

# Module 2: Sustainable practices in Clothing Manufacturing

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Deliverable: PR1/T1.4



**DATE:31/01/2023**

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Project Number: 2021-1-EL01-KA220-VET-000034695



Co-funded by the  
Erasmus+ Programme  
of the European Union

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## REVISION HISTORY

Version	Date	Author	Description	Action	Pages
1.0	30/08/2022	ATERMON	Creation	C	9
1.1	31/01/2023	TUIASI	Insert	I	38

(\*) Action: C = Creation, I = Insert, U = Update, R = Replace, D = Delete

## REFERENCED DOCUMENTS

ID	Reference	Title
1	2021-1-EL01-KA220-VET-000034695	AR4REClothing Proposal
2	PR1/T1.3	Set Up AR4ReClothing Training Guide structure & Training methodology

## APPLICABLE DOCUMENTS

ID	Reference	Title
1	Validation Plan	Validation Plan
2		





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# 1. Introduction

This module presents concepts and solutions that can be implemented in the garment industry to transform it into a sustainable industry. To clarify what sustainability means for the garment industry, the following topics were discussed: basics of the clothing manufacturing process, categories of textile waste and solutions to reuse them, efficient, sustainable practices in garment manufacturing, a solution to promote these new practices and how to increase citizen/customer awareness and motivation to act sustainably.

## 1.1 Learning Outcomes

<b>Module 2:SUSTAINABLE PRACTICES IN CLOTHING MANUFACTURING</b>	The AR4RECLOTHING expert will be able to understand the concept of sustainability in the clothing industry and how to be a sustainable customer.	
<i>KNOWLEDGE</i>	<i>SKILLS</i>	<i>COMPETENCIES</i>
a. Identify the category of textile waste.	a. Distinguish the categories of textile waste and their source	a. Raise awareness to reduce the amount of waste
b. Describe the importance of textile waste in transforming the clothing industry into a sustainable industry	b. Explain the problems caused by the different types of waste and their minimisation techniques	b. Provide solutions for the reuse of textile waste in different production processes
c. Formulate recycling and manufacturing habits for products made of reusable materials	c. Analyse the problems caused by textile waste and consumer behaviour for the environment	c. Provide solutions for upcycling and recycling of worn garments and educate customers to act sustainably

## 1.2 Keywords

Sustainability, clothing manufacturing, textile waste, up-cycling, awareness and motivation

## 1.3 Estimated seat time to complete the Module

It is expected that you will need about 20 hours to complete this Module.





## 2. Sustainable practices in Clothing Manufacturing

### 2.1. Understand the basics of clothing manufacturing

The **chain of clothing manufacturing** starts with fibre production; then, the fibres are transformed into threads or can be transformed directly into a non-woven material. The threads can be woven and turned into a fabric or knitted and turned into a knit. A garment can be made from textile materials (woven, knitted or non-woven) or with a 3D printer. High-couture models are made of textile materials because they are comfortable materials that offer many design options and can meet customers' needs.

The fashion supply chain describes the process of tracing each step of garment production, from the sourcing of raw materials to the factories where these materials are processed into final products (garments) and the distribution network through which the garments are delivered to consumers.

Technological flow is the map of the garment manufacturing process in a company. The length and complexity of this flow depends on a variety of factors, such as product category and complexity, type of production, technical equipment, location, management vision, financial resources, etc.

The general flow starts with preparation and continues with the specific activities of the cutting room, the activities of sewing rooms and the finishing, and ends with storage/delivery.

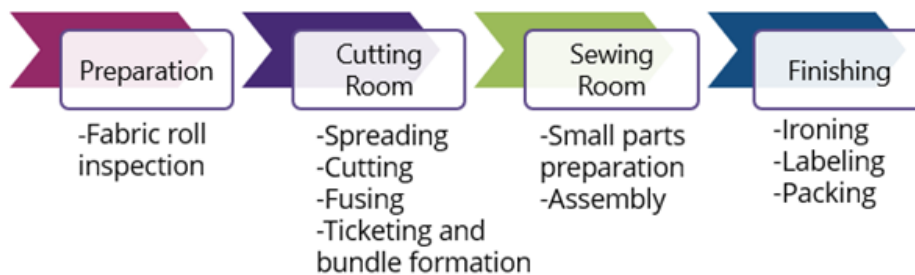


IMAGE 1. GARMENT MANUFACTURING FLOW

#### a) Preparation

Raw materials, either purchased or sent by the client are inspected to verify that they meet the required technical specifications (quantity, quality, stage, etc.). The specific inspection activities are carried out in the storage area.

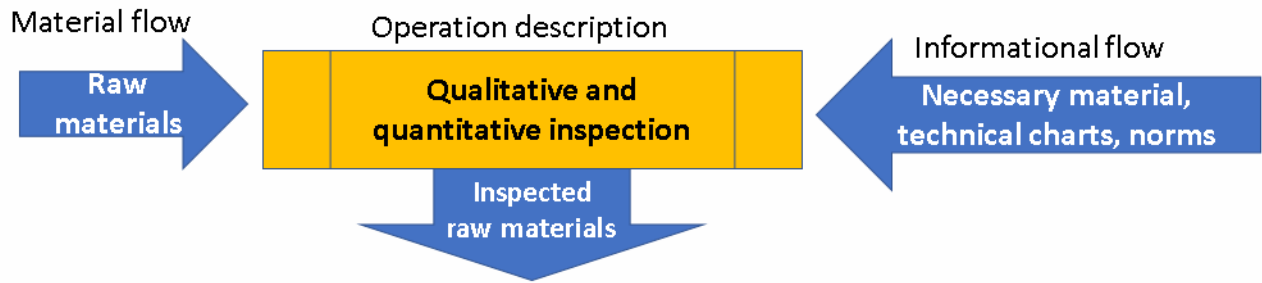


IMAGE 2. RAW MATERIALS PREPARATION

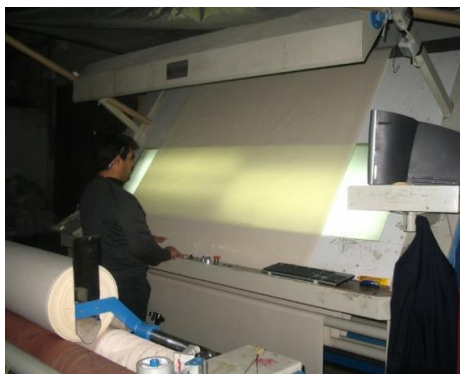


IMAGE 3. QUALITATIVE INSPECTION  
(HALIL İBRAHİM ÇELİK ET AL.)

The fabrics and all accessories are randomly inspected for quantity and quality. Quantitative inspection refers to the length, width and number of rolls in textile fabrics.

In qualitative inspection (see image 3), the operator looks for defects in the textile material, spots, holes, etc. The test for shrinkage, colour fastness, bending, etc. can be carried out in a special laboratory that has the appropriate equipment. The sorted rolls of fabrics are stored in racks; from there, the rolls will be transported to the cutting room.

This fabric relaxation process is optional; it is recommended especially for knitted fabrics. When the fabric is rolled up, it is stretched. It is, therefore important to get the fabric into a

stable shape; otherwise, the garment will shrink after it is made. The role is opened, spread out, and stored for about 24 hours to relax the fabric.

### b) Activities in the cutting room

Some of the most important operations are developed in the cutting room, as shown in image 4.

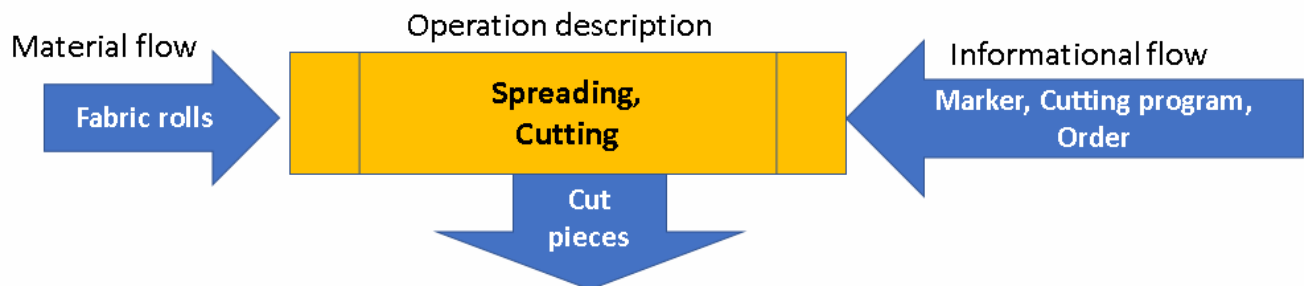


IMAGE 4. FLOW IN CUTTING ROOM

The fabric rolls are brought from the warehouse (with trolleys) according to the order launching and the matching sheets for spreading (fabric layering).

The fabric rolls are used in a specific order according to length and model maker to reduce fabric waste as much as possible.



IMAGE 5. THE AUTOMATIC SPREADING MACHINE (KARTHI KRISHNA S. ET AL.)



IMAGE 6. CUTTING MACHINE (WWW.LECTRA.COM)

Spreading (see image 5) is the operation of superposing the fabric plies on a table, in order to be cut simultaneously. It can be done manually or fully automatically. Cutting (see image 6) can be done in two steps: block and pattern cutting.

After cutting the fabric pieces are prepared for sewing, as shown in image 7.

