strategy for sustainable and circular textiles: creating a greener and more competitive textile sector

The European Green Deal, the Circular Economy Action Plan (CEAP) and the Industrial Strategy identified textiles as a priority sector in which the EU can pave the way towards a carbon neutral, circular economy, and announced an EU strategy on textiles. Textiles and clothing make up a diverse industrial ecosystem covering different value chains and types of products. The industry employs 1.5 million people, spread across more than 160,000 companies in the EU, most of which are SMEs, with an EU annual turnover of 162 billion euros in 2019.
On 30 May 2022, the European Commission adopted the EU Strategy for Sustainable and Circular Textiles with the main objective of creating a greener and more competitive textile sector. The Strategy, launched in 2022 by the European Commission, is part of the Circular Economy Action Plan 2020, mentioned in the previous chapter, whose aim is to accelerate the transition to a circular and sustainable economy in several sectors, including textiles. Furthermore, the strategy is among the initiatives of the New Industrial Strategy for Europe aimed at achieving the latter's objectives.
The EU strategy addresses the production and consumption of textiles, in recognition of the importance of the sector, and in implementing the commitments of the European Green Deal, the New Circular Economy Action Plan and the Industrial Strategy.

Textiles are the fabric of everyday life - in clothes and furniture, medical and protective devices, buildings and vehicles. However, urgent action is needed as their impact on the environment continues to grow. Textile consumption in the EU has, on average, the fourth highest impact on the environment and climate change, after food, housing and mobility. It is also the third highest area of consumption for water and land use, and the fifth highest for primary raw material use and greenhouse gas emissions.
The strategy looks at the entire life cycle of textile products and proposes coordinated actions to change the way we produce and consume textiles. The strategy aims to create a greener and more competitive sector that is more resilient to global shocks. The Commission's Vision 2030 for the textile sector is:

- all textile products placed on the EU market are durable, repairable and recyclable, largely made of recycled fibres, free of hazardous substances, produced with respect for social rights and the environment.
- 'fast fashion is out' and consumers benefit longer from affordable, high quality textiles
- profitable reuse and repair services are widely available

- The textile sector is competitive, resilient and innovative, with manufacturers taking responsibility for their products along the value chain with sufficient capacity for recycling and minimal incineration and landfill.

Actions

The strategy sets out a series of forward-looking actions. The Commission intends to:

- ➔ Set design requirements for textiles to make them last longer, easier to repair and recycle, as well as requirements on minimum recycled content
- ➔ Introduce clearer information and a digital product passport
- ➔ Reverse overproduction and overconsumption and discourage destruction of unsold or returned textiles
- ➔ Tackle the unintentional release of microplastics from synthetic fabrics
- ➔ Tackle greenwashing to empower consumers and raise awareness of sustainable fashion
- ➔ Introduce mandatory and harmonised rules on producer responsibility for textile products in all Member States and incentivise producers to design more sustainable products
- ➔ Limit the export of textile waste and promote sustainable textiles globally
- ➔ Stimulate circular business models, including re-use and repair sectors
- ➔ Encourage businesses and Member States to support the objectives of the strategy

Implementation

- ➔ The eco-design regulation for sustainable products, proposed in 2022, establishes a framework for setting eco-design requirements for products, including textiles.
- ➔ The Directive on Empowering Consumers in the Green Transition Directive and the Directive on Green Claims, proposed in 2022 and 2023, aim to combat greenwashing.
- ➔ The 'Reset the Trend' (#ReFashionNow) campaign was launched in 2023 to raise awareness for sustainable fashion.
- ➔ The regulation on waste shipments, proposed in 2021, will help limit the export of textile waste.
- ➔ The transition pathway for the textile ecosystem, published in 2023, and the European Stakeholder Platform for the Circular Economy (from 2018) promote and foster cooperation between industry, public authorities, social partners and other stakeholders.

- ➔ Within the framework of Horizon Europe, calls have been made to further develop technologies and processes that increase circularity and sustainability in the textile sector.
- ➔ In 2023, the Commission proposed a revision of the Waste Framework Directive to introduce mandatory and harmonised Extended Producer Responsibility (EPR) schemes for textile products in all EU Member States.

In short, the EPR aims to enhance sustainable and quality products, proposes actions for the whole life cycle of textile products and supports the ecosystem in the green and digital transitions. It focuses in particular on the way textile products are designed and consumed, including by examining sustainable technological solutions and innovative business models.

The central objective of the Strategy is to suggest actions and measures with which to enhance products that favour quality and sustainable production processes and to curb the fast-fashion phenomenon.

