

**Integration from a linear to a  
circular supply chain:  
Investigating circular  
practices in the Greek  
fashion industry**



**Hellenic Open University**

Author: Xanthippi Karathanou  
Supervising Tutor: Geranios Michail

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## **Abstract**

Fashion industry is considered to be one of the most wasteful consumer industries globally and this fact can be tacked back to fast fashion's significant development the past decades. According to European commission data published on August 2021 (Kohler, Watson, Trzepacz, Ran, & Danneck, 2021), an average European citizen buys 60% more items of clothing every year and keeps them about half of the time compared to 15 years ago. This proves that clothing tends to become from a durable good to a frequent purchase. Although, currently only 1 percent of second-hand textiles are recycled into new clothes, the circular trend is expected to have great impact by receiving the support of more and more companies willing to adopt green practices and integrate from a linear to a circular supply chain. Meanwhile, the European Union adopted on March 2020 the new "Circular Economy Action Plan" as a result of the European Union's "Green deal" and it's expected to expand year by year and apply obligatory recycling and circularity practices for all mainstream fashion companies. Fiber to fiber recycling where textile waste is processed and turned into new fibers ready to be reused, is an innovative practice that embrace circularity in Fashion industry. Technologies like mechanical recycling for some of the main used materials are already established while other technologies like chemical recycling is under development, promising great impact on the textile recycling. By focusing on the Greek fashion industry, the research was conducted in order to find out the way in which companies manage the three stages of take – make – waste of their supply chains and whether sustainable or circular practices have been already adopted or there is the willingness and the interest from the companies to insert them. The gap between actions already implemented by Greek industries and the principles of circularity will be explored. Through the results of a questionnaire and interviews with 9 Greek industries, the research will analyze circular strategies – of micro and small sized brands – across the stages of their supply chains and the inhibiting factors of the integration from a linear to a circular supply chain. Conclusions and recommendations for further studies are proposed in the end of the current thesis.

## Introduction

The last decade, Circular Economy has been a main subject of discussion and researches for industries, governments and the academic field that are trying to invest and conclude on how to make industries – including fashion industries - more sustainable. Fashion industry -along with food and construction industries- has a high position in the list of waste released by industries while serving customer needs by adjusting to different trends. Following up the high couture standards, all the companies around the world are struggling to offer clothes in different sizes, qualities, colors and quantities according to each time period. As the production of clothes has increased, the number of times an item of clothing is worn has dramatically decreased (Agency E. E., 2014). According to European commission data published on August 2021, an average European citizen buys 60% more items of clothing every year and keeps them about half of the time compared to 15 years ago. These data are re-confirmed from US Environmental protection Agency and the data that were published in 2018 (Agency U. E., 2018) and prove that year by year – even the recycling processes seem to be increased, there is such a huge increase reading the generation of textile waste – in USA - that amount of tons that end up in landfill is also significantly increased. Data also presented in below table with amounts mentioned to be referred in thousand tons.

Management Pathway	1960	1970	1980	1990	2000	2005	2020	2015	2016	2017
Generation	1,760	2,040	2,530	5,810	9,480	11,510	13,220	16,060	16,880	16,890
Recycled	50	60	160	660	1,320	1,830	2,050	2,460	2,510	2,570
Composed	-	-	-	-	-	-	-	-	-	-
Combustion with Energy Recovery	-	10	50	880	1,880	2,110	2,270	3,060	3,240	3,170
Landfilled	1,710	1,970	2,320	4,270	6,280	7,570	8,900	10,540	11,130	11,150

*Table 1 Data for Management of textile in US for time period 1960 – 2017, amounts in thousands of tons (Source : US Environmental Protection Agency , 2018 ).*

Same data also appeared in the below diagram:

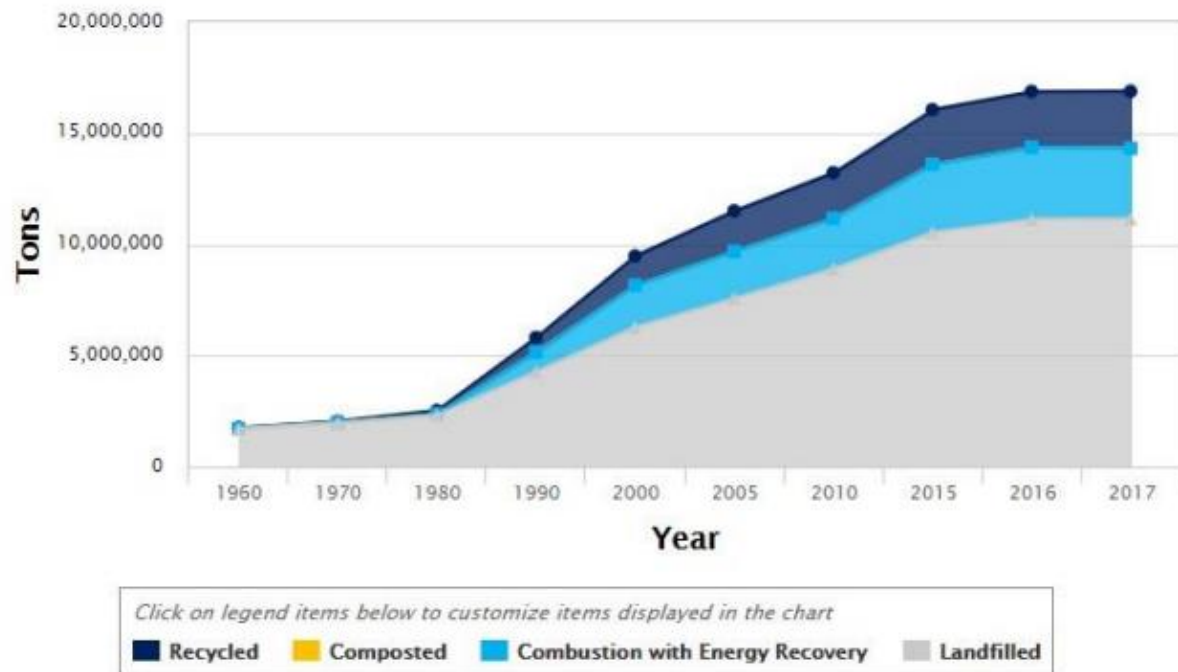


Figure 1 Textile waste for period 1960 – 2017 ( Source : US Environmental Protection Agency , 2018 ).

Every year millions of tons of clothes for kids, women or men are produced, worn and then thrown away. The environmental impact of textile industry – that mainly includes clothes and shoes – is significant according to what proves the Commission’s Joint Research Centre at a report published on 2021 (Triollet, 2021) that reveals that “4 – 6 % of the European Union overall footprint in the environment can be traced back to textiles”. According to data from Recycom (Recycom, n.d.) – a global recycling organization – more than ten million of tons - both America and Europe – is thrown in rubbish dump every year. This is where the 85 % of global textile production ends up . More than 98 million of tons of non-renewable energy resources – gas oil included – are consumed in order to cover fashion industry’s needs. According to calculations this number will reach the amount of 300 million of tons within 2030, while each year almost 93 billion cubic meters of water are used for textile production. But this is not how it should be as we need a fashion industry that is beautiful inside out. As the Ellen MacArthur Foundation reveals, “every second the equivalent of a rubbish truck load of clothes is burnt or buried in landfill”. This fact proves that unfortunately, fashion industry is one of the major contributors of many of the environmental issues we are dealing with and mainly one of the biggest contributors of plastic microfibers entering our oceans.

From the above, arises the need or redesign the fashion industry and the way the clothes are made and used. To achieve this, it is mandatory that the manufacturers should open up their mentality and work hard on the integration of their supply chain from a linear to a circular one. For sure, government should support such decisions by offering first of all education of how this change will be achieved, economic support to cover any additional cost (for instance hiring a person to redesign supply chain) and of course by rewarding such initiatives. Hopefully there is some progress in regards of this as we recently see Sustainable fashion awards organized in Milan by

Camera Nazionale della moda Italiana (CNMI) which is a key fashion organization around the world and highlights how fashion should be redefined through circular design. The Awards recognize the firms that set ambitious targets and walk beyond changes that have a positive impact with a strong focus on sustainable and circular innovation. By highlighting the winners that are redefining the future of global fashion, the hope that more companies will rethink and be encouraged that they can also can design for a regenerative, circular economy. Customers willingness and support plays a key role as well. They should revert in buying this kind of products in order to achieve better environmental impact of what they wear. They should not only follow the trends but be informed about the history and process of their production. They should refuse fast industries no matter the price or the attractiveness of the clothes.



*Picture 1 Clothes ending up in landfill (Source : Antonio Cossio/ Picture alliance via Getty Images )*

## **Literature Overview**

### **1.1 Sustainability**

The highly increased demand for various products in the latter half of the 20<sup>th</sup> century and the fast rhythm of their consumption has increased lately the pressure on the supply chains. This demand that led most of the organizations to risky, but at the same time, profitable terms of production, had also a negative impact on both the environment and the society. Increased rates of pollution, gas emission, waste and environmental disasters during the past decades, reveal the urgent need of businesses to work on a sustainable production and also consumption issues within the context of a sustainable supply chain management. Industrial accidents, such the largest oil spill from oil tanker in France dated on 1978, the chemical plant accident named as Bhopal Gas Tragedy in India , the Chernobyl nuclear disaster in Ukraine on 1986 and many more that followed forces the stakeholders, the governments , the manufacturers and the customers as well to reconsider current

economic business models, the way they work and to embrace implications of practices in regards to society and environment.