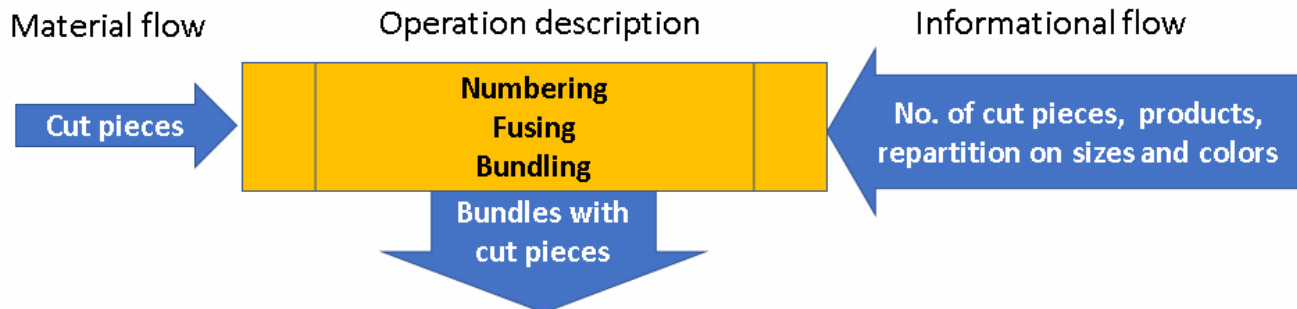


IMAGE 7. SEWING PREPARATION

The garment pieces are separated and numbered to ensure that all pieces are sewn together from the same layer when sewing. It is essential to avoid colour differences in a garment. Between cutting and sewing, the cut pieces may go through other processes, such as fusing (see image 8), printing, or embroidery.



IMAGE 8. FUSING PRESS  
SEE MOVIE 1

Fusing can be done on the whole part of the cut piece or partially. Some of the cut pieces will be fused with an interlining layer. Usually, this operation happens in the cutting room, but it is possible to be done in the sewing room, too.

The parts belonging to a garment are tied together. This process is called bundling. Each bundle is marked with



the bundle number, the style name, the size number and the number of pieces in that bundle. Then the pieces are ready to be sewn.

### c) Activities in the sewing room (image 9)

Sewing is the most important step in making garments or other similar products. Sewing means joining different parts of garments together with the help of a needle and thread. Without needle and thread, we can also make garments using alternative joining methods of joining as adhesive, welding, etc. In general, there are two things that play a role in sewing: stitches and seams. The main purpose of sewing is to create a seam.

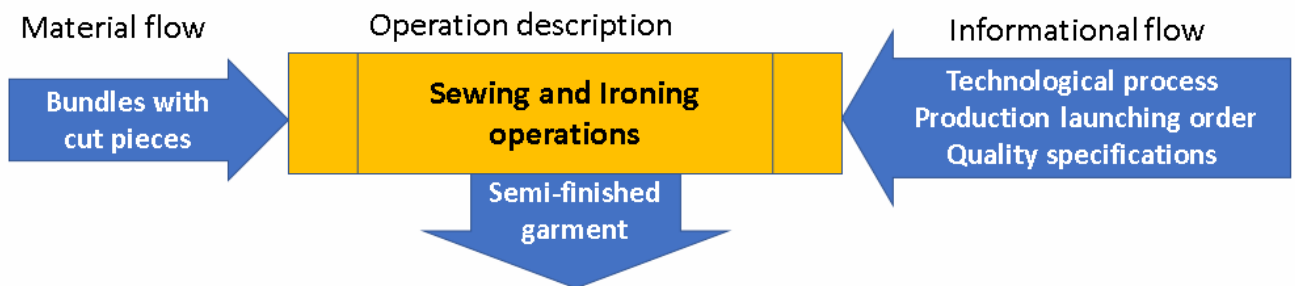


IMAGE 9. SEWING ROOM OPERATIONS



IMAGE 10. SEWING MACHINE; SOURCE: [WWW.PEXELS.COM](http://WWW.PEXELS.COM); COPYRIGHT: FREE TO USE UNDER THE LICENSE OF PEXELS. NO ATTRIBUTION IS REQUIRED  
SEE MOVIE 2; MOVIE 3



IMAGE 11. ONLINE IRONING  
SEE MOVIE 4

The bundles of cut pieces are launched on the sewing line. According to the technological process, the cut pieces are stitched, ironed, or manually manufactured at different workplaces. First, the small elements of the product (e.g. collar, cuffs, pockets, see Movie 2) are sewn, then the main elements (front, back and sleeves if it is a shirt, blouse, jacket, dress, etc.), and finally, the final shape of the garment is achieved.

Different stitches and seams are used in the manufacturing process of garments or other apparel goods.





IMAGE 12. AUTO SERGING MACHINE (KARTHI KRISHNA S. ET AL.)



IMAGE 13. AUTOMATIC POCKET-ATTACHING MACHINE (KARTHI KRISHNA S. ET AL.)



IMAGE 14. AUTOMATIC BELT-LOOP ATTACHING MACHINE (KARTHI KRISHNA S. ET AL.)

During a manufacturing process, depending on the model, complexity and structure are necessary to iron the sewing allowances (see image 11). In our days some of the sewing operations can be done with automatic machines, so that the quality of the final product is improved (see images 12, 13, 14)

**d) Finishing stage**

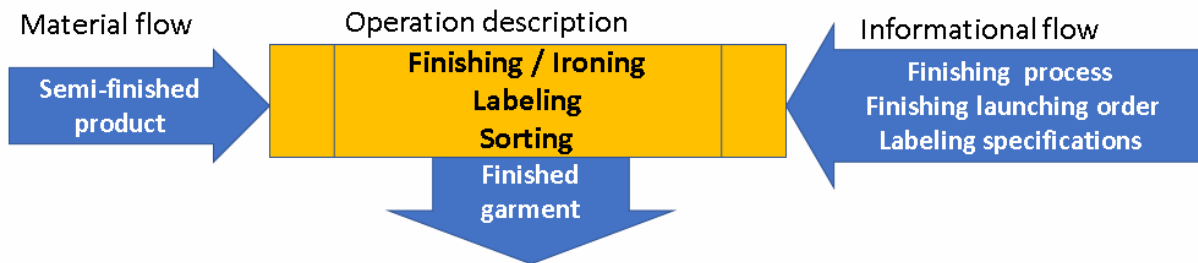


IMAGE 15. FINISHING SPECIFIC OPERATIONS

First, the product is cleaned from all the threads ends and in some cases the buttons are attached (see Movie . To improve the appearance of the product, the garment is ironed at the end of the manufacturing process. Depending on the type of product, it can be ironed or pressed with specific pieces of equipment.



A) BUTTONS MACHINE SEE MOVIE 5



B) BUTTONHOLES MACHINE SEE MOVIE 6  
IMAGE 15. FINISHING



C) VEIT PRESS (VEIT, 2023)



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IMAGE 16. CLOTHING WAREHOUSE; SOURCE: DREAMSTIME.COM, COPYRIGHT: FREE TO USE UNDER THE LICENSE DREAMSTIME.

The garments are finally checked and labelled. At this stage, only the hangtag is applied. The garments are sorted and stored in the warehouses by sizes and colour positions according to the order and the customer's packaging specifications and prepared for delivery (see image 16).

As a part of the textile and garment sector, the fashion industry is one of the world's biggest polluters and significantly impacts the world's available raw materials and human resources needed for product manufacturing. Fast fashion has led to a large increase in the amount of clothing produced, purchased, and thrown away each year, filling landfills, polluting nature, and water, and negatively affecting the health and lives of living beings. Because of ongoing changes in the fashion market and low pricing, the lifespan of textile materials is decreasing daily.

Every product has its own life cycle (see image 17), which begins with its production and ends with its useful life.

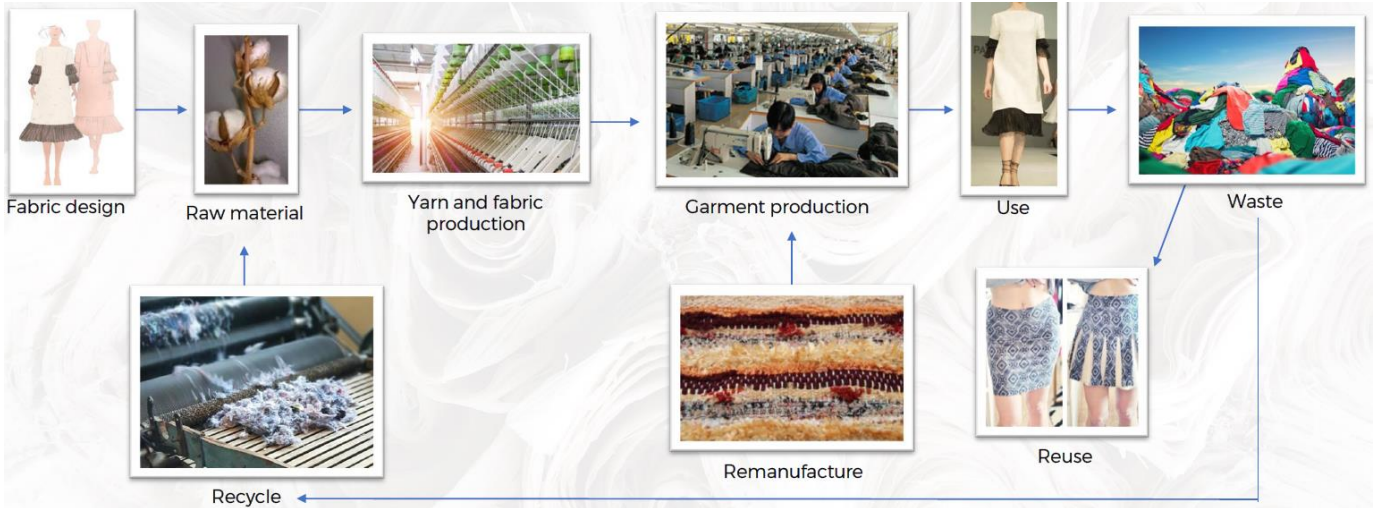
- *Product development*: this phase can include various actions, for example, idea generation, sketch development, product design, material selection, production of first samples, testing, post-production of samples, etc.
- *Raw material output*: In this phase, the raw materials for production are produced, grown or otherwise obtained. These processes may use soil, energy and water resources. Soil, air and water can be contaminated, so choosing the most environmentally friendly raw materials is very important.
- *Production*: Energy, water and chemicals (dyes, pigments, softeners, bleaches, etc.) are consumed in the production of the product. Air and water are polluted, and the soil is also contaminated in the worst case. It is important that you choose production processes that have as little impact on the environment as possible.
- *Use*: It is essential to determine what additional measures are needed to preserve the product.
- *Waste management*: To reduce the amount of waste and the impact on the environment, the amount, type and possible recycling of the waste generated should be considered when designing and manufacturing the product.