Possible actions to be implemented

An effort is now needed to understand how to apply these strategies practically:

- Strengthen the role of small and medium-sized enterprises in the textile and footwear sectors, whose business models emphasise product quality and sustainable production processes, unlike typical fast-fashion models.
- Highlight the figures of tailors, shoemakers and cleaners as they specialise in the textile and footwear sector. Activities that, through their professional repair and maintenance services, help limit the environmental impact of the textile sector and contribute positively to the reduction of waste water to make textile and footwear products more durable.
- Encourage the recovery, and reuse, of textile waste for the use of secondary raw materials for subsequent production and the establishment of innovative hubs (Textile hubs) for the recovery and reuse of textile waste.
- Provide for proportionate and equally distributed obligations throughout the production chain in application of the principle of extended producer responsibility to protect subcontractors (which are often micro, small and medium-sized enterprises).
- Strengthen free market surveillance measures to ensure that textile and footwear products sold comply with EU sustainability principles

Global Fashion Transparency Index 2023

Sustainability in the fashion sector not only regards the production.
The most pressing issues in the fashion industry, including the climate crisis, decent work and decent wages, waste and overproduction, and legislation.
The Global Fashion Transparency Index is a tool we use to push major brands to be more transparent about their operations and supply chain to enable civil society, industry experts and citizens to demand greater accountability in the global fashion industry.

The index collects 64,500 data points across 258 different indicators, from supply chain traceability to carbon emissions, purchasing practices to sustainable materials, hazardous chemicals to microplastics and more.

Anyone, anywhere should be able to find out how, where, by whom and under what conditions their clothes are made

The greater level of transparency we have in the fashion supply chain, the more information we have to hold big brands to account, and the more we can inform our activism to demand better.

Shopping alone will not achieve systemic change. While we do encourage individual efforts towards conscious consumerism, we need everyone's voices to come together and challenge the root causes of this exploitative, extractive and unjust system by calling on brands and policymakers for change.

The hope is to see a fashion industry where transparency and accountability are so deeply embedded that the Fashion Transparency Index no longer needs to exist.

2. PRACTICAL SOLUTIONS

a. Fashion zero waste

The fashion zero waste movement aims to reduce the environmental impact of the fashion industry by minimizing waste and promoting sustainability. The fashion industry is known for its high levels of waste, from the overproduction of clothing to the use of materials that are harmful to the environment. The fashion zero waste movement seeks to change this by promoting a more circular fashion system, where resources are used more efficiently and waste is minimized at every stage of the fashion supply chain.

Environmental problems caused by the Fashion Industry

The fashion industry has a disastrous impact on the environment.
Putting the environmental perspective at the center, rather than the logic of the industry, is thus an urgent concern if fashion is to become more sustainable.
Globalization has made it possible to produce clothing at increasingly lower prices, prices so low, and collections shifting so fast, that many consumers consider fashion to be disposable. However, fast, and thus disposable, fashion adds to pollution and generates environmental hazards, in production, use, and disposal.
High water usage, pollution from chemical treatments used in dyeing and preparation and the disposal of large amounts of unsold clothing through incineration or landfill deposits are hazardous to the environment.
Only around 20% of clothing is recycled or reused, huge amounts of fashion product end up as waste in landfills or are incinerated. It has been estimated that in the UK alone around 350,000 tons of clothing ends up as landfill every year.

Sustainable fashion

Is a term describing products, processes, activities, and actors (policymakers, brands, consumers) aiming to achieve a carbon-neutral fashion industry, built on equality, social justice, animal welfare, and ecological integrity. Sustainable fashion concerns more than addressing fashion textiles or products. It addresses the entire process in which clothing is produced, consumed and disposed; who, what, how, when, where and the expected useful life of the product before entering landfill. The sustainable movement looks to combat the large carbon footprint that fast fashion has created by reducing the environmental impact of fashion such as air pollution, water pollution and overall climate change.

Adherents of the sustainable fashion movement believe that the fashion industry has a clear opportunity to act differently, pursuing profit and growth while also creating new value and deeper wealth for society and therefore for the world economy.
The goal of sustainable fashion is to create flourishing ecosystems and communities through its activity. The movement believes that clothing companies ought to place environmental, social, and ethical improvements on management's agenda. This may include:

- Increasing the value of local production and products;
- Prolonging the life cycle of materials;
- Increasing the value of timeless garments;
- Reducing the amount of waste;
- Reducing the harm to the environment as a result of production and consumption.

Another goal is to educate people to practice environmentally friendly consumption by promoting the "green consumer", which can allow for the company itself to gain more support and a larger following. Green consumerism is the change in consumer behavioral attitudes that advocates the efficient use of energy, and reducing greenhouse gas emissions.

