CLEANTEX

Clean and Innovative Textiles Strategy for Circular Economy

MODULE 1
Introduction to Circular Economy

Unit 1.3
Circular Economy in Textile Sector

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Unit 1.3 deals with:
definition and principles of Circular Economy;
the environmental, social and climate impacts of the current textile production;
Transition to from a fast to a circular fashion system and its application in textile supply chain with a particular focus on measures, challenges, barriers to be addressed.
At last initiatives and platforms towards Circular Economy in textile are presented.

Although there is not a clear origin of the circular economy, there is evidence that the first concepts related to this term arose in the 70s, although it was not until the 90s when it began to have greater repercussion. Even though there isn't a clear creator, there are several contributors to this "new" concept of economy, the main contributors are professor John Lyle, William McDonough, a chemist called Michael Braungart and the architect and economist Walter Stahel.

What does mean Circular Economy?
Circular Economy is a concept with many definitions: the most prominent and accepted was provided by The Ellen Mc Artur foundation, which reads:

"An industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models".
The collection of concepts composing the circular economy enables reducing the waste by incorporating reusing components of goods by design via closed loop and cascaded approaches, containing the dependence of the economy on material and energy inputs, increasing the resilience of the economic system, the preservation of the environment, supplying the growing demands of the ever more populated planet and increasing the operationability and cost -efficiency of production.

Since the Industrial Revolution in the 18th century, the "linear economy model" has been the most accepted version of economic model. During the era of industrialization stages, raw materials were abundantly available for cheap prices, and this model was the model of business due to the developing technologies. In fact, it manifested the growth of material production, employment, cities' development, living standard, profit, and also the demand for all goods.
By this economic model, the companies extract the raw material from the resources, convert them into products, and distributed them to the society. The customers of these products use them for a given time depending upon the product quality and type. Once the customer's need or the lifetime of the product ends, the product is disposed of as waste ultimately. The only possible way to discard the disposed wastes is through either landfill or incineration. In this model, the attempt of the product or waste to extract or to recover the useful raw material is merely absent.

Circular economy is an alternative model that assumes an endless flow of raw materials, product life-cycle extension and incorporates the principle "reduce, reuse, recycle" instead of the principle "take, make, dispose".

Reduce use less material, energy and produce less waste/pollution

Reuse: operation by which a product or component is used repeatedly and for long periods of time, for its original purpose, without being significantly modified, remade, or recycled. Products might need to be 'prepared for reuse', which often involves cleaning, repairs, or small modifications so that they can continue to be used throughout time and multiple users.

Recycling: the process of reducing a product back to its basic material level, reprocessing those materials, and using them in new products, components or materials.

According to the Ellen MacArthur Foundation there are three core principles associated with transition to a circular economy:

Reduce- Design out waste and pollution

A circular economy reveals and designs out the negative impacts of economic activity that cause damage to human health and natural systems. This includes the release of greenhouse gases and hazardous substances, the pollution of air, land, and water, as well as structural waste such as traffic congestion.

Preserve- Keep products and materials in use

A circular economy favours activities that preserve value in the form of energy, labour, and materials. This means designing for durability, reuse, remanufacturing, and recycling to keep products, components, and materials circulating in the economy. Circular systems make effective use of bio-based materials by encouraging many different uses for them as they cycle between the economy and natural systems.

Regenerate - Regenerate natural systems

A circular economy avoids the use of non-renewable resources and preserves or enhances renewable ones, for instance by returning valuable nutrients to the soil to support regeneration, or using renewable energy as opposed to relying on fossil fuels.

The visualisation of the circular economy as a “butterfly” was created by Ellen Mc Arthur Foundation: the right side illustrates the technical cycle and closing the loops of resources facilitated by circularity strategies such as reuse, refurbish and recycling; the left side of the diagram shows the biological cycle and the loops and cascades assuring the sustainable management of biological resources and creating renewable flows and stocks. The ultimate aim of this economic model is to minimize the extraction of raw materials and waste generation.