Nowadays, when natural resources are becoming increasingly scarce, and we are confronted with global warming, it is necessary to integrate sustainability into clothing production processes.



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Sustainable clothing includes the use of second-hand clothing and often uses upcycling and recycling of clothing. It also refers to how these fabrics are made. This principle requires fabrics from environmentally friendly resources such as sustainably grown fibres or recycled materials.



**IMAGE 17. GARMENT LIFE CYCLE (CIRCULAR ECONOMY)**

**SOURCE: (DESIGN4CIRCLE, 2020)**



## 2.2. Analyse the different means towards a more sustainable environment



IMAGE 18. SUSTAINABILITY

SOURCE: (MOON, 2018)

The concept of **sustainability** has grown in recent years and has become a strategy adopted by more and more manufacturers. It is based on the theory of John Elkington, an entrepreneur who specialises in sustainable development in companies.

The idea is expressed representatively by a diagram uniting the main elements affected by production enterprises: People (social pillar), Planet (environmental pillar) and Profit (financial pillar) (see image 18).

From a *social point of view*, a company's sustainability can be seen in the fact that it provides jobs, that there is no abuse of employees or members of the community in which the company operates, that the company contributes to regional development or that it is transparent.

From an *environmental perspective*, the theory refers to the pollution level and the impact the company has on the

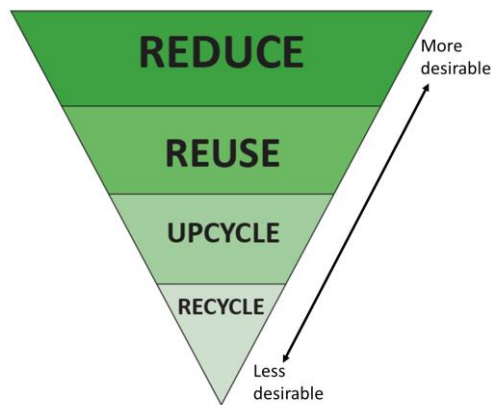
environment through its operations. For a garment company, but also for consumers, this pillar is implemented through the management of the waste generated.

From an *economic point of view*, a company's profits and losses are analysed and translated into the economic impact on the national economy (taxes, etc.).

The EU Waste Framework Directive defines two objectives for the protection of the environment and human health: "to prevent and reduce the negative impacts caused by the generation and management of waste and to improve resource efficiency". The Directive establishes a 'hierarchy' that EU member states must apply to waste management, where waste prevention and reuse are the most appropriate options, followed by recycling (including composting), then energy recovery, while waste disposal through landfills should be the very last resort ([Commission, European Commission - Waste prevention and management, 2022](#))

The fashion industry's most widely known sustainable waste management strategy is the 3Rs waste hierarchy - reduce, reuse, and recycle (see image 19). However, considering the rapid growth of fashion consumption and their subsequent disposal, the search for alternative solutions for waste management has become an important issue, so another approach to fashion waste management has appeared: the refashioning of used clothes ([Dissanayake, 2013](#)), or, as the currently widely used term - "upcycling".





**IMAGE 19. TEXTILE WASTE MANAGEMENT HIERARCHY**

The textile sustainability pyramid clearly shows what should be the attitude of everyone toward textiles and clothing. The pyramid is upside down to reveal the importance of each part better. It makes you think about resources, quality, and your attitude toward clothing. First, you should use your own clothes and other textile materials for as long as possible. You should shop wisely and choose clothes that will last a long time, that can be combined with other items of clothing, and that will not go out of fashion for a long time, or you can buy used clothes, thus reducing the amount of waste. Before recycling, it is possible to transform your own or used clothes and give them a new look through upcycling. The clothing can be given away, sold, or recycled when it is no longer needed. At the very beginning, which is the most important thing in order not to harm ourselves and nature, we must think about using only sustainable clothing and textiles, i.e., those that provide the greatest benefit to humans while having the lowest negative impact on the environment.

## **Reducing**

Waste reduction or prevention is closely linked with improving production methods and influencing consumers to demand greener products and less packaging (Petarčić, 2020).

In general, reducing at the product manufacturing level means preventing or minimise the amount of waste, hazardous content and pollution generated at all stages of production. At the consumer level, reducing means less demand for new textiles and clothing, which would result in less waste. However, this is difficult to accomplish since retailers, particularly fast fashion brands, encourage excessive consumption by regularly introducing new fashions throughout the year and offering them at low prices. To reduce over-consumption, it is necessary to educate consumers and create an understanding of sustainable consumption (Apsara, Walahapitiya, Perera, Madushan, & Abeygu, 2022)

The low quality of products and the environmentally damaging effects of fast fashion have fuelled the growth of the 'slow fashion' movement, i.e., using greener fibres, reducing waste, or considering the movement of a product in the supply chain. Slow fashion is gaining popularity as designers move away from the fast fashion industry and embrace flexible, seasonless designs. However, since fast fashion companies are not interested in reducing consumption, the idea that slow fashion could replace fast fashion is currently impossible (Coskun, 2019).



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However, the popularity of fast fashion, which could replicate runway looks quickly and cheaply, is waning in favour of slow fashion, or items that are better for the environment and designed to last longer. As consumers look for brands that take a stand for the environment, nearly half of the fast fashion retailers have reported a recent decrease in customer purchases (Blake, 2020). To maintain sales volumes, but at the same time to “look greener” in the eyes of consumers, fast fashion companies participate in actions that could indicate their sustainability, for example, the H&M initiative, where customers can hand over old clothes for recycling.

A circular economy aims to attain a sustainable society and economy by avoiding and reducing resource consumption through multiple product and material loops. Consisting of two opposing terms, sustainability and consumption, sustainable consumption is a complicated and ambivalent concept. The main goal of sustainable consumption is to find a balance between satisfying the needs of customers and protecting the environment, which means reducing the negative effects of material extraction, production, and consumption (Michalak, 2022).

The concept of reducing focuses on changing people’s habits to decrease consumption. However, reducing consumption is complicated because it conflicts with the current consumption-driven culture. That’s why we as consumers need to start realising how to change our thinking. A start would be to buy less low-quality, cheap products that quickly lose their value and thus become unusable and thrown away. We must think, maybe we should reduce the number of clothes in our wardrobe and buy only high-quality, universal clothes that can be easily combined with each other.

### **Reusing**

In general, reuse is using an item again, prolonging its life. Reusing is the most environmentally friendly approach to handling waste from discarded clothing since it increases the life of clothes without reprocessing them. Textile reuse is giving away or selling to other products that are no longer useful but are still in good condition and fully wearable. One of the ways to reuse textiles is through charitable giving. Donated textiles are sorted by quality, degree of wear and tear, seasonality, and use, while also extending the life cycle of textiles. Charities provide clothing, shoes, home textiles, and other necessities to those in need. This is a good opportunity to reuse unwanted textiles. The most common example for reusing is the second-hand clothing market. Waste sorting companies that provide cities with waste sorting containers help used clothes end up on store shelves for resale.

One of the newest consumer behaviour trends is collaborative fashion consumption which includes an alternative approach to meeting needs. Instead of buying new fashion products, consumers have access to already existing garments either through alternative opportunities to acquire individual ownership (gifting, swapping or second hand) or through usage options for fashion products owned by others (sharing, lending, renting, or leasing). Digitalisation, consumer awareness of environmental issues, and anti-consumer attitudes have contributed to the popularity of collaborative consumption (Michalak, 2022). For example, if the clothes are no longer in use, a good option is to share them, for example, with friends or family, or sell them to others. Websites for selling and exchanging used clothing are becoming more popular, allowing people to sell or give away unwanted textiles. In addition, some of the most popular clothing brand shopping sites have separate blogs in their online stores where customers can resell items they purchased in that store but no longer use.





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Currently, you can rent products that interest you or lease those that you do not need. The rental of formal wear, suits, wedding dresses, and other social event outfits is also becoming increasingly popular. It is also good from a sustainability point of view, with the outfit being worn several times rather than stored in the closet until it is no longer needed.

Companies are also beginning to adapt their operations to this principle. For example, the brand “MUD Jeans” offers its customers the choice of renting jeans for a fixed amount per period - if you like the pants, you can buy them, making a thoughtful purchase, while if they are worn out, they can be recycled into new ones (Circular, 2022). Also, luxury fashion brands offer to rent their clothes. For example, Burberry is expanding its garment rental business via collaboration with the luxury rental and resale platform My Wardrobe HQ ([My Wardrobe, 2022](#)). It is possible to rent out many of Burberry’s best-known designs for a minimum of four days and up to 14 days. If a buyer does not want to give up, it is also feasible to purchase a thing second-hand, which is less expensive than purchasing it new. Renting clothing is becoming increasingly popular among young people since it is the only way they can afford to acquire high-end designer gear for occasions such as weddings, theme parties, picture shoots, and filming ([Textile Focus, 2022](#)).