Fast fashion

One of the most apparent reasons for the current unsustainable condition of the fashion system is related to the temporal aspects of fashion; the continuous stream of new goods onto the market, or what is popularly called "fast fashion." The term fast fashion is used to refer to the fast paced production of goods at an unethical level which often has a negative impact on the environment. As a way to conform to the latest fashion styles and keep consumers wanting new garments, current fast fashion trends pre-suppose selling clothing in large quantities. Due to fast fashion being affordable and able to keep up with the trends, there has been an increase in apparel consumption.

Slow fashion

Sustainable fashion, predominantly ethical and ecological in fashion, requires a change in infrastructure and a reduction in the production of assets.
Slow fashion challenges growth fashion's obsession with mass-production and globalized style. It becomes a guardian of diversity and changes the power relations between fashion creators and consumers, therefore forging new relationships and trust that are only possible at smaller scales. It fosters a heightened state of awareness of the design process and its impacts on resource flows, workers, communities, and ecosystems.

Garment use and lifespan

The environmental impact of fashion also depends on how much and how long a garment is used. With the fast fashion trend, garments tend to be used half as much as compared to 15 years ago. This is due to the inferior quality of fabrics used but also a result of a significant increase in collections that are being released by the fashion industry. Typically, a garment used daily over years has less impact than a garment used once to then be quickly discarded.

So how can fashion be more sustainable?

Many designers, brands, and scientists are exploring ways to make fashion more sustainable and circular.

Less waste

Since 80 to 90 percent of the sustainability of a clothing item is determined by decisions made during its design stage, new strategies can do away with waste from the get-go.
To eliminate the 15 percent of a fabric that usually ends up on the cutting room floor in the making of a garment, zero waste pattern cutting is used to arrange pattern pieces on fabric like a Tetris puzzle.

Better materials

Many brands are using textiles made from natural materials such as hemp, ramie or bamboo instead of cotton.
Textiles are also being made with fibers from agriculture waste, such as leaves and rinds. Many brands are using orange fibre or cupro, fully biodegradable and recyclable yarns and fabrics made from the fibres of kapok tree pods in a tree-friendly process.

Upcycling

It involves taking an old piece of clothing and creating a new garment with higher quality value. One example of "Upcycling" is the nets that are disposed in the water by the fishermen once they are damaged, and they can be recycled and used to create new clothes so they don't become a danger for the marine especies.

Repurposing

Involves turning an old piece of clothing into something else. For example, an old t-shirt can become a bag, a scarf or a pillow case.

Minimalistic fashion

Is about creating a capsule wardrobe, a small collection of high quality clothes that can be mixed and matched to create various looks

DIY Fashion

You can create your clothes from scratch using sustainable and natural materials

b. Traditional Dipping "from India”

The textile industry is one of the largest and most polluting industries in the world, and dying clothes is a significant contributor to environmental problems. An estimated 280,000 tons of textile dyes are discharged in nearby industrial water globally every year.

The large-scale production and extensive application of synthetic dyes cause considerable environmental pollution, making it a serious public concern.

Toxic textile dyes are one of the major causes of altering physical and chemical properties of soil, deteriorating water bodies, and causing harm to the flora and fauna in the environment.

Harmful dyes cause death to the soil microorganisms, which affect agricultural productivity. Azo dyes, in particular, are also highly poisonous to the ecosystem.

In India, dyeing fabrics is an ancient art form that has been passed down through generations. Dyeing is done by hand, using natural dyes such as madder, indigo, and turmeric. These dyes come from the roots and bark of plants, as well as from insects and minerals.
The process of dyeing begins with the preparation of the fabric. The fabric is washed, soaked, and then treated with mordants such as alum, which helps the dye adhere to the fabric. Then, the dye is applied to the fabric by hand, either in the form of a paste or a liquid. The fabric is then immersed in the dye bath and left to soak for several hours, or even days. The fabric is then removed from the dye bath and allowed to dry in the sun.
Once the fabric is completely dry, it is washed again and the colors are set. After this, the fabric is ready to be used in garments. The fabrics are also often embellished with intricate patterns, such as block printing or hand embroidery, which further enhances the beauty of the fabric.

The traditional art of dyeing fabrics in India has been practiced for centuries. In the international trade of the pre-industrial era, spices and textiles were the main commodities. India in particular was known for the quality of its fabrics, and for centuries was involved in active trade with China and Southeast Asia. The Portuguese were the first to arrive, having discovered a sea route between Europe and the Orient, which allowed them to avoid the burdensome taxes on goods shipped overland through the Middle East. Later, the English arrived. Soon, Indian fabrics were exported directly to Europe, where they became very fashionable, making India the largest exporter of textiles the world had ever known, reaching its peak in the 18th and 19th centuries.
One of the reasons why Indian fabrics were so sought after by European consumers was because they were the first fabrics in which the color could withstand washing and did not fade in the light.
In addition, Indian cloth, with its motifs and design, was perceived as exotic, in the same way as Chinese porcelain and Japanese lacquer.