This linear system leaves economic opportunities untapped, puts pressure on resources, pollutes and degrades the natural environment and its ecosystems, and creates significant negative societal impacts at local, regional, and global scales.
The environmental impact of the production and consumption of textiles reflects the high complexity and linearity of their value chain. The range of impacts varies depending on the different textiles and fibres considered, as well as the environmental and socio-economic contexts underlying the production, distribution, use, and end-of-life phase. Amongst others, environmental impacts to which the textile sector is a major contributor include the depletion of material resources and water, land use, climate change and chemicals’ toxicity.

The textiles industry relies mostly on non-renewable resources – 98 million tonnes in total per year – including oil to produce synthetic fibres, fertilisers to grow cotton, and chemicals to produce, dye, and finish fibres. For example fossil fuel use in the production of synthetic fibres is a hotspot with regard to climate impact and non-renewable resource depletion. Actions to address these impacts include increasing the use of renewable and secondary materials in the production of synthetic fibres (while ensuring that renewable resources are sustainably sourced), and avoiding the resource loss at end-of-life (through increasing the lifespan of products and increased recovery at end-of-life).

Textile production requires an large amount of water, it's estimated that the global apparel industry consumes some 215 trillion litres of water per year.
Value chain stages that are significant consumers of water are raw material production, bleaching, dyeing and finishing in textile production, and use (laundering), while high water use in fibre production is due to the high levels of water required in growing cotton.
For example Levi Strauss found that more than 3,000 litres of water is used during the full production cycle of a single pair of jeans. Of that amount, 49 percent is used to grow cotton, and 45 percent by customers when they wash their jeans. The remaining 6 percent is used during the manufacturing process of the cloth.
Chemicals are used in virtually all textile production processes, from fabric preparation and bleaching to finishing. Although at the legislative and regulatory level the use of permitted chemicals is well controlled (e.g. REACH regulation in Europe), the pollution load of these chemicals is still a major problem, especially for water treatment. It is estimated that between 1.5 and 6.9 kg of chemicals are used in the production of 1 kg of garments meaning that the amount of chemicals used is greater than that of the textile product itself. Hence, the development of technologies to reduce chemical consumption, and generate as low a pollution load in effluents as possible, is critical.
Textiles are estimated to account for approximately 9% of annual microplastic losses to the oceans. These microfibres end up in the ocean and other bodies of water, where they potentially have an effect on aquatic life, birds and even humans (given their potential to be passed up the food chain).
The climate impact of the global apparel industry is substantial, with over 3.3 billion metric tons of greenhouse gases emitted across the value chain per year.
The wet processing stages of dyeing and finishing are especially energy intensive, as large volumes of water need to be heated. Greenhouse gases emissions during the use phase of textiles are also significant. Washing and drying clothing alone are estimated to account for 120 million tonnes of CO2 equivalent.
Land use is one of the main drivers of loss of biodiversity worldwide, responsible for nearly two thirds of the world's terrestrial surface having declined beyond a "safe" level in terms of biodiversity intactness within planetary boundaries. Land use associated with global apparel is strongly weighted towards the fibre production stage.

Today's textile system also has socio-economic impact:
Damage to human health: textile workers who come into direct contact with the chemicals bear the brunt of the toxicity and cancer risks, but chemicals discharged into rivers affect local communities and contaminate drinking water, while chemicals in textiles coming into contact with human skin can put the wearers at risk.
Social risks can be related to high cost and time pressures are often imposed on all parts of the supply chain which can lead to workers suffering poor working conditions with long hours and low pay. Unacceptable working conditions and some instances of modern slavery and child labour have made cotton cultivation and textile production the focus of NGO campaigns and significant media attention.

Next section is focused on the transition to from a fast to a circular fashion system.

What is Fast Fashion?
There is not an official definition of fast fashion, it can be described for example as the mass production of clothes that represent the latest trends at high speeds and low costs to maximise profits.
The definitions can vary, however they all have the same four base elements that underpin fast fashion, being cheap, quick, trendy and mass produced.
A transition to circular economy model is necessary to tackle the damage of the fast fashion industry. Organizations and clothing manufacturers are moving towards "circular fashion" practices.