All the methods described above are very good because the products are returned to circulation completely without or with minimal resource and energy consumption, benefiting both people and nature.

### Clothing care

Regardless of whether new or used clothing is worn, it is necessary to properly care for it. Garments are usually accompanied by labels that indicate both the composition of the textile materials and the care instructions in the form of symbols ([GINETEX\(n.d.\), 2022](#)), which help to understand how to act correctly to maintain the properties of the garment. Regarding washing, the instructions only indicate the main conditions but do not talk about the frequency of washing. It must be evaluated individually, depending on the degree of soiling of the clothes. Except for dirty physical work or exercising, there is really no need to wash clothes after every wear. Underwear, shirts, and sportswear should be washed more often - even after wearing them once, but for example, pants and jackets are washed only when they are dirty. Re-wearing clothing between washes has benefits: clothes will last much longer, reduce microplastic pollution from synthetic materials (acrylic, nylon, and polyester) and ultimately reduce water and energy consumption ([Uncomplicated Spaces, 2019](#)).

### **Recycling**

Recycling of waste is defined in the Waste Framework Directive ([Eurostat, 2022](#)) as “any recovery operation by which waste materials are reprocessed into products, materials, or substances whether for the original or other purposes. Recycling can be split into the subcategories’ Material recycling’ and organic recycling, ‘Recycling - composting and digestion’. The latter is only possible for separately collected organic waste.”

Recycling is transforming waste into new products to save potentially usable materials and reduce the use of fresh raw materials. The goal of recycling is to provide the manufacturer with recycled raw materials to reuse as input in the production of new products. Material recycling can save resources



and typically consumes less energy than the creation of new materials ([Rathinamoorthy, 2018](#)). To preserve natural resources and reduce climate change, textile waste recycling is a high priority. Everything in the textile and clothing sectors should be utilised since textiles are almost entirely recyclable ([Yalcin-Enis, 2019](#)).

To make recycling possible, a special sorting of textile materials is performed, in which products are divided primarily by colour and fibre composition instead of wear, and then all non-textile parts are separated from them - buttons, zippers, rivets, etc. After that, the textile waste is processed mechanically, thermally, or chemically to produce textile fibres. In this way, more energy and resources are consumed than through reusing or upcycling, but it is less than the extraction of new materials, and the waste does not end up in landfills. For example, there is a city in Italy that has come together to mechanically recycle unwanted textiles and turn them into new products ([Bettiza, S. \(Reporter, Editor\) & Patruno, P. \(Camera\). - BBC News, 2020](#))

#### What is preventing clothing recycling, and why is it so difficult?

Textile recycling gives materials that would otherwise end up in landfills a second life, protecting the environment. However, not every textile item yet is recyclable, and some may end up in landfills due to a variety of factors ([Kanchana, 2013](#)). In clothing manufacturing, we do not see as much recycling as in other industries, such as paper or plastic recycling. One of the biggest challenges to face is that most clothes are simply not made for recycling and are very difficult to recycle. Garments are very diverse, with many different components of raw materials, so they are unsuitable for classic recycling processes that require a constant material ([Rissanen, 2022](#)).

- First, the recycling of clothing begins with its disassembly and separation. However, not all textile products can be disassembled; there are those whose dismantling takes much time, and there are those whose dismantling is no longer possible at all.
- Second, even seemingly simple products are often made from a combination of different fibres or raw materials. For example, a T-shirt made of 100% cotton yarn but sewn with 100% polyester threads cannot be recycled unless it is separated into raw materials - fabric and sewing threads. Meanwhile, some innovations in this area have appeared, such as heat-dissolvable thread by [Resortecs \(Resortecs, 2022\)](#).
- Thirdly, colour is important; recyclable textile products must also be sorted according to it. Colour is especially important for a category of textiles that are intended to be mechanically recycled and then mixed with new fibres of the same colour to form yarn of the same colour.

Recycling methods vary depending on the fibre composition. Wool and cotton are two examples of natural fibres that can be mechanically processed. The chemicals used to dye or finish the fabric may also have an impact on its recyclability. In addition to the fittings that must be removed, a complex product, such as a lined jacket, may have more than five different types of fabric. If the material composition of the clothing, fabrics, and sewing threads differs, they must be separated. As a result, it is costly and time-consuming. Sometimes it is easier to shred the garment and convert it into a downcycled product, such as thermal insulation, but some separation steps are still required.



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Even in the best eco-design scenario, a portion of textile production, such as women’s underwear, cannot be recycled. A single bra can contain up to 140 different elements, and disassembling it is both time-consuming and technically impossible because not only fasteners, hooks, and other parts must be separated, but also different fabrics and materials, which are frequently compressed or fused together. Laminated fabrics and membranes are not recyclable either.

Across the fashion industry, only 13% of the total material input is in some way recycled after clothing use. Most of this recycling is cascading into other industries and being used in lower-value applications like mattress stuffing, wiping cloths, insulation, and other materials that are currently difficult to recover and, therefore, likely constitute the final use (see image 20). Given the complexity of textile recycling, less than 1% of the material used to produce clothing is recycled into fibres for new clothing. Even though some countries have high rates of clothing collection for reuse and recycling, most of the clothing collected there is exported to countries lacking their own collection infrastructure. Despite these valuable efforts to increase clothing utilisation, most of these clothes end up in landfills or are used in lower-value applications (Ellen MacArthur Foundation, 2017).

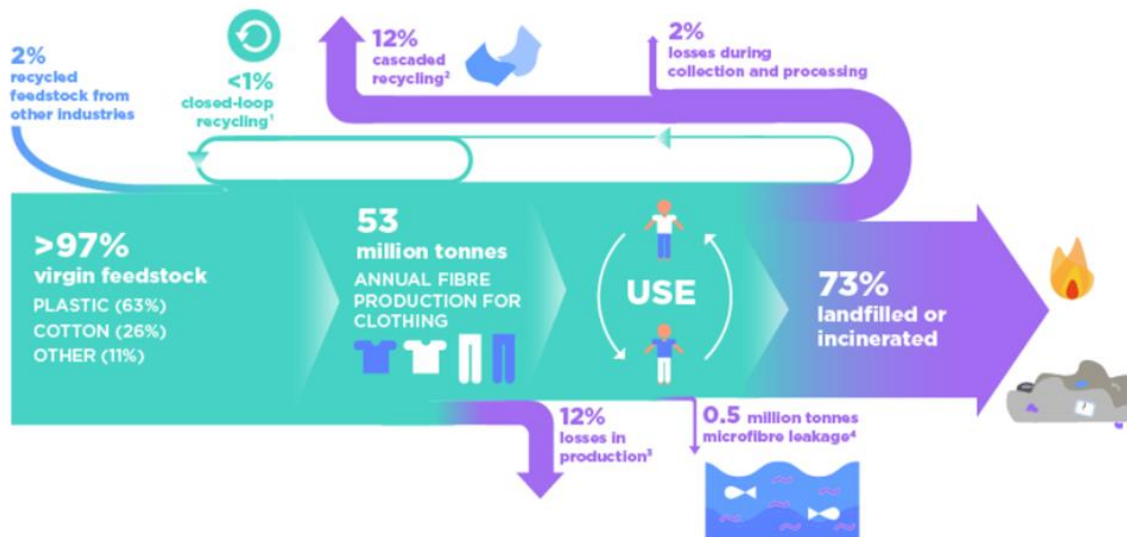


IMAGE 20. GLOBAL MATERIAL FLOWS FOR CLOTHING IN 2015

SOURCE / COPYRIGHT: ELLEN MACARTHUR FOUNDATION. A NEW TEXTILES ECONOMY: REDESIGNING FASHION’S FUTURE, 2017

Because the current dominant textile recycling process degrades the quality and value of the materials by mixing different materials and/or adding other materials or chemicals, recycling is quite often “downcycling” (Sung, 2019). Currently, most mechanically recycled textile fibres obtained from textile waste are shorter and more heterogeneous, i.e., lower quality compared to virgin fibres. For recycled fibres to be used in yarn production, it is necessary to add virgin fibres to them. Even though downcycling benefits the environment by keeping waste out of landfills (for a while at least), it frequently ends up there in the long term (Rathinamoorthy, 2018).

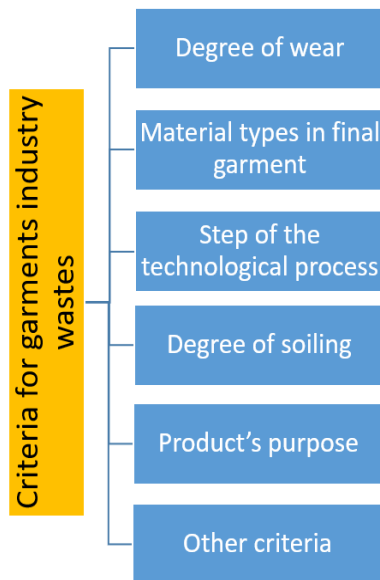


IMAGE 21. TEXTILES WASTE CATEGORIES

The garment industry is an industry that provides beautiful and amazing items, but it also produces various types of waste (see image 21). Over the years, waste has become a major issue for which society needs to find an efficient solution to reduce its quantity and use it as a primary resource for various production activities.