Today, India continues to be known for the quality of its fabrics, silks and textiles and these products have become one of the country's major industries, making India the world's second largest exporter of fabrics.

Fabrics used in India

Cotton, silk and wool are the three materials used to weave Indian textiles.

Cotton: The cotton plant grows in many regions of India, and each region produces different qualities.

Silk: Wild silkworm moths, native to the central and northeastern regions of the country (and different from those found in China) are the source of silk.

Wool: Wool comes from goats in the colder regions of India, such as Kashmir, Ladakh and the Himalayas. These wild goats shed their winter coats each spring and the fleece that gets caught on rocks and bushes is used to make pashmina (also known as cashmere).

Dyes of Indian fabrics

India's rich natural resources used in textiles are unrivaled. Its varied topography and climate provide an impressive variety of plant fibers and natural dyes for use by cultivators, weavers, dyers, printers and embroiderers. Each region developed its own expertise based on locally available resources such as the golden silks of Assam, the fine cottons of Bengal, or the red dyes of south-east India.
The most common colors of red, black, blue, violet, green and yellow are obtained from plants and minerals native to the Indian subcontinent.

Blue: Indigo plants are processed and marketed in the form of dried cakes that are used to create different shades of blue.

Red: Red dye is extracted from plants and trees such as chay.

Yellow: Yellow is extracted from turmeric or saffron (the latter mostly for silks).

Black: Black is created by mixing indigo with an acidic substance such as tannin.

Green and Purple: Green and purple can be made by layering yellow or red dyes on blue fabric.

Techniques

Below we explain some of these techniques that show us the impressive creative variety they possess:

Batik: Batik is a cotton fabric printing technique used in several Asian and West African countries. It is like a kind of textile painting. There are four main steps to create a batik. Artisans first draw the final pattern on the fabric, then apply hot wax to protect certain areas. Then, to apply the colors, they soak the fabric in dye baths. The wax is then removed with an iron or by soaking in boiling water.

The Tie and Dye: This is a traditional textile dyeing technique of Rajasthan. The choice and combinations of colors vary, but there is always a predominance of yellow, orange, red or green. It is a fairly simple technique, it is necessary to tie the fabric beforehand to preserve certain parts of the color, then it is immersed in one or more baths of paint. The duration of the bath plays with the intensity of the color, and only the parts outside the knot are painted.

Dabu (block printing): Dabu is a way of printing patterns on fabric using wooden blocks. It is a widespread technique in Rajasthan. The wooden blocks are carefully hand carved by artisans (Chippai), then used to print the patterns on silk or cotton. Dabu is a hand printing technique that is still practiced today.

Ikat: Ikat is a process of dyeing and weaving. The design is created by first dyeing the weft yarn with all the colors that will appear on the final piece very precisely. At the time of weaving, the elements of the design are created by juxtaposing the parts of the yarn of the appropriate color.

Chanderi: This fabric takes its name from its original production center in the state of Madhya Pradesh in India. It is a production group dating back several centuries and produces fine textured fabrics embellished with silk and cotton. It is a very light and very fragile canvas, decorated with intricate patterns, used to make very elegant saris.

Madras: Madras is a brightly colored fabric from the city of Chennai . It is a fabric made of banana, cotton and silk fibers. After Indian immigration to the West Indies, Madras is now associated with the traditional female dress of the West Indies and Guyana.

Khadi: Traditionally, the khadi is a cotton fabric, but it can also be made of wool. For Indians it is not just a simple piece of cloth, it has a strong sentimental value. Gandhi promoted this fabric to improve India's rural economy in the 20th century during and after independence. The Khadi movement aimed to boycott foreign products and promote Indian products. The freedom struggle centered on the Khadi port.

KalamKari: KalamKari is a traditional South Indian art. It is a cotton canvas hand painted with vegetable dyes. The cotton fabric is dipped for an hour in a mixture of myrabalam (resin) and cow's milk. Then, using a bamboo stitch, we draw the outlines and patterns. Then we apply the vegetable dyes gradually, after the application of each color, the Kalamkari is washed.
Therefore, each fabric can undergo up to 20 washes. Different effects are also obtained by using cow dung, seeds, plants or even crushed flowers.
It is an important part of the country’s culture and heritage and is a great way to create unique and beautiful fabrics.

c. Collaboration between cutting and packing

Identify high value opportunities and manufacturing challenges to improve energy efficiency, reduce material/water use, and enable increased recycling and reuse.

Textile production involves numerous steps and processes that are becoming increasingly moderate to meet the challenges of sustainability. One of the stages is cutting and packaging, which leads to a lot of waste throughout its process but which is getting better and better thanks to new state-of-the-art technologies.