The Brundtland Report published in 1987 by the world commission on Environment and development – WCED (Dehghanian & Mansour, 2009), defines how the sustainable development will be achieved. Sustainability, from economics standpoint, is defined as *“the specification of a set of actions to be taken by present people that will not diminish the prospects of future people to enjoy levels of consumption, wealth, utility of welfare comparable to those enjoyed by present people... Economic models of sustainability seek axiomatic guidance for the selection of rules regarding natural resource use”* (Bromley, 2008). Since then, researches, studies and publishes regarding sustainable management of supply chain have been increased emphasizing on the three pillars of sustainable development: Social, Economic and environmental studies: The Triple Bottom Line (TBL) (Joyce & Paquin, 2016). This specific field has attracted many researchers and practitioners to study different aspects such as introduction of advanced technologies, use of natural resources for economic development and other related factors. In addition, the past 25 years, in developed countries, society has been involved and implemented laws and regulations in order to overview the processes and protect the environment and the society. This is the reason why many companies choose to outsource the polluting segments to other underdeveloped countries where such laws do not apply or are not properly implemented. It has been noticed that Emerging nations tend to compromise their social and environmental standards in order to assure economic growth (Meyer, 2004). Another issue that arises in regards to the green supply chain management according to Dehghanian and Mansour, (2009) is that is mostly focused on environmental and economic aspects and fails to arise social concerns which is also one of the main objectives.

Hopefully most of the big global companies – among all sector industries- have rapidly integrated the perspective of sustainability into their supply chains taking into consideration all the steps required. Taking into account economic, environmental and social considerations, businesses' systems and procedures have been re-designed to efficiently and effectively manage materials, information and all flows regarding procurement, production and distribution of products so they meet customers and shareholder's needs, increase their profitability and competitiveness.

We end up that the importance of a sustainable supply chain means much more than going green. The three elements of sustainability include the social responsibility, environmental responsibility and the financial responsibility as well. The social responsibility concerns all the expectations/requests that a society has for a business. This involves the moral, ethical and philanthropic actions, reaction and support from businesses for current phenomenon and ongoing events. Social responsibility is also related with the behavior that all involved parties are receiving by the company. It means that every person in a sustainable supply chain – no matter his position– employees, suppliers, shareholders etc are treated fairly, are getting paid according to the job they offer and their human rights are respected (labor laws, working hours, insurances etc).

The second element, is the most well known and the one where most of the companies focuses on as it is the most visible from the end customers – and may add the higher value in the end product/service. Environmental responsibility is equal to protecting the environment from a potential harm



and any disaster caused by businesses' operations, suppliers and partners. It's important for any business to understand the impacts of its processes on the environment and the consequences running out from daily operations. These could vary from company to company depending on the size, type of product or service delivered and other parameters. Once the business figures out the above mentioned, it's needed an action plan in order to reduce the environmental impact by focusing on the weakest points. Each company needs to comply to relevant obligations and laws as they have been issued.

The third and last element of a sustainable supply chain is the financial responsibility. Each firm should manage its financial needs by covering financial needs of all parties involved internally and externally— from Shareholders, employees and customers to business partners, banks and institutions. Compliance with financial laws and regulation is essential.

Sustainability strategy involves reviewing the entire manufacturing process. This includes that sustainability practices should be respected by all suppliers providing raw materials, by processes of assembly, manufacture the products in the plant, deliver them to the end customer, disposal and recycling of waste. A supply chain that follows sustainable standards, increases partnership opportunities as environmental and social responsibility is a focal point on today's industry. Customers are becoming more aware about this model, day by day, and look for products and companies that not only offer a product or service that can afford but a product that respect the above-mentioned standards as well. It seems that sustainability is not just a trend for end users but increased awareness regarding threats and opportunities for society and environment as well as the worry of covering next generation's needs. This fact, of course, affects shareholders investments as they prefer to support this kind of firms. Adopting sustainable practices in every aspect of the business, improves the reputation, a fact that is surely correlated with profitability. So, a sustainable supply chain also improves productivity while saving money at the same time. Several businesses have proved that using sustainable resources and techniques, efficiency of the use of buildings and machines is increased and that leads to a significant cost saving. Many global leading brands are considered as bright examples that need to be followed as they have managed to change the way they manufacture their products in order to improve results for environment and society, to reduce the labor cost and the material use. As a result, they managed to have a great increase in margins. As such, we now see that 62% of executives and managers consider sustainability in supply chain necessary for a supply chain in order to be competitive while another 22% think that it will be important in the near future (Henrich, Li, & Mazuera, 2022).

Any change regarding a company's supply chain should be considered in depth, before its implementation. It seems that the integration into a sustainable supply chain is a necessary decision that each firm needs to take as it is connected with significant positive results that the company can take advantage of. In order to start the implementation process, it's important for the company to identify the sustainable goals and objective. Having a clear vision is always the first step before planning how to achieve it. Analyzing the entire supply chain by breaking it down into its elements and identify which of them should be adjusted, improved or totally changed, is a vital process. At this point, we should highlight that some of the elements are easy to be identified -as some of them can always be improved, for instance haulage emissions - while some other elements need more

attention and investigation. As the manufacturing process starts with the input of raw materials, checking the quality and the resource of them is an important process that needs to be followed. It's vital to create sustainability policy for the suppliers where waste disposal, energy use, transportation and detailed manufactured procedures should be clarified. Once this policy is settled, the company needs to stick on it so they assure that all raw materials are suitable to be used for production. Providing recognitions and awards or sharing the costs of sustainability improvements are ideas that embrace suppliers to follow the sustainable way of providing the raw materials. In additions, suppliers that have achieved ISO 14001 or have any other certification regarding following strict environmental standards throughout all their operations are more reliable in terms of the green practices that follow – as they have been certified by a third specified body- and companies can be sure that they can incorporate their operations into the firm's sustainable supply chain. Reducing the fuel consumption is also an important fact. This includes much more than just encouraging drivers to avoid idling the engines. Once this is achieved, it can make a huge difference to both emissions and costs. Investing in another way of transport – for example investing in air transports instead of trucks, might involve an extra cost but improves time and environmental consequences.