The global production of textile fibres, the consumption of textiles and the amount of textile waste are an ever-increasing problem. One way to reverse this situation is to reuse already used garments in the production chain.

Depending on the degree of wear, the main categories of waste are:

- Pre-consumed textile waste;
- Post industrial textile waste;
- Post consumer waste.

**Pre-consumed textile wastes** are wastes generated during the production processes, such as yarn wastes, knitting wastes, textile wastes and packaging wastes. These can no longer be used in the same technological process.

**Post-industrial textile waste** arises between the production and consumption phases. This is waste generated during the distribution system or for commercial reasons. (e.g.: unsold products or products in stock).

**Post-consumer waste** is waste in the form of finished products resulting from a use process that has led to a partial or total reduction in the use value of the product. Post-consumer textile wastes are end-of-life products destined for disposal or landfill. It may be destined for household use or for industrial use.

In the case of post-consumer textile waste for industrial use, such as nets for agriculture, recycling must be specifically designed as it usually involves large quantities.

The largest part of post-consumer textile waste is the garments collected from the population. The production/pre-consumer waste is regulated according to HG No. 856/2002 on waste management records.

The main categories of waste according to the technological process stages are shown in the following figure (see image 22).

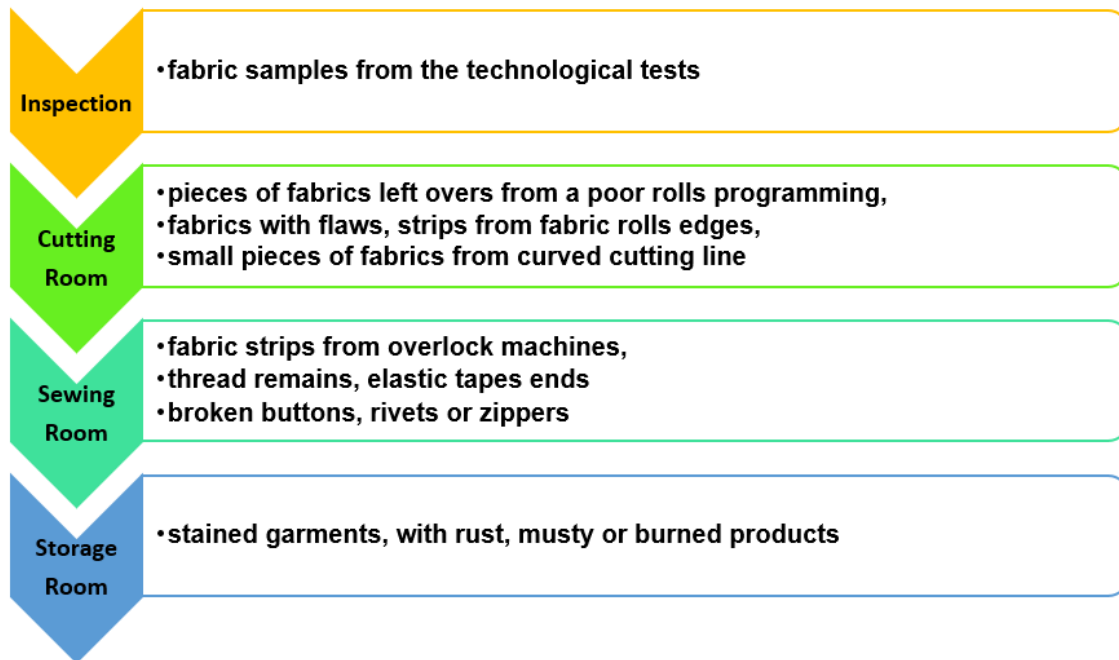


IMAGE 22. TECHNOLOGICAL WASTE CATEGORIES

Waste types according to the degree of soiling are:

- Clean wastes
- Soiled wastes that need undusting and/or washing processes.

Wastes type according to the product's purpose are:

- Wastes from used garments
- Fabrics for garments
- Wastes from materials (yarns, threads, fabrics) for technical products
- Wastes from fabrics for upholstery etc.

Other criteria for classifying the wastes from the garments industry are:

- According to colour: monochrome, bicoloured and multicoloured
- According to the electrostatic charge degree: with and without electrostatic charge
- According to ecological impact: with a high polluting degree, polluting or non-polluting

The identification of the type of waste, in correlation with the above-mentioned criteria, will lead to a specific recovery route.

The following solutions can recover the pre-consumed waste and the finished products resulting from an using process:

- Material recycling (mechanical decomposition);
- Chemical recycling (decomposition into monomers);
- Recycling at high temperature (combustion - thermal energy).

Textile waste can be used in different ways depending on the fibre quality (see image 23):



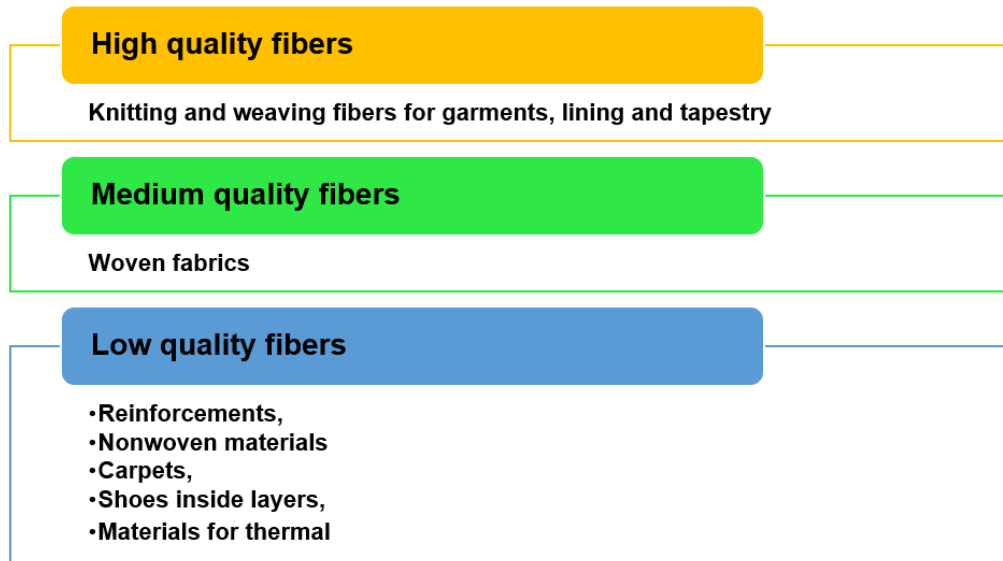


IMAGE 23. TEXTILE WASTE UTILISATION IN RELATION WITH FIBER QUALITY

Textile waste sorted by type of fibre can be used as follows (see image 24):

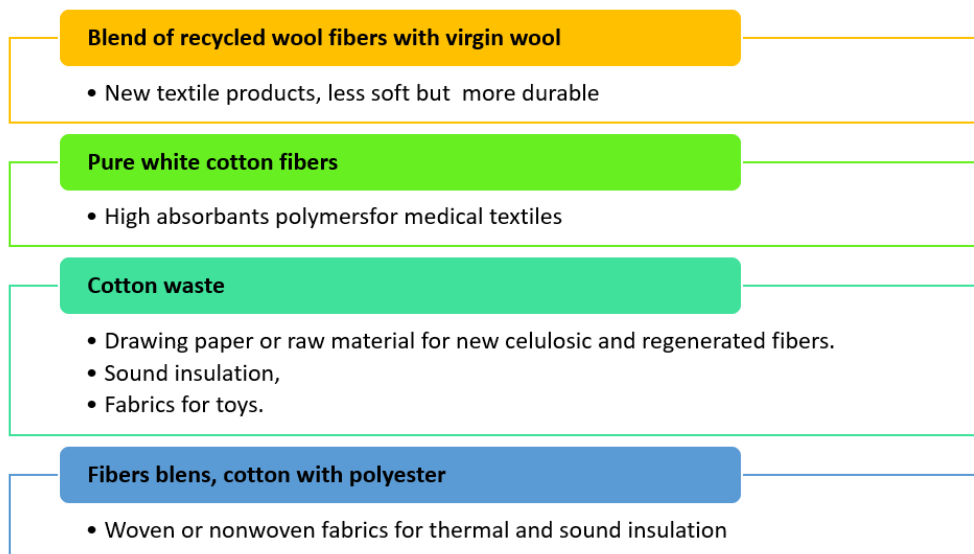


IMAGE 24. TEXTILE WASTE UTILISATION IN RELATION WITH FIBER TYPE

According to the European Commission data, European textile consumption has the fourth highest impact on the environment and climate change, after food, housing and mobility. It ranks third in water and land consumption and fifth in primary raw material consumption and greenhouse gas emissions. The average European throws away 11 kg of textiles every year. Globally, one truckload of textiles is landfilled or incinerated every second. Global textile production almost doubled between 2000 and







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2015, and consumption of clothing and footwear is expected to increase by 63% by 2030. In parallel with this relentless expansion, the negative impacts on resources, water, energy consumption and climate continue to increase. The need to get a grip on the production and consumption of textiles is more urgent today than ever before. (Commission, 2015)

The EU strategy for transforming the textile industry into a sustainable industry recommends the following measures (Commission, 2015):

- "New design requirements for textiles under the Ecodesign for Sustainable Products Regulation, setting mandatory minimums for the inclusion of recycled fibers in textiles, making them longer-lasting, and easier to repair and recycle;
- Clearer information on textiles and a Digital Product Passport based on mandatory information requirements on circularity and other key environmental aspects;
- Tight controls on greenwashing, with stricter rules to protect consumers and direct links to the upcoming Green Claims Initiative;
- Action to address the unintentional release of microplastics from textiles;
- Harmonised EU rules on extended producer responsibility for textiles, and economic incentives to make products more sustainable ("eco-modulation of fees"), as part of the revision of the Waste Framework Directive in 2023;
- Support to research, innovation and investments and to the development of the skills needed for the green and digital transitions;
- Addressing the challenges related to halting the export of textile waste;
- The co-creation of a Transition Pathway for the Textiles Ecosystem to establish the way forward and set out concrete step on how to achieve the 2030 goals set by the Textiles Strategy."