Let's briefly explain what cutting and packing is and what the most important innovations on the subject are to improve energy efficiency, reduce material/water use, and enable increased recycling and reuse.

The cutting and packaging process in a nutshell:

- The fabrics arrive from the textile factories wrapped in rolls.

  A machine unrolls them and prepares them according to the different processes for which they are destined.

  The fabric is first washed and softened, then squeezed to remove water and finally dried naturally. The drying time depends on the type of fabric.

- Calendering phase: the fabric is ironed in a steam machine

- Cutting and packaging stage: an inspection machine checks the fabric for defects and checks the quality of prints, color etc.

The stylist draws the model and creates the paper pattern of the desired dress by hand. The first size is made by hand. Using a magnetic board, the measurements of the paper pattern are then entered into the computer, which then develops all the other sizes.

The final paper patterns are then printed and passed on to the cutting department. This is where the hand cutting of the prototype piece takes place.

The fabric is then loaded onto a machine that cuts it and arranges it in overlapping layers to create the so-called mattress. Here the pattern of the various parts of the piece of clothing is placed on top: back, front and sleeves; this serves as a guide for cutting.

The fabric is first sectioned for the various pieces to be cut, and then the real cutting is carried out using a band saw.

In the case of tubular fabrics, which are used for example for making up underwear, the cutting operation is carried out by machine thanks to metal templates differentiated by size and pattern.

In the packaging department, the cut piece is assembled thanks to different machines according to the type of manufacturing and finishing desired.

For example with a sewing machine specialised in edging clothes.

Another machine equipped with a circular saw is used to cut cuffs and collars.

In short:

Arrival of fabrics in the factory

- Sprinking
- Washing, Softening, Pressing
- Calendering

Cutting And Packaging Stage

- Quality Control
- Pattern creation

- Hand cutting of prototype piece
- Mattress creation
- Band saw cutting
- Packing

Clothing technologies

The basic technique of clothing production has remained essentially unchanged over time; it
is still based on the use of needle and thread; the sewing instrument is still the sewing machine, invented in the mid 19th century and since then perfected in terms of operating speed and the variety of stitches that can be produced.
The sewing operation is therefore the focal point of technical developments, but has so far resisted various attempts to bring about a high degree of automation. The other operations in garment manufacturing, especially the operations prior to sewing, have proven to be more accessible to new technologies.

In order to enable the problems related to the automation of the garment-making process to be understood, it is appropriate to briefly illustrate the various operations involved, from the creation phase to the finished product.
The main manufacturing steps are:

- creation,
- the operations prior to packaging,
- packaging,
- finishing.

Creation includes the design and pattern-making of the garment. By definition, this is the most creative phase; it determines the nature of the product and how it will be worked. The
design takes into account fashion trends, variations in consumer taste and behaviour as well
as the brand image of the manufacturer. Pattern making determines the method of construction of the garment.
The second phase covers all the operations prior to making the garment, first and foremost
size development and sizing.
Size development consists of reproducing the prototype in each of the sizes in which it is to
be made; the purpose of sizing is to determine how the fabric is to be cut in order to obtain
the various parts of the garment. Cutting is therefore the stage of producing these parts from
the fabric, usually after sewing.
The procedure to be followed for the remaining two operations is different: making-up, which
consists of joining the different parts of the garment together by stitching, and finishing, where the product undergoes operations that make it suitable for sale in terms of presentation,
i.e. ironing, folding and packaging.
An apparent paradox is that it is the operations requiring greater skill and ability (i.e. drawing, pattern-making and cutting) that have so far been the areas most affected by technological innovation, while operations involving greater manual dexterity and repetitiveness have not been tackled with significant results.
The underlying reason for this is the fact that the material used, the fabric, whether woven or
knitted, is flexible, and the packaging requires a vast number of operations that are very difficult to automate.
Technological progress in garment production is consequently a function of the possibility of

producing equipment capable of handling flexible materials.

The clothing production cycle comprises a number of fundamental phases/structures:

- design;
- production planning and organisation;
- cutting;
- assembly;
- sewing;
- ironing;
- finishing;
- quality control;
- warehousing of finished products.

Current cutting technologies

Cutting comprises a series of complex operations that precede stitching, i.e. the actual packaging. The logical flow of operations starts with the control of the pieces with minimum
tension stretching machines, then moves on to the creation of basic cartons/patterns with automated systems, and the development of patterns. This is done manually or, alternatively,
with automatic CAD/CAM development.
Cutting paths are then laid out, either manually or automatically. The study of the positioning
and layout allows the optimal use of the tissue with the exclusion of selvedges, other defective parts, etc.).