In regards to transportation, companies should eliminate extra- useless – miles. Even after reducing the gas emission there is still the issue of the return journey. This means that after delivering a quantity of a material the truck should return empty to the pick-up place in order to load the next cargo. But when they are driving back to the starting point, they are burning fuel, creating carbon emissions and also reserving a truck available by moving it to another place without transferring any quantity. This rises up the need of a better organization of operational logistics by using groupage and any other option suitable – according to the material and each company's needs. Logistics department, in order to simultaneously decrease cost, increase transit time for orders and improve the sustainability of the supply chain should look into ways that will make this return journey more efficient. There might be materials that should be sent back to the starting point. In this way, the return journey is no longer – extra lost miles but an efficient journey that also delivers more return of the investment of fuel and time.

Companies should also try to insert sustainability in the process of packaging of the products. Reducing single use packaging such as carrier bags, especially when it's plastic, it's a great opportunity for increasing sustainability in the supply chain. Thinking of alternative ways more environmentally friendly like paper or for options like packages that can be reused is a basic step of reducing impacts to the environment, increase customer's satisfaction and the margins as well. Organizations should also concentrate on cutting the waste and encourage recycle and reuse. Waste management is maybe the most important “chapter” in creating a sustainable supply chain. And this is significantly correlated with the circular supply chain that will be examined below.

## **1.2 Integration from a Linear to a circular supply chain**

The fashion industry mainly follows the linear model developed under three principles / stages, those of take (buying the raw materials), make (processing and production of new materials) and waste (the wearing and subsequent disposal of garments) (Macarthur, 2017). All entities have realized the emergency of considering their role in preserving natural resources, despite their

profitability and efficiency. The ecological economic theory that emphasizes on the impacts of the human activities on the environment (Harte, 1995), has been well communicated to everyone and awareness has been increased. While the concept of sustainability creates a balance in the biosphere between society and the environment (Seuring & Muller, 2008), the business management has been significantly influenced by this idea during the past years. In order to achieve sustainable development, most of the firms pay attention on the way that they already handle their supply chain. This holistic overview of all the supply chain processes during the production of a good has been analyzed lately in many supply chains theories that indicate this as fundamental step for establishing sustainable economic and production systems (Walton, 1998) (Muller & Seuring, 2008) (Sarkis, Zhu, & Kee- hung, 2011). The concepts of a green supply chain management have been developed in parallel to circular economy. They seek the integration of an environmental- friendly function by minimizing material flow, reducing negative consequences of all production processes or by using the material over and over again.

Transitioning to a circular economy is considered the most promising way to both economic and environmental sustainability. However, except of the challenges and potential benefits, companies also take into consideration threats that prevent the redesign of the existing linear supply chain into a circular supply chain (CSCs). For supply chain entities, the question is not why should the supply chain entity implement sustainable, re-used cycles in the supply chain, but how quickly and efficient can these cycles be implemented- the focus should be on the improvements (economical/social/environmental side, customer/shareholder wise) that the organization could take advantage of after this implementation. Many recent studies re confirm the fact that modern supply chains must evolve into a circular supply network, not a straightforward line-like network. Starting with suppliers, the linear supply chain flows to manufacturers, to distributors, and to consumers. Alternatively, the circular supply chain has many links between each of these parties. As a result, the level of relationships complexity is higher and affect the manager's final decision. Although previous studies have argued for the need to combine circular economy and supply chain management (DeAngelis, 2018) (Sauve, Bernard, & Sloan, 2016) the circular supply chain remains an underexplored area of research (Geissdoerfer & et all, 2018). Today the global economy is only 9% circular. (Circularity Gap report, 2021).

### **1.3 Sustainable waste management**

In the context of a sustainable development, waste management is an important action that supports the environmental protection. Organizations and municipalities develop intensive activities in this direction. Even if, in the beginning, they were emphasizing on selective waste collection (Brunner & Rechberger, 2015), currently there is a more intense concern and focus for waste management and recycling. Sustainable waste management involves the transition from the traditional make – use dispose model to a more circular economy. According to this circular economy, waste returns into production cycle in many different ways. It could return as a new raw material, as energy or even as a new product. This concept offers plenty of benefits to businesses that have the opportunity to decrease disposal costs and quantity of material purchased by re-using products that come from their own stream. In addition, sustainable waste management reduces the greenhouse

gas emissions that is equal to the reduction of carbon tax paid, and subsequently reduce the variable cost of a company. Furthermore, embraces and promotes energy efficiency and even preserves the natural resources as it offers the opportunity to the manufacturer to use the waste products in their production chain. In order to integrate to a sustainable waste management system, detailed planning and thought are required in order to chose and insert the appropriate methodology before a company brings waste info manufacturing cycle.