### 2.3. Identify the most efficient practices in clothing manufacturing that establish sustainability



IMAGE 25. SUSTAINABLE FASHION



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The manufacturing process is a crucial step in the development of clothing products. Fabric contributes to the aesthetics, function and usability of a garment. It gives a garment a fashion context and contributes to the exclusivity of a product developer's line. The choice of fabric plays an important role in the customer's appreciation.

Fabrics are classified as either base goods or outer goods, which refers to their suitability for skirts, trousers and jackets or shirts, blouses and dresses.

Basic goods are usually the core products of a group. Novelty goods provide a fashion advantage and help to differentiate the line.

Some companies have separate product development departments for knitwear and woven fabrics, as the design process and sourcing partners for these fabrics are different.

Product developers can select the exact fabrics they will use in a line, or they can ask their sourcing partners to search for suitable fabrics. Branded and private label product developers are usually more involved in the fabric selection process, while private label product developers may be less specific in their fabric specifications.

Designers select fabrics based on a specific fibre type, composition, weight, drapeability and other criteria determined by the garment's destination and the client's requirements (see image 25).

The fabric properties influence how the designer uses the fabrics to create the model silhouettes. It is important for product developers to keep up with new textile technologies that improve aesthetics and function. The use of high-performance fabrics helps maintain profit margins and gives product developers a competitive edge. Consumers see improved fabrics as adding value and novelty to their apparel purchases. The use of prints helps differentiate one developer's product line from another. Prints can be purchased or designed in-house.

Just as we have learned to recycle our paper, glass and plastic, the day is approaching when there will be collection points for recycling our clothes. One of the biggest concerns with textile products is that too many of them end up in landfills and are not biodegradable.

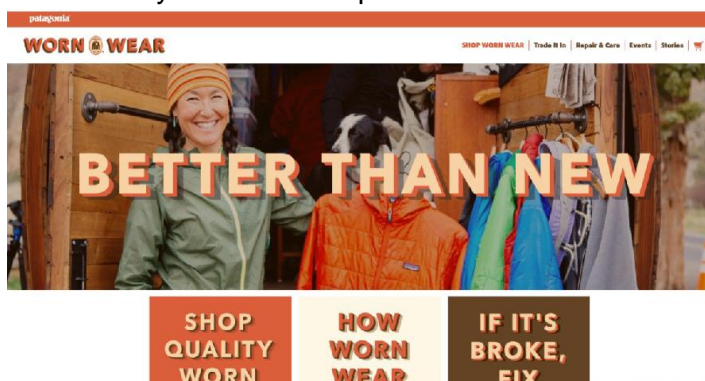


IMAGE 26. PATAGONIA WORN WEAR WEBSITE (LUCY CHAMBERLIN)

Patagonia uses recycled nylon fibres and yarns collected from a spinning mill and then processed into Nylon 6, which can be recycled indefinitely. Recycled nylon uses no additional crude oil, requires less energy to produce and produces less carbon dioxide pollution during processing.

Discarded polyester garments can also be recycled. Common Threads by Patagonia is the world's first garment recycling

programme. The new polyester made from discarded polyester garments results in an energy saving of 76% and a reduction in carbon dioxide emissions of 71%, compared to making this fibre from virgin raw material (see image 26) (Patagonia, 2023).





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Plastic bottles made of polyethylene (PET) can be sorted, melted down and reformed into small pellets. These pellets are sold to fibre manufacturers who use them to make new polyester fibres and yarns. While this is a good way to prevent bottles from ending up in landfills, many would argue that our consumption of bottled water over tap water is both expensive and offers no additional health benefits. Cotton and wool fibres can also be recycled, although the second generation product is of much lower quality and these fibres can only be recycled once.



**IMAGE 27. PHOTO OF THE ALABAMA CHANIN TRUNK SHOW (WARDROBE)**

An alternative to recycling is the reuse, repurposing or upcycling of old garments or fabric scraps left over after a cutting job. Project Alabama, now Alabama Chanin, started its brand by reusing plain T-shirts (see image 27). As the business grew, they had to supplement their stock of old t-shirts with organic cotton interlock. Expanding into yard goods also allowed them to diversify their product range. Knitwear manufacturers can also recover the yarn from their defective jumpers by unravelling it, steaming out all the crimps and then splicing sections together so it can be made into a new garment.

Given the cost of research and development to make textile processes and products more sustainable, and the urgency to limit their harmful impact on the planet, there are a number of collaborative efforts that are driving competitors to work together towards this worthy goal. Nike, Gap Inc, H&M, Levi Strauss, Marks & Spencer and Walmart have joined forces in the Sustainable Apparel Coalition to develop an industry-wide index that measures everything from water and energy use to greenhouse gas emissions, waste and labour practises.

Levi Strauss is also a member of the Better Cotton Initiative, which addresses the environmental impact of growing and processing cotton for denim. Gap Inc. is trying to make a difference with its Denim Clean Water Programme, launched in 2004, which closely monitors more than 90 denim laundries used by vendors around the world. ([Çelik, Mehmet , & Canan Dülger, 2015](#))

Patagonia has worked with Walmart to help them establish criteria for sustainable clothing. Yvon Chouinard, the founder of Patagonia, advised them to “take responsibility for your product from birth to birth.” He explained, “People are trying to make organic cotton clothes, and there is not enough organic cotton in the world to ever supply Walmart. There never will be. So the company needs to move to making, say, workwear out of 100% recyclable polyester and then, when customers are done with it, recycle it back into its original polymer and make more workwear. We have to stop the idea of consuming and throwing away” ([Company, 2009](#))

Chemical companies around the world have developed and implemented Responsible Care initiatives ([www.responsiblecare.org](http://www.responsiblecare.org)).



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These initiatives have been endorsed by major trade associations; some have made compliance with these standards a condition of membership. They require open communication about activities, incidents and achievements throughout the supply chain. The presence of a Responsible Care programme is a good indicator of a supplier's integrity and commitment to best practises in safety, health and the environment. They improve confidence in the chemicals used in textile finishing throughout the supply chain. (Keiser & Myrna, 2012)

Apparel supply chains are working together to better protect the environment as they become increasingly aware of the costs of using textiles or finishes that later turn out to be harmful to health, safety or the environment. Consumers can influence this by showing through their purchasing behaviour that these issues are important to them. We all need to be aware that fast fashion is not sustainable and that environmentally friendly textiles will cost a little more in the short term, but this is the only way to ensure that we leave a habitable planet for future generations.

Sustainability is becoming a necessity in all aspects of our lives. We can develop a sustainable future as follow:

- Improving the environmental performance of the sector is material-specific and depends on the energy and toxicity profile of the material's life cycle. For conventional cotton products, the energy demand is determined by the laundry, while the use of toxic chemicals is driven by agriculture. For viscose, on the other hand, the energy demand is dominated by production;
- For products where production dominates impact, process efficiency should be increased. Impacts are reduced by extending the life of the product or by reusing materials through some form of recycling;
- Alternative processes or materials should be sought in addition to measures to extend product life for products where raw material production dominates. A switch from conventional to organic cotton production would eliminate most toxic releases;
- The energy demand for cotton clothing is mainly determined by washing, drying and ironing. In response, washing temperatures can be lowered and tumble drying avoided. Novel treatments can provide odour resistance and thus reduce the total number of washes or allow faster drying with less ironing;
- The second-hand sector is growing and there is further demand. Therefore, improved collection and sorting methods will help reduce waste and provide usable clothing to developing countries;
- Recycling is important for materials that have major impacts in the production phase. Technology innovations could provide a way to extract longer fibres from used textiles, although a recent innovative carpet recycling company has not been able to achieve profitability;
- The globalised structure of the clothing and textile supply chain does not have any significant disadvantages for the environment, as energy consumption for transport is relatively low and the world does not have a supply of relevant raw materials. Technological innovations such as 3D knitting and weaving can lead to economically viable production, with consumers benefiting from increased responsiveness.

It is important to mention that sustainable methods have been developed to raise public awareness of this problem in our society:





- ✓ The Circular Game - is a program created to educate, connect, and develop a sustainable design. The program members are designers, scientists, and entrepreneurs who together develop new recycling methods.
- ✓ THE TEN by TED – the Worn Again project together with a team from TED (Technology, Entertainment, Design) laid the foundations for a set of sustainable design strategies to be applied by designers. These strategies arose from the need to better understand the issue of sustainability and how each of us can make more innovative decisions.

## **2.4. Develop and promote new practices in the field**

A change in this industry to reduce environmental impact and promote social justice will occur when consumers choose to:

- Buy second-hand clothes and textiles when possible.
- Buy less durable clothing and textile products.
- When buying new products, choose those made with the lowest energy consumption and pollution emissions, and produced by workers who are paid a credible living wage and decent labour rights and conditions.
- Lease clothes you would not otherwise wear until the end of their natural life.
- Wash your clothes at lower temperatures using eco-detergents, let them air dry and avoid ironing where possible.
- Extend the life of clothes and textile products by repairing them.
- Dispose of used clothing and textiles through recycling companies that return them for second-hand sale if possible, but otherwise extract and recycle the yarn or fibres.