We then move on to the cutting room, which contains a number of very important functions:
the functions of the cutting room are to produce, by cutting the material, the garments that

will later go to the clothing department.
The garments that are cut must be as identical as possible and the various pieces must necessarily be easily identifiable (both by colour and size).
In addition, the cutting room must take care to cut the garments with as little material consumption as possible.
To perform these functions in the best possible way, the cutting room is, according to need and possibility, equipped with a series of machines that current technology makes available:

- computerised nesting and cutting development systems
- systems for reproducing signatures
- the weaving machines
- cutters and band saws
- automatic cutting
- press cutting

After the tracing, fabric splicing and tracing, the mattress is now ready to be cut. To make it easier to explain the machines and their use in cutting the mattress, we will mention the system normally used:

- mattress cutting
- contour cutting of the walls

Splitting the mattress is the operation of dividing the mattress into parts of a sufficiently manageable size. The parts obtained from the cut-up are then cut exactly according to the outline of the outlined patterns. The cutting of the mattress is carried out with the use of electric table saws and belt saws.
Electric table-top cutters are divided into circular- and vertical-blade cutters. Circular-blade cutters are used for cutting mattresses of small and medium thickness. These cutters cannot be used for contour cutting because of the difficulty of making tight radius bends and corners in particular, due to the shape and thus the bulk of the blade itself. Vertical blade cutters are used both for cutting mattresses of small, medium and large thicknesses and for contour cutting. This is due to the reduced overall dimensions of the blade and the reciprocating vertical movement, which allows the contours of the tracks to be followed with good precision.
For greater cutting precision, especially for small parts, band saws are used, with which the handling of parts is facilitated as the operator uses both hands to control the blank during cutting. The latter machine can be equipped with two speeds of blade rotation; the lower speed is used for cutting fabrics with a high synthetic fibre content in order to avoid melting effects.

The cutting steps are as follows:

- Formation of the cutting clichet (nesting). The various component parts of the pattern are placed on a sheet of paper (clichet) the size of the fabric to be cut, which will be placed on it for cutting. The component parts of the pattern are positioned so that as little fabric as possible is wasted.

- Application of labels on each layer of fabric. The parts of the same pattern are all taken from the same layer of fabric, to avoid the danger of having slightly different coloured parts. In fact, the fabric changes colour slightly in the various sections of the piece.

Garment companies tend to purchase fabrics with the same widths as far as possible in order to unify the cutting method and equipment and thus achieve optimum utilisation of the fabrics. For this reason, certain spreading machines are also equipped with a device for automatic alignment of the fabric edge. Furthermore, it is possible to unroll and rewind a piece of cloth with minimum tension. There is in fact a relationship between this operation and the formation of defects in the mattress preparation phase.
The cutting operation has a cost that tends to decrease as the thickness of the mattress increases, since the personnel cost can be spread over a larger quantity of fabric. Consequently, especially in companies that produce classic men's clothing, the problem of having mattresses as thick as possible is particularly acute.
In the cutting department, a series of elementary operations are carried out, such as:

- drafting
- cutting
- gathering
- numbering
- division
- thermoadhesive
- parcel preparation

Automatic cutting systems

Today, automatic cutting can be performed in four different ways:

- reciprocating blade (the most widespread) suitable for cutting

- single sheets
- medium mattresses
- high mattresses

- by laser beam used only for the cutting of
  - single sheets

- water beam used for the cutting of
  - single sheets
  - medium mattresses

- by plasma suitable for the cutting of
  - single sheets

- ultrasonic

It is possible to combine the cutting systems with automatic trolleys for spreading the fabric. With these systems, either the cutting data can be transmitted directly to the cutter (on-line connection) or magnetic tapes containing the cutting data can be produced for use by the cutter's computer (off-line connection).
The cutting head is a highly sophisticated mechanism that performs the numerous operations controlled by the computer, such as automatic knife compensation, notching, up and down movements, blade rotation, etc.
The knife blade is raised, sharpened and sunk automatically during cutting operations. Each sharpening cycle lasts only a few seconds, and blade wear is automatically compensated for by the processor, which allows the quality of the cut to be maintained.
The speed of the reciprocating knife motion is adjusted according to the material to be cut.
A vacuum is applied to the mattress lying on the table from below, compressing it until a solid, stable layer is obtained.
The movements of the cutting carriage are controlled by the computer.
By moving the carriage along the length of the cutting table and the head along its width, it is possible to cut any shape in any area. The gear transmission enables cutting tolerances of 0.08 cm to be achieved.

Plasma jet cutting

A plasma jet cutting system has recently been developed after a series of tests on a very wide range of materials (plastic, rubber, wood, glass, steel, aluminium, impregnated glass wool, polypropylene and, of course, clothing fabrics).
This system is a fast and cost-effective method of cutting, especially in medium-sized garment factories.