For the most of the companies and for society as well, the most common action in order to support a sustainable waste management is recycling the waste. According to the 5 R's model that has been developed (Shelby, 2020), there are four actions that need to be taken before we reach at the final step of recycling.



*Picture 2 The 5 R's (Source : Shelby Bell, 2021, The 5 R's : Refuse ,reduce ,reuse, repurpose , recycle )*

This methodology can lead to a significant waste reduction and proposes that the company before disposing waste should walk into the following steps: Refuse, Reduce, Reuse, Repurpose and then recycle. We should highlight that the step of recycling should be treated as the last resort after trying the rest of actions according to the hierarchy mentioned above.

The first step of refusing waste is related to the procurement team that should refuse to invest and purchase wasteful and non-recyclable products. As also mentioned on the senction.1, inputs and raw materials is the first part of each supply chain and it's important to invest on this stage in order to save money and time from the rest of the procedures that follow. Extra packaging that could be avoided, should be refused same as materials that are not recyclable or containers that are not reusable or returnable. Taking smarter decisions regarding purchases, settling a common sustainable line with suppliers and setting standards accordingly, will make the process of refusing waste much easier.

Reducing is also a key word for this process. Any extra material that is not essential or it's possible to be replaced by another more environmentally friendly material should be deducted. Using the minimum amount required means avoiding unnecessary waste. At this stage, firms should also take into consideration forecasting in order to avoid having an excessive production than the market's demand. Manufacturing products that will not be sold is an extra waste, cost, time and space for the warehouse and the company.

Then we move to the third stage of reusing. There is an ongoing, huge effort to eliminate this “throw-away” culture where consumers are using disposable products once and then they throw them away. Especially due to the plastic crisis that has become one of the greatest environmental challenges, companies should embrace within the company’s working environment as to the customers as well the mentality of reusing and replacing all the single use products with compostable or reusable alternatives. Marketing has a key role on this as it’s possible to present and give a second life to the products or focus on convincing the customers to reuse a product that they already have in order to cover a need instead of creating new – and most of the times fake-needs of buying new products that will be used once. The impact that sustainability actions adopted by organizations marketing department and the impact of consumers’ increasing appreciation for environmentally friendly products have been studied in marketing literature (Straughan & Roberts, 1999) (Sen & Bhattacharya, 2018).

The last stage before recycling is repurpose. For any item that is not possible to follow any of the actions mentioned above, companies should try to find another use than the obvious one. Placing a new idea by proposing a creative alternative is the last step of waste management before we pass to the last step. Once a company has gone through all the above steps, recycling is the most environmentally friendly waste disposal. Establishing an effective recycling program could assist the company to benefit all the advantages of a successful waste management. In order for recycling to have a positive impact on the supply chain, company should correctly work on this process. Education, regarding different materials and whether they can be recycled or not, is really important. Organizations, except recurring to internal actions, could take the lead and promote recycling to the end customers as well so they offer an advantage to the society as well. It’s important to mention that it’s vital for each company to assign a person in charge for all this process so he can track , detect potential challenges, improve weak points and assure that all possible actions have been checked before waste disposal.

#### **1.4 Circularity in fashion industry**

Circular economy is developed under three principles regarding design and production . First, is the waste perception/ management and how it should be eliminated, the second one is related with the fact that materials and products should be in use – produce them in a way that they can be used more than once, and the last one concerns the regeneration of natural systems. Materials flow’s in circular economy can be split in two cycles.

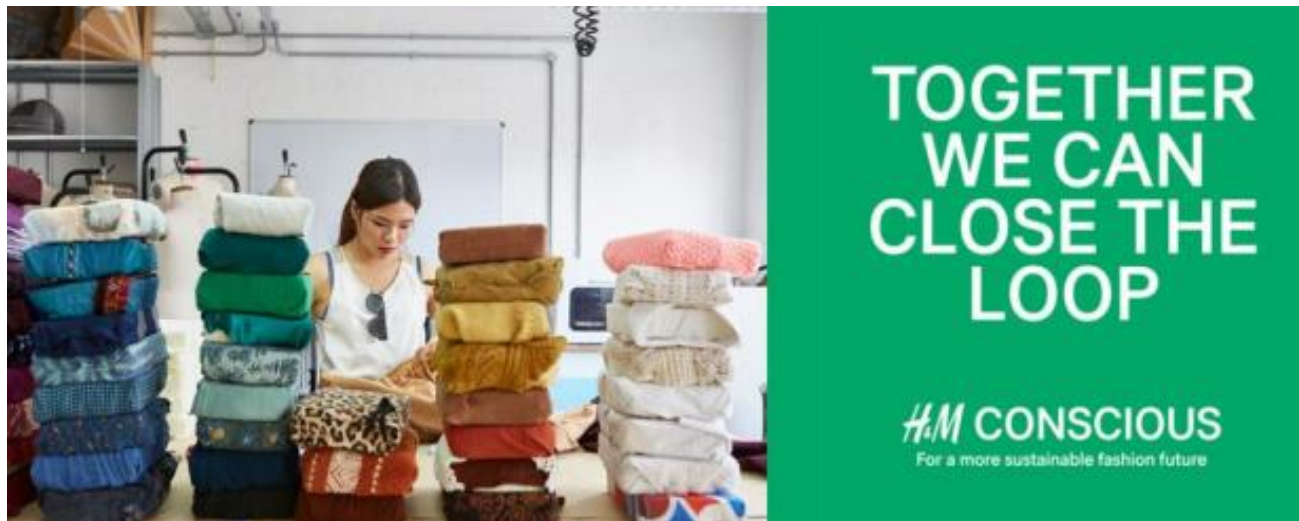
The first one is the technical cycle and the second one the biological cycle. For fashion, all materials – including the biological inputs for instance cotton - should first pass through the first loop. This means that it is necessary for products to be moved through the technical cycle that includes reusing, repairing, remaking and recycling, according to the 5 R’s theory that was analyzed in paragraph 1.3, regarding the sustainable waste management. This aims to the maintenance of their value at the highest lever during all the times. Afterwards, materials could enter the biological cycle in order to digest and compost, so they generate additional value. Circularity for fashion creates the same – or better sometimes – quality products for customers, contributes to a resilient fashion industry and protects the environment. The new trend should be