Several obstacles may prevent the consumer from implementing these measures. To overcome these obstacles, it is necessary:

- Consumer education: ensure that fact-based information on the specific impacts of a product is available and understood.
- A greater emphasis on durability as a component of fashion would support a move towards reduced material flow.
- The industry could halve its material flow without economic loss if consumers pay a higher price for a product that lasts twice as long.
- New business models where profit growth is decoupled from increased material flow are possible if consumers pay for services - such as repairs, novel coatings, other maintenance services, remanufacturing or 'fashion upgrades'.
- Technological development could lead to new ways of refurbishing clothes without washing, efficient sorting of old clothes, new technologies for recycling fibres and new low-temperature detergents.
- The clothing collection infrastructure could be improved.
- Government environmental policies should be changed to promote the reduction of the total or embedded impacts of products.



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Clothing and textile products begin as fibres - which are either natural (e.g. cotton, silk, wool), man-made (from cellulose, e.g. viscose) or synthetic (oil used to make polymers, e.g. polyester, acrylic and nylon). The demand for natural fibres has remained roughly constant, while the demand for man-made fibres has almost doubled. The production of textiles begins with the spinning of the original fibres, which are relatively short and thin, into yarns. These yarns are transformed into fabrics (often flat webs) by one of two processes: Weaving or knitting. The 'flat' fabric must then be shaped into a '3D shell' so that it can be used as clothing.

From designing a garment to pressing and packaging the finished product, a range of processes are required - each with different demands on capital, technology and labour: designing, pattern making, grading, nesting and marking, cutting, sewing, quality control, pressing and packaging. Technology is constantly being developed at all levels of these activities to reduce labour intensity and shorten delivery times. However, in 300 years of innovation, no technical substitute has been found for human hands that can process and sew all types of fabrics - a task that is still too complex for robots. Instead, the industry has shifted in search of cheap labour (often women) for whom a low-paid job with repetitive tasks in a factory is more attractive than any other option.

However, thanks to innovations in knitting machines, knitwear is increasingly produced by machines that deliver seamless whole garments. Other innovations in production technology include laser cutting of fabrics, automated sewing machines that 'learn' from people, and inkjet printing of fabrics or made-up garments.

The integration of computer-aided design and computer-aided manufacturing throughout the supply chain is being developed to reduce lead times and improve product quality and performance. Recent research in the industry aims to transfer technologies from the automotive industry to use the 'new industrial robotics' to reduce the need for expensive labour. This is economically attractive to high-cost manufacturers in developed countries, but could eliminate important employment opportunities in developing countries.

This clothing and textile industry has also seen rapid adoption of novel IT solutions for production system control and virtual design, inventory management, replenishment and real-time monitoring of fashion trends.

### **2.5. Increase own awareness to maximise understanding and motivation**

As noted in the Commission Staff Working Document (SWD) 2017 "Sustainable Value Chains in the Apparel Industry through EU Development Actions", the textile industry generally refers to the production of yarn, textiles and fabrics, while the clothing industry (also referred to as the apparel/clothing/fashion industry) refers to the production of garments. The sector also includes other types of textile products such as household textiles and technical/industrial textiles (e.g. textiles for industrial filters, hygiene products, textiles for the car and medical industries). In addition to clothing, the fashion industry can also include shoes, bags, jewellery and other accessories.







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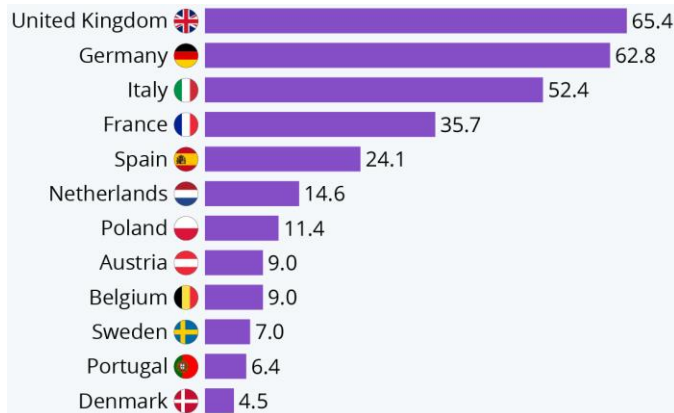


IMAGE 28. CONSUMER SPENDING ON CLOTHES (RAYNOR DE BEST)

The amount of clothing bought per person in the EU has increased by 40% in just a few decades, due to falling prices and faster delivery of fashion to customers. Clothing accounts for between 2% and 10% of the environmental impact of EU consumption (see image 28). The production of raw materials, spinning into fibres, weaving of fabrics and dyeing require huge amounts of water and chemicals, including pesticides to grow raw materials such as cotton. Consumption also has a large ecological

footprint, as washing, drying and ironing use water, energy and chemicals, and microplastics are released into the environment. Less than half of used clothing is collected for reuse or recycling when no longer needed, and only 1% is recycled into new clothing, as technologies that would allow clothing to be recycled into new fibres are only emerging.

The production of textiles and clothing today has one of the most complex global value chains, with most products on the EU internal market being manufactured outside the EU, often in countries with lower labour and environmental standards.

According to the European Commission, the main exporters to the EU in 2015 were China, Bangladesh, Turkey, India, Cambodia and Vietnam. Nevertheless, according to Euratex, the EU textile and clothing sector exported €48 billion worth of products in 2017, making the EU the second largest exporter in the world - with China in first place. At the same time, the EU imported €112 billion worth of textile products from third countries.

The environmental impact of the consumption of textiles and clothing in the EU is difficult to assess due to their diversity and the fact that they occur around the globe. A 2006 report by the Joint Research Centre (JRC) estimated that 70-80% of the environmental impact of EU consumption is attributable to food and drink, transport and private dwellings, while the remainder is attributable to clothing, which accounts for 2-10% depending on the type of impact.

A 2017 report by the Global Fashion Agenda (GFA) estimated the EU's environmental footprint caused by textile consumption at 4-6%. The Pulse of the Fashion Industry 2017 report, produced by GFA and Boston Consulting Group, estimates that the global textile and apparel industry was responsible for the consumption of 79 billion cubic metres of water, 1.715 billion tonnes of CO2 emissions and 92 million tonnes of waste in 2015. It is also estimated that these figures would increase by at least 50% by 2030 under a business-as-usual scenario.

The production of raw materials is responsible for a large share of the environmental impact of the textile and clothing industry, not least through the cultivation of plants for natural fibres. Cotton, which accounts for more than 43% of all fibres used for clothing in the EU market according to a 2015 report by the European Clothing Action Plan (ECAP), is considered particularly problematic as it requires large amounts of land, water, fertilisers and pesticides. The environmental impact of organic cotton



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can be drastically reduced compared to conventional cotton as it uses less water and has less impact on the environment.

According to the Pulse of the Fashion Industry 2017 report, natural fibres have the greatest impact on the environment. Silk has a particularly detrimental effect on natural resource depletion and global warming, cotton contributes excessively to water scarcity and wool contributes to greenhouse gas (GHG) emissions. However, the industry is also testing less commonly used natural fibres such as hemp, flax, linen and nettle, which require less water, fertiliser and pesticides.

Polyester, which is made from fossil fuels and is not biodegradable, accounts for 16% of fibres used for clothing, according to ECAP.

Its main advantages are that, unlike cotton, it uses less water, needs to be washed at lower temperatures, dries quickly and hardly needs ironing, and can be recycled into new fibres. Recycled polyester, which is mainly made from plastic bottles, increased its market share from 8% in 2007 to 14% in 2017. However, several studies have also recently shown that one load of laundry made from polyester clothing (also nylon and acrylic) can release 700 000 microplastic fibres, which can release toxins into the environment and enter the human food chain. It is estimated that about half a million tonnes of microplastic fibres from laundry end up in the sea every year (Šajn, 2019)

When designing a new model, it is important to consider the following principles (Dam & Teo Yu , 2022):

- Great design is based on observed, human needs.
- Great design comes from understanding people's behaviours, thoughts and emotions.
- To make good design decisions, it is first important to create multiple options to choose from.
- Great design comes from a desire to achieve real results.
- Great design is iterative. It uses continuous learning and never really ends.



IMAGE 29. RESOURCE EFFICIENCY (SUSTAINABLE DEVELOPMENT GOALS)

resources and limiting harmful emissions and waste.

Resource efficiency (see image 29) is a very important but relatively underused concept that is essential for sustainable development. Resource efficiency is about creating more wealth and producing more goods and services while using fewer



## 2.6. Implement knowledge and skills in the long run within real environments and create impact, among others

There is a strong push in the industry to make every step of production more sustainable. According to the 2018 Pulse of the Fashion Industry report, large sportswear companies and major fashion brands are leading the way in investing in new technologies and business practises, but mid-priced companies are also making great strides and even fast fashion is becoming more sustainable. There are warnings that companies that do not change the way they operate will face rising material costs and may run out of resources in the future (see images 23 and 26). The task is difficult, however, because efforts to reduce environmental impact can lead to higher prices for consumers, and convincing consumers to buy less clothing could cut into companies' profits. According to various studies, greenhouse gas emissions would fall by 44% if the number of items of clothing worn were doubled on average.



IMAGE 30. SUSTAINABLE FASHION BADGE  
(SUSTAINABLE DEVELOPMENT GOALS)

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The concepts that can lead the clothing and textile industry to a sustainable manufacturing industry are (see image 30):

- **Slow Fashion.** In contrast to fast fashion, slow fashion is an attempt to convince consumers to buy fewer clothes of better quality and keep them longer.