Cutting predominantly single-ply or mattresses of a few layers, it can achieve a perimeter cutting speed of 50 metres per minute, with an investment that can be estimated at a quarter of that for a laser beam cutting system.
The fineness of the jet (0.7 mm) ensures a precise and clean cut, with simultaneous edge welding for some particular materials.
Tests have shown that it is possible to cut fabric at a speed of 15 metres per minute using 150 watt power, or lace for curtains at a speed of 52 metres per minute, again using 150 watt power.
It is also possible to cut mattresses or carpets, up to a thickness of 8 mm, at a speed of about 8 metres per minute, using 200 watts power.

Although clearly the power to use, and the cutting speed are subject to variations, depending on the type and thickness of the fabrics to be cut, the running cost should be quite low and competitive, especially when considering the price of argon and the installed power, which is only 100-200 watts.

Plasma cutting

This is an integrated numerically controlled cutting system using an argon gas jet particularly
suitable for single-layer cutting.
In terms of operation, the plasma jet is similar to that of the laser beam, with the advantage of
being more cost-effective and fully satisfying user requirements with minimal maintenance costs.
The cutting speed can be quantified at approximately 50 to 60 metres per minute; naturally, this speed is subject to variations depending on the type of materials.
Argon gas consumption is limited to only 5 litres per minute, and is particularly suitable for
cutting prototypes or single garments.
The diameter of the plasma output nozzle is variable according to requirements and reaches a
maximum of 1 mm.
It can also be used for tailor-made garments, starting with the collection of the consumer's data and measurements by means of terminals, in fact a computer processes the information and automatically produces a series of patterns and placements.

Water jet cutting

The disadvantage of mechanical cutting tools is their wear and tear, particularly with hard, tough fabrics, and their limited suitability for precise, seamless cutting of complex contours.

In addition, a vacuum system to hold the fabric in place is absolutely necessary to achieve high cutting speed and precision.
With laser or plasma cutting systems, there are no wear problems and complex contours can
be created, even at high speed and without equipment to hold the material in place.
However, the disadvantage of excessive heat, which causes structural and colour changes on
the cut edge, the welding effect between the edges when cutting several layers, the burning smell and the need to aspirate smoke and gases must be taken into account.
The need to eliminate these defects, combined with the need to achieve high cutting speeds, led to the development of a waterjet cutting system.

3. SOME EXAMPLES

Let's see some examples about how to make clothes out of forest or trees.

Wood:

There are many trees that can be good for wood textile.
We can use wood or other cellulose as a raw material for producing textile fibers.
Sustainable fibers such as tencel, modal, viscose and lyocell, are produced from the cellulose of wood.

The innovation in wood fibers contributes toward a sustainable future as the fiber is both recyclable and can be made from sustainable cellulose sources, which help reduce CO2 emissions, while consuming less freshwater than, for example, cotton plantation. Also fibers are made from cellulose, they do not contribute to the spread of harmful microplastics.

Orange textiles:

Orange peels have a high cellulose content, that is what is used to transform into a fabric.

The most ecological way to convert the citrus peel is from the organic citrus juice industry leftovers, which today represents 60% of the original weight of the processed fruits that should be otherwise disposed.

Even when apple and orange trees are indeed trees, but the ones used to produce orange and apples are not from the forest, they can be considered a crop.

Apple leather:

Apple leather is a bio-based material, meaning that it is partly biological: natural, organic.

When making juice or jam, the seeds, stalks and skins of apples can't be used. Before apple leather came to be, these 'left-overs' were simply discarded, unuseable by the industry.

The left-overs are crushed, and then naturally dried into a fine powder. This powder is blended with a kind of resin that is, essentially, dried and laid flat into a final material : apple leather.

Up to 65% of the final material is apples, and the remaining material is the resin, which basically coats and holds together the powder. This resin is what makes up conventional synthetic leather, and it's called polyurethane.

Mushroom leather:

The production process to make mushroom textiles fits perfectly with the ethos of the circular economy and is fully sustainable. Mushroom fibres are natural and biodegradable at the end of the life cycle.

Mushroom textiles completely remove the need for industrial animal agriculture which is the primary required for leather. The positive impact goes far beyond this though. The materials which are used to grow the mycelium can be waste materials and furthermore, the waste generated from the production of the mushroom can be reused and repurposed.

Mushroom leather is an environmentally friendly fabric because it can be grown and produced without polluting substances and once you are finished, it's 100% biodegradable and compostable.

Mushroom leather production is entirely closed-loop. Closed-loop manufacturing in fashion means that the used materials must come from post-consumer waste. These products are recycled, repurposed, and converted into eco-friendly products. In the making of mushroom leather, corn cobs, wood chips, and straw are post-consumer waste.