the design of products that are used more, are made to be made again and for sure made from safe and recycled or renewable inputs.

In order to analyze more these three principles, we start from the fact that products designed under the scope of circularity are used more. Textile reuse refers to various means by extending the practical service of life of textile products by transferring them to new owners with or without any prior modification (for instance, mending). Business models that manage to keep products at their highest value, without the need of using again raw materials but focusing on not relating the economic development from the resource consumption instead, is the norm across the industry. This is what Durability assumes. It defines the ability of a product to continue being functional after several uses. It can be separated into two main categories: The physical and the emotional durability. As it is obvious, physical durability concerns products that are made by materials and through production processes that can resist to damage, wear or use during time. The category of emotional durability is related with the ability of product to be attractive and desirable for a user, more than one time. Designers should provide products that the customer will consider to use for several times. Marketing can also provide support at this stage. A bright example where this business model is found is the rental of cars or properties. According to this model, a firm is managing to reduce the costs – as there is a decoupling from resources- while the price remains on high levels. Furthermore, while the products are designed and manufactured in order to last, the company “educates” the end customers by providing them the tools and knowledge so they would be able to maintain the product in a good condition in order to reuse it. As per definition provided by “Framework for Implementing the principles of a circular economy in organizations – Guide, BS 8001: 2017” reuse is defined as “... *the operation by which a product or a 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, repair, or small modifications so that they continue to be used throughout time and multiple users*”. It is worthy to mention the value of repairing products as well. Clothes is a good that can be easily repaired most of the times with a low cost or even by the end customer himself. Repairing is a key strategy that allows products to be used again. The companies could invest – and actually some of them are already doing it - on receiving faulty or broken products, repairing them and reusing them or reusing only the non-damaged components of them, so they decrease the production cost and eliminate purchases of raw materials. Another important aspect of designing products that will be used more than once is that all products manufactured will be used. As also mentioned in paragraph 2.4 regarding the sustainable waste management, the inventory should be minimized as much as needed according to the forecast and the demand so we never dispose or destroy it. Technology is always a big asset in each innovating process, so a proposal of virtual or digital collections that will help the production decrease could assist a lot. Decreased production may be considered as a disadvantage or a proof of an unsuccessful business. However, taking into consideration the costs that are decreasing the same time – of course when demand, prices and the rest of the factors remain the same- it can be a great advantage that the company could exploit in order to increase efficiency.

The second principle is making products that can be made again. From existing data, (World Survey on Textiles and Nonwovens, 2015), it comes up that about seventy percent of textiles

produced are derived from petrochemicals giving rise to carbon dioxide emissions, while the rest thirty per cent are dominated by natural fibers such as cotton and wool. Making products that could be used again involves the fact that each good and its components should be produced by taking into consideration the ability of being disassembled so that it can be reused, remade, recycled and after reaching the maximum number of uses to be safely composted. Composting is a natural process “that involves the biological degradation of organic wastes under aerobic conditions” (Pandey & Larroche, 2018). This process leaves no visible residues while reduces the waste volumes by producing an important end product for agriculture. Before a company considers composting, it’s necessary to run through all the prior steps of reusing, repairing, remaking and recycling. Products designed by compostable materials offer the opportunity to the companies – after completing all the above stages- when their use is no longer possible, to be returned back to the biosphere without leaving any contaminants. One of the biggest advantages of composting is that it can take place not only in an industrial environment, as no special facility is needed, the process can be even completed in house from end users. Of course, related proof and certificates that components or the whole product is compostable should be checked before the company assures that all requirements are met and the return in the biosphere is safe. Another concept that is wrongly consider a synonym to composting is “Biodegradable”. This should not be confused with Compostable as bridgeable products might refer to any material – even plastic- that could leave toxic residues behind while compostable products are made by organic materials and could only leave beneficial residual for gardening. It was also mentioned above that we need products designed with the ability of disassemble. This is a design principle that “*enables the products to be taken apart in such a way that allows materials and components to be reused, remade or recycled*” (ISO 14021:2016(en) , 2016). Waste to energy, landfill or burning waste of course can not be part of a circular supply chain. When it comes to the packing, companies need to assure that extra and not necessary materials- components are eliminated while the one used should be reusable, recyclable or compostable. Especially plastic parts should be replaced by more eco-friendly options as analyzed in point 2.4. This model should be issued in practice and not only in a theoretical framework. This means that process should be followed up and cross check that products are collected and sorted so they will be reused, remade or recycled. From its side , the business needs to contribute and support the infrastructure according with their output – product they send to the market and secure that the company itself is well educated and ready to handle the products that will be collected in order to reuse, remake or recycle them . At the same time, the government in order to support such actions, can provide public collection infrastructures and facilitate creation of self-sustaining funding mechanisms. In order for the customers to participate in this procedure, efficient information sharing is needed. In addition, any motivation that would encourage them to be active and assist on the improvement of circular fashion is considered as an asset. A great example to follow is H&M that on 2017 in collaboration with the swiss Organization or recycling initiatives named I:CO run the project “Bring it” at shops all over Europe . For each quantity of clothes that was returned and recycled by the end customer in ”special bins“ placed in each store they were getting a discount voucher for future purchases. (H&M Group, 2017)