- **Fashion as a service.** New business models could increase the number of garments worn by using the principles of the sharing economy. Some brands already offer clothes as a service, i.e. they rent out their clothes instead of selling them. In doing so, they are taking their cue from already established services such as wedding and party wear rentals, protective clothing and newer services such as maternity and baby wear rentals. Other companies offer clothing subscriptions, where consumers pay a

monthly fee to rent a certain number of garments so they can change their wardrobe frequently without having to buy new clothes.

- **Improved collection for reuse, repair and upcycling.** Brands such as Filippa K. (Filippa-k.com, 2023) are pioneering the idea by selling their used clothing in their regular shops to make it easier to buy second-hand clothes. Others offer long-term guarantees that include repairing or replacing a product for free, offering repairs or instructions on how to repair, or offering upcycling or instructions on how to upcycle.

- **Smart and fast fashion.** Smart fashion could produce the clothing of the future that uses smart technology to instantly adapt to the consumer's wishes, for example by changing colours, which would also reduce the need to produce multiple versions of the same garment. Instant fashion could enable on-demand production at the point of sale, for example using future and improved 3D printing, which



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could also bring production back to the EU. Consumers would be able to have what they want produced locally without overproduction. Some smaller brands already avoid overproduction by producing only what consumers order.

- **Raise consumer awareness.** Research shows that consumers are generally in favour of environmentally conscious fashion, but that this is not necessarily reflected in their actual behaviour. There are a number of factors that discourage consumers from sustainable fashion, including higher prices (although the number of environmentally conscious consumers willing to pay more for the sustainable option is increasing) and the perception that recycled clothing may be of lower quality and that it is made in less sophisticated styles, etc.
- **Increased transparency and environmental labelling.** Some companies already provide consumers with information on the environmental footprint of their products, such as CO2 emissions or water consumption. Choosing a more sustainable option could be facilitated by clear and standardised labelling of environmentally friendly products.
- **Better instructions for washing and drying.** As washing and drying are a major contributor to the environmental impact of clothes, the industry could help by providing better information to consumers on how to reduce this impact, for example on care labels. Other companies offer step-by-step instructions for repair and care on their websites. ([Šajn, 2019](#))

It is hard to imagine living in a world without textiles. Almost everyone and everywhere encounters them almost constantly. Clothing provides comfort and protection and is an important expression of individuality for many. The textile industry is also a major sector of the global economy, providing employment for hundreds of millions of people around the world.

Transforming the industry towards a new textile economy requires system-level change with unprecedented levels of engagement, collaboration and innovation. Existing activities that focus on sustainability or sub-aspects of the circular economy should be complemented by a concerted, global approach that matches the scale of the opportunity. Such an approach would rally key industry players and other stakeholders behind the goal of a new textile economy, set ambitious shared commitments, launch demonstration projects across the value chain and coordinate and strengthen complementary initiatives. ([Ellen Macarthur, 2017](#))





### 3. Additional materials and resources

This section aims to make your life easier!

It provides a variety of resources to foster your understanding of the topics scrutinised in the previous section. Each of the resources serves as material for further reading and more practical implementation of the AR4Reclothing practices and ideas.

<b>Module 2: Sustainable practices in Clothing Manufacturing</b>			
<i>Type of resource</i>	<i>Title</i>	<i>Topic</i>	<i>Link</i>
Video	Clothing manufacture – cutting room, waste materials	Topic 1: Understand the basics of clothing manufacturing Topic 2: Analyse the different means towards a more sustainable environment	<a href="https://youtu.be/Clw_aTIC5U">https://youtu.be/Clw_aTIC5U</a>
Video	Clothing manufacture – sewing – waste materials	Topic 1: Understand the basics of clothing manufacturing Topic 2: Analyse the different means towards a more sustainable environment	<a href="https://youtu.be/tUXteB43kXc">https://youtu.be/tUXteB43kXc</a>
	Clothing manufacture – the lifecircle of a garment	Topic 1: Understand the basics of clothing manufacturing	<a href="https://youtu.be/BiSYoeqb_VY">https://youtu.be/BiSYoeqb_VY</a>
	Raw materials from old garments	Topic 4: Develop and promote new practices in the field	<a href="https://youtu.be/obO1PKfXGpQ">https://youtu.be/obO1PKfXGpQ</a> <a href="https://youtu.be/2RPq_v8WEkA">https://youtu.be/2RPq_v8WEkA</a>
	Fast fashion effects	Topic 6: Implement knowledge and skills in the long run within real environments and create impact among others	<a href="https://youtu.be/tU0Yo3yQ8Ug">https://youtu.be/tU0Yo3yQ8Ug</a>
Web	Sustainability	Topic 2: Analyse the different means towards a more sustainable environment	<a href="https://www.mdpi.com/journal/sustainability">https://www.mdpi.com/journal/sustainability</a>
Web Article	H&M Launches Global Clothing Recycling	Topic 4: Develop and promote new practices in the field	<a href="https://www.environmentalleader.com/2012/12/hm-launches-global-clothing-recycling/">https://www.environmentalleader.com/2012/12/hm-launches-global-clothing-recycling/</a>
Web Article	A New Systems Approach to Sustainability:	Topic 4: Develop and promote new practices in the field	<a href="http://www.jsedimensions.org/wordpress/wp-">http://www.jsedimensions.org/wordpress/wp-</a>





	University Responsibility for Teaching Sustainability in Contexts		<a href="content/uploads/2012/03/PappasJSE2012.pdf">content/uploads/2012/03/PappasJSE2012.pdf</a>
Web article	The Ethics of Sustainability	Topic 2: Analyse the different means towards a more sustainable environment	<a href="https://www.ethicalreading.org.uk/wp-content/uploads/2020/02/Ethics-of-Sustainability-Textbook.pdf">https://www.ethicalreading.org.uk/wp-content/uploads/2020/02/Ethics-of-Sustainability-Textbook.pdf</a>

## 4. Wrap-Up

In this module we started with basic knowledge about the processes developed in clothing manufacture and the life cycle of garments as necessary information for the circular economy path. In order to analyse the different pathways to a more sustainable environment, we first defined the concept of sustainability for garment manufacturing and then identified the main waste categories in this sector. In the next chapter, the most efficient practises for sustainability in garment manufacturing were highlighted, starting with the design process and ending with customer awareness. A change in the garment industry to reduce environmental impact and promote social justice starts with the development of new practises in the field, followed by increasing one's awareness and long-term implementation of knowledge and skills in real environments and creating impact on others.



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## 6. Assessment

### 6.1. Introduction

The following is an assessment to check that the content of this Module has been understood. Firstly, we have a set of 10 questions of different types: single correct answer with three options, multiple answer with four options, relating the terms with their definitions, relating the concepts with their explanations and relating the problems with their solutions. Finally, a practical case study is presented to assess critical and creative thinking.

Estimated time to complete: **2 hours**

### 6.2. Knowledge assessment

**Question 1: What are the main processes from the clothing companies?**

- [sewing and ironing]
- [cutting]
- [spreading.]
- [all the above]**

**Question 2: Which of the bellow sencences are true:**

- [Every product has its own life cycle which begins with its production and ends with its useful life]
- [The life cycle of a products ends when it is bought by the customer]
- [The life cicle of the garment has no impact on sustenability]

**Question 3: The main categories of waste, according with the degree of weare criteria are:**

- [preconsumed textile waste]**
- [post - consumed textile waste]
- [post industrial textile waste]**
- [post consumer waste]**
- [washed garments]

**Question 4: The fabric strips from overlock machines are:**

- [waste from inspection operation]
- [textile materials used in the cutting room]





**[waste from the sewing room]**

[not waste materials]

**Question 5: Waste types according to the degree of soiling are:**

**[clean wastes]**

**[soiled wastes]**

[un-washed waste]

[chemical waste]

**Question 6: The pillars of sustainability in the clothing companies are:**

[social, climate, financial]

**[social, environmental, financial]**

[women rights, environmental, financial]

[social, environmental, design]

**Question 7: The EU strategy for transforming the textile industry into a sustainable industry recommends the following measures:**

**[Action to address the unintentional release of microplastics from textiles]**

[The research innovations and investments are not to be considered]

[reduce the wages for the people involved in clothing industry]

**Question 8: Match the terms with their definitions. (Answers: 1-B, 2-E, 3-C, 4-A, 5-D)**

- |                        |                                       |
|------------------------|---------------------------------------|
| 1. Old (used) clothes: | A. pollution                          |
| 2. Slow fashion:       | B. Recycle                            |
| 3. Fashion as service: | C. New business model                 |
| 4. Fast fashion:       | D. greatest impact on the environment |
| 5. Natural fibers:     | E. sustainability                     |

**Question 9: The amount of clothing bought per person in the EU**

[decreased in the last decade]

**[increased with 40%]**

[remains the same in the last decade]





**Question 10: Match the problems with their solutions.** (Answers: 1-B, 2-D, 3-A, 4-C)

- |                                   |   |
|-----------------------------------|---|
| 1. Recycled poliester:            | A. require less water, fertiliser and pesticides            |
| 2. Cotton environmental impact on | B. from plastic bottle                                      |
| 3. hemp, flax, linen              | C. deliver seamless whole garments                          |
| 4. modern knitting machines:      | D. large amounts of land, water, fertilisers and pesticides |

### **6.3. Skills assessment**

- 1) Propose a business model for a company related with the clothing field with the possibility of high level of sustainability. Describe the type of activity, identify the main ways of achieving sustainability goals.
- 2) Create a label for a garment that can enhance the product sustainability.

**Thank you!**  
**AR4RECLTHING Team**