Bamboo Fiber:

Bamboo rapidly sequesters carbon in biomass and soil. It has a lot of adventages :it grows fast, it is flexible, lightweight, strong and it is really versatil,Also it is sustainable and works perfectly as a carbon sink , to filter water, protect the water sources, retain the soil and restaurate degrade landscape.

The bamboo crop can be used to depurate the water and help degradate lands. It can grow 1 meter per day and after being cut, bamboo resprouts and grows again.

Bamboo has more than 1.500 applications and of course, one of them are the fibers that can be used for clothing, substituting others like cotton, which requires much more water and land.

Banana trees:

The trunks of banana plants are not woody but composed of sheets of overlapping leaves wrapped tightly around one another, a design feature that enables them to conserve water.

Grown in every humid, tropical region on Earth, bananas are the fourth largest fruit crop in the entire world.

Banana leaves and steam are used worldwide as cooking materials, plates, umbrellas, seat pads for benches, fishing lines, clothing fabric, and soles for inexpensive shoes.

Rainforest Alliance Certified farms meet a rigorous set of standards that protect wildlands, wildlife, soil, and water, reduce agrochemical use, and improve the quality of life for farm workers and their families.

Algae:

Same as mushrooms, the algae is not collected directly from the sea , but grown especifically for this, so, as long as the area used to grown this algae is not negatively impacting to the sea, its also a win win solution as it is absorbing Co2 when its growing

Group of innovators believe harnessing living bacteria, like algae, is the key to zero-waste sustainable fabric." It can be created in bioreactors so doesn't require large amounts of land or the use of harmful pesticides. It is also completely biodegradable with all pieces breaking down into non-toxic substances when thrown away.

Several companies and researchers are now developing algae fabric. The properties that they are going to invest on are its biodegradability, eco-friendly ingredients, and one more thing that makes it incredible is it can photosynthesis by itself.

Nylon nets:

As we mentioned before, reclaiming these nets from the ocean presents a mutually beneficial solution. Abandoned nets in the sea pose a significant hazard, entangling fish and turtles, while also contributing to microplastic pollution."

Here are some examples of 'best practice':

- Zero Waste Garment Design: Fashion brands such as Zero Waste Daniel focus on designing garments in a way that utilizes all fabric without generating waste. This involves efficient cutting patterns and creating designs that make the best use of available material.

- Textile Recycling: Companies such as "The Renewal Workshop" are dedicated to collecting used and damaged clothing, repairing it and then reselling it. This prolongs the useful life of garments and reduces the amount of clothing that ends up in landfills.

- Sustainable Materials: The Patagonia brand is known for using sustainable materials in its products, such as organic cotton and recycled polyester. This reduces the demand for virgin raw materials and reduces the environmental footprint.

- Supply Chain Collaborations: Textile companies are collaborating more closely with their suppliers to improve efficiency and reduce waste in production. This includes optimizing dyeing and manufacturing processes to reduce water and energy consumption.

- Circular Business Models: Brands such as "Rent the Runway" offer designer clothing rental services rather than sales. This promotes extended wear and reduces the need to buy new clothes frequently.

- Education and Awareness: Some brands and organizations educate consumers about the importance of caring for and repairing their garments rather than discarding them. This encourages a more responsible approach to clothing.

- Use of Sustainable Technology: The incorporation of advanced technologies, such as 3D textile printing and additive manufacturing, can significantly reduce waste and the environmental footprint of garment production.

- Supply Chain Transparency: Some brands, such as Everlane, are transparent about their supply chains, allowing consumers to make informed purchasing decisions and promoting supplier accountability.

- Textile Fiber Recycling: Companies such as The New Denim Project recycle textile fibers to create new fabrics and products, reducing the need to produce virgin fibers.

- Continuous Research and Development: Many textile companies invest in research and development to find more sustainable materials and processes. This includes finding alternatives to chemical dyes and experimenting with innovative organic fibers.

CONCLUSIONS

On the path towards transforming and moving the textile industry towards more sustainable and responsible practices, this Guideline has shed light on a number of key findings. These conclusions not only summarize key findings derived from our research and collaborative efforts, but also outline a clear path towards a more sustainable future for the textile industry in Europe and around the world.

Sustainability is Imperative: Our research has unequivocally confirmed that sustainability is not an option, but an imperative for the textile industry. Environmental and social challenges demand a profound change in the way we operate and design, and sustainability must be at the center of every decision.

Design as a Lever for Change: We have demonstrated that design is a powerful lever for change in the textile industry. Embracing sustainable approaches from the design stage can reduce waste, reduce the environmental footprint and generate economic and social value.

Collaboration is Key: Collaboration among all industry stakeholders, from designers and manufacturers to consumers and regulators, is essential to effective transformation. Together, we can drive meaningful change and share best practices.