Picture 3 Promotion of circularity in Fashion (Source H&M Group Website, 2020)

Recycle, as a process, tends to have a lower value compared with the option of reuse and remaking as labor, energy and costs for the whole procedure arises. As mentioned above, recycling should be a process in action and when products are designed to be recyclable this fact should be proven. The idea it would be a recycling procedure within the industry in order to switch one design for recyclability, innovation regarding the material used and estimation of the demand for recycled inputs. According to reference (Chae & Hinestroza, 2020), in order to build a new practice, lifestyle and ecology under the upcoming circular economy transition, implementation of concepts such as materials circularity and clothing utility are needed. In a circular model, materials are circulated in their highest value and this principle is normal to also affect recycling. There is a preferable technique in order to recycle each product and circularity is in favor of techniques that retain most of the value. On textile recycling, practices could vary according to the way the material is gathered. It could be sorted by color – especially when its fiber recycling – where afterwards material is shredded and processed again back into fibers. This process is named as “Mechanical fiber recycling”. Another kind of textile recycling is polymer recycling. By following this process fibers are getting back to polymer lever. Even the technical structure of the material remains the same without any significant change, this procedure aims to destroy the fibers either by melting and extruding textiles by using “mechanical polymer recycling” or by extracting the polymer with a solvent by using the “chemical polymer recycling”. Furthermore, in order to break polymers down into individual monomers or into any other constituent material that could be used as a raw material for the production of new virgin quality polymers, chemical monomer recycling is followed. All these recycling techniques are useful in order to reach the stage of remaking. Recycling processes for the main textiles are also presented on the below table according to data received from “Ecodesign report” based on reference (Rengel, 2017) .

Material	Mechanical Recycling	Chemical Recycling
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<b>Polyester</b>	Sorting by type and color / washing and chopping / extrusion into yarn	Depolymerisation and extrusion into chips
<b>Nylon / Polyamides</b>	Cleaning and palletisation	Depolymerisation to make new yarn
<b>Cotton</b>	Sorting by color / Shredding and spinning	Under development
<b>Wool</b>	Sorting by color / Pulling the garment back into a fibrous state	Not applicable
<b>Polycotton</b>	Small – scale processes for producing insulation materials	Still in pilot phase, requires first separation into cotton and polyester

*Table 2 Recycling process for main textiles (Source Ecodesign report, Rengel , 2017).*

Unfortunately, due to lack of technology and expertise, textile recycling capacity is not fully available at this moment. Because of these technology's challenges we are still far from the fact that fully recycling of clothes is possible to be achieved. Technologies needed for chemical recycling is available for materials as polyester and nylon but are still under development and will become slowly available to be used for the rest of the materials such as cotton and blends. Within this procedure, by using existing products or part of them – components – a new product is made. In order to increase the durability of the new product, amendments to the old product like disassembling, restyling and any other modification that aims to bring an improvement in this product can be made. Remaking could be considered both in regards of a product level or in regards of a component level. The first option includes the process of improving the condition of an old product and turn it into a good condition/ as new. The process in terms of a component refers to the development of the performance. Some examples of remaking in textile industry involves the practices while the whole fabric or just some part / pieces of it , it is taken from products that have been already used so the firm put them together by sewing them in order to create a new product. Remaking could be also considered the replacement of a part of a used product. When it comes to knitted products, remaking could be more easily completed – without any technical procedure needed – by unraveling the yarns without making any modification on them and reknit them into a new product.