Circular fashion, prioritizes source reduction, as well as adaptive reuse of clothing products. Instead of ending up in a landfill, circular fashion strategies involve repurposing and reusing clothing and fabric for other purposes.

A circular fashion industry is defined as a regenerative system in which garments are circulated for as long as their maximum value is retained, and then returned safely to the biosphere when they are no longer of use: the fashion products should be designed with the notion of resource efficiency, non-toxicity, biodegradability, and recyclability in mind. They should also be sourced and produced with priority given to recyclable sources and ethical practices.
The concept 'circular fashion' was first invented and used in 2014 by Dr. Anna Brismar, Head and Owner of the innovative consultancy Swedish firm Green Strategy and Felix Ockborn, Sustainability Manager of H&M. As defined by Dr. Brismar, the concept 'circular fashion' is based on the main principles of circular economy and sustainable development, and relates to the fashion industry in a wide sense, i.e. not only to fashion but also apparel, sportswear and outdoor wear, however, garments is one of the main focus area.
Green Strategy, has identified sixteen key principles to support and promote a more circular and sustainable fashion, apparel and textile industry:
The first 13 principles are defined from a producer's perspective, and the other three are relevant to the consumer's perspective.
Wide range of goals are identified to foster a transformation of the textile industry and the transition towards a circular textile economy. They can be summarized as:

Inputs for textiles are safe, recycled, or renewable:
The first objective refers to moving to material inputs, including fibers and chemicals used in textiles production, that are (1) safe for both workers and consumers, and (2) either renewable (such as cotton or wood-based fiber sourced using sustainable agricultural practices) or recycled (either synthetic or natural fibers), or both (such as recycled plant-based fibers). The first element, safety, involves ensuring substances used in production don't pose health concerns for workers, and products don't pose the threat of releasing hazardous substances or microfibers throughout use. The second component sets out to reduce and eventually eliminate the use of virgin non-renewable resources.

Textiles are kept in use for longer:
The second objective concerns the degree to which textile products, in particular clothing, are utilized and involves both production and consumption
Underutilization can occur in a few different stages, for example, when items remain unsold in warehouses or stores, left unused in wardrobes, or are discarded by consumers while still in good condition. It means that:
1) all products that are made are used, and excess stock is minimized and never destroyed;
2) all products are used repeatedly and for long periods of time, instead of being left unused or thrown away prematurely.

Textiles are recyclable and recycled at end-of-use:
When textiles cannot be used or reused any longer, they should be collected and recycled. Mechanical recycling is currently the most common way of recycling textiles, where fabrics are deconstructed into fibers that can be used to make new yarn. Chemical recycling of textiles, though still under development, uses chemical processes to dissolve synthetic or natural fibers so they can be used as new feedstock. Increasing recycling rates will require change throughout the value chain: textiles must be designed to be easy to disassemble and recyclable in an economic way, consumers must dispose of them properly, and collection/sorting systems must effectively separate different textile waste streams to avoid cross contamination in recycling and increase upcycling (a process where waste or useless products are converted into new materials or products of equal or better quality or a higher environmental value).

For the design to be considered circular the product must be:

Designed so that its components can be separated to facilitate their disassembly or repair and to facilitate the action of reassembling, reusing and eventually recycling the material at the end of its useful life.
Designed with quality materials and with a timeless style to maximize its durability, longevity and attractiveness for many users (depending on whether during its useful life it goes from one user to another, and to new users).
Designed on demand, custom-made, to be created in a more efficient way for its specific user in terms of fabric, material, style and fit, thus increasing its perceived value and likely useful life.

For the manufacturing process to be considered circular, the product must be:

Produced with non-toxic, high quality and preferably biodegradable materials, so that their components can be safely biodegraded and composted at the end of use; or produced with non-toxic synthetic materials that can be effectively recycled, such as recyclable polyester.
Produced in such a way that all waste generation is minimized during the manufacturing process in the textile factory and all left over material in the cutting, tailoring, dyeing and finishing processes can be recovered and reused as raw material for other processes and other articles, thus minimizing the extraction and use of new virgin raw material.
Produced, transported and marketed using renewable energy such as wind or solar whenever possible and using water and other resources efficiently and safely during production and distribution;

Taking into account the extension, durability and end of life of the product:

It can be used by multiple users throughout its useful life through exchange, loan, rental, redesign or second-hand services, thus extending its useful life;
It can be recovered and recycled safely and effectively, so its components are used as raw material for the manufacture of new products or are biodegraded and converted into biological nutrients for microorganisms in the soil.

Circular economy in textile industry is beneficial to business and economy, citizens and society and regenerates the environment.
The most environmental benefits can include:
Lower GHG emission: for example using low-carbon materials and production processes (including renewable energy and energy-efficiency measures) would further reduce the GHG emissions of a new system.
Reduced consumption of virgin, non renewable materials and of energy: it can be obtained by high rates of clothing utilisation, improved recycling, and reduced waste in production
No leakage of hazardous substances into the environment: substances of concern would be phased out, reducing the negative impacts of polluted wastewater and soil, and the accumulation of hazardous substances in the environment.

Benefits for citizens and society
Positive health impact: safe and healthy material inputs into textiles production would not leave workers exposed to substances hazardous to their health, and would reduce health risks for everyone wearing clothes.
A circular economy for textiles will have a complex effect on decent work, shifting employment from farming and manufacturing to later stages of the value chain such as repair, resale, sorting and recycling. It provides the potential for higher quality jobs, especially for informal workers, improving working conditions and safety, as well as wages and social security.
At the same time a close cycle of production and consumption favour the increase in productivity.

The vision of a new textiles economy – creating clothing that by design circulates in a system that maintains its value – is a powerful spur for new ideas that would redirect the focus of innovators. These innovations would help the textiles system to become more circular, by developing new and improved materials, processes, and services.

Despite significant opportunities, barriers that impede the advancement of circular economy in textile can be faced, they are classified as:
Technological: chemicals additives can compromise the quality and safety of recycled output, fiber blends are challenging to recycle;
Market/economic: due to globalization and many partners in the fashion industry, it is more difficult to create a completely circular/sustainable chain.
Much of the fashion industry has not yet realized that everything starts with product designs that are less harmful to the environment, and there is a lack of conscientious fashion design professionals.
Cultural: sustainability is not consumers' most important purchasing decision driver.
Institutional/ Regulatory: lack of support from governments to create openness, guide efforts, and reduce costs, to implement more ecological solutions.

Last section is dedicated to initiatives and platforms towards Circular Economy in textile:
PACE is a public-private collaboration platform for global leaders and their organizations to accelerate the transition to a circular economy at a scale that can improve human and environmental well-being for current and future generations.
Ellen MacArthur Foundation, an international charity, committed to the creation of a circular economy that tackles some of the biggest challenges of our time, such as climate change and biodiversity loss.
In May 2017 it launched Make Fashion Circular, an initiative that brings together leaders from across the fashion industry to work with cities, philanthropists, NGOs, and innovators. The aim is to lead international efforts to stop waste and pollution in fashion by creating a circular economy for the industry, where products (apparel, footwear and accessories) are used more, are made to be made again and are made from safe and recycled or renewable inputs.
Several platforms address sustainability in textile production, they include:
Alliance for sustainable action, European Clothing Action Plan (ECAP) and Global fashion Agenda:
the first is an initiative of United Nations agencies and allied organizations that works to support coordination between UN bodies working in fashion and promoting projects and policies that ensure that the fashion value chain contributes to the achievement of the Sustainable Development Goals' targets, ECAP aimed to embed a circular economy approach across Europe for the clothing sector.
This LIFE funded project explored production, design, public procurement, sustainable consumption, collection, recycling and reprocessing as a means of waste minimisation and effective waste recovery.
At last Global fashion Agenda is a leading global forum on fashion sustainability founded in 2016 and anchored around Copenhagen Fashion Summit, the world's leading event on sustainability in fashion for industry decision-makers. Global Fashion Agenda advances a year-round mission to mobilise the international fashion industry and community to transform the way we produce and consume fashion.

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