The third principle focuses on the raw materials that products are made from. Health of both customers and environment is protected by ensuring first of all that inputs- products and their raw materials are free from hazardous substances. According to (ZDHC Knowledge Base – Glossary , 2020) Hazardous substances are defined as compounds exhibiting intrinsically negative properties such as being persistent, bioaccumulative (vPvB), carcinogenic, mutagenic and toxic for reproduction (CMR), or endocrine disruptors (ED). In a circular economy, materials and substances that are hazardous have been excluded so the safe material circulation is assured. In this way, we could ensure that no pollutants will be released into the environment during or after products use. At the same time, not only the use and consumption of the products but neither its

production should discharge hazardous substances into the environment. This kind of dangerous microfibers that could cause damage by reaching the environment should not be disposed even after the use. Microfibers are textile fibers also named as fragments that are released from the product during production, use or after use as mentioned and we can find them both in synthetic and in natural fibers. It is needed to end up in a common test method so sources of macrofibre shedding will be identified. According to current data from Ellen Mac Arthur Foundation – there is a great lack in this field. Eliminating their release by changing how clothes are designed has been a main field where efforts were gathered but still unexplored, according to the above Foundation – an institution launched in 2010 aiming the acceleration of transition to the circular economy. A basic characteristic of a product made by recycled or renewable inputs is the effective use of resources. According to the standards of ISO 14021: 2016 “Environmental labels and declaration – self declared environmental claims, recycled material is considered “... any material that would have been disposed as waste but instead reprocessed by means of manufacturing process and made into a final product or into a component for incorporation into a product ...” . Another term used in order to describe the same process is secondary raw material (SRM) . Following up the importance of recycled materials and its use we should set the limits regarding the impact that their production has in the ecosystem. The way the land is used and all the processes followed should not have a negative impact on the environment, for instance forests or landscapes as it makes not sense trying to improve the one aspect by negatively affect or even destroy another one. The action plan should aim on the development of all renewable materials – organic materials like trees, crops and waste - by using regenerative production. Regenerative production practices improve the resilience of ecosystems and such examples are the organic farming or any practice in agriculture like agroforestry, permaculture etc. Productions and supply chain management should focus on the optimization of the use of water, energy and chemicals. All the manufacturing, distribution, sorting and recycling of products, should be powered by renewable energy. The last point included under these criteria is the need of reaching zero correlation between the production and the consumption of resources. Moving out of the model take – make – waste, a circular economy as mentioned above aims on the elimination of consumption at all stages. The need of resources – even if it comes to virgin resources, environmentally friendly – is minimized by increasing the use of existing products and materials. When you reuse a component, you avoid costs of inputs in order to produce it, all costs occurring during the production process and use of energy and other resources. By evaluating the post – consumer recycled content the company can also stimulate demand, willingness and interest regarding the collection and the recycling. According (Brydges, 2020) we consider as waste “...*materials or substances that are discarded and no longer used, typically resulting in landfill, incineration or leakage into the environment ...*”. In circular economy definition of waste is not accurate – it has been excluded from the models’ structure - as materials neither substances never become waste. Through all processes analyzed in chapter 2.5, materials or components that would have became waste are decreased and turn into raw materials for the production of other goods (process of remaking) or safely return in the environment by composting, recycling) .

#### **1.4.1 Textile Circularity in European fashion Industry**

According to data published in the European commission site (European Commission, European Commission, 2022), European consumption of textiles (mainly included clothes and shoes) has the fourth highest impact on the environment and climate change after food, housing and mobility. At the same report is released the info that the average European throws away 11 kg of textiles within a year. In addition, textile sector employs more than 1,5 million people in over 160 thousand of companies – most of them small and medium size. Especially after the pandemic period of Covid – 19 virus, in order to support the industry's recovery and to strengthen its resilience while increasing its attractiveness, Europe tends to embrace innovative brands and support quality textile products.

The EU strategy for sustainable and circular textiles, published in March 2022 presents a new action plan in order to achieve its green goals. This strategy combined with the European green deal – with the slogan of “striving to be the first climate – neutral continent ” and the new Circular Economy action plan (CEAP) adopted by the European commission in March 2020 (European Commission, A new Circular Economy Action Plan For a cleaner and more competitive Europe, 2020) focuses on a new agenda of sustainable growth. It's only the 2015 when the European commission proposed the first circular economy plan where 54 actions were included mainly concerning products sustainability and support for business that would integrate to a circular supply chain. This was adopted and set in action only in 2019. It's important to highlight that circularity is a new model/field under development within the European Union and there is way to go until all plans and projects will be implemented so we could have an overview regarding their impact and results both to society and environment. From 2015 till now, there is some progress done by the European commission by adopting rules and regulation regarding waste especially when it comes to energy and maritime shipments. Circularity in the clothing industry is even a newer project as it was introduced during the last year. Some of the measures included under the scope of “EU strategy for sustainable and circular textiles” are the new design requirements – analyzed in “Ecodesign for Sustainable Products Regulation” also published in March of 2022 where standards are setting (European Commission, European Commission, 2022). For instance, there is a minimum number of recycled fibers in textile that should be used, mandatory rule of providing long lasting products that enable the repairment and recycling in an easy way. The proposal also prohibits the destruction of products that have not been sold under specific conditions.

Another action of the plan is the clearer information on textiles that will be mainly based on mandatory information requirements on circularity and other environmental aspects. Measures will be also applied to the manufacturing process regarding the release from microplastics from textiles. Industrial manufacturing plants are obliged to monitor the unintentional release of such residues while measures will also target pre washing at industrial plants, promotion and use of innovative recycled materials. The action plan also includes economic incentives for companies to make the products more sustainable, this aims to the introduction of more green supply chain and it should be considered as an economical support for any extra cost that might arise during this integration. European Commission is also working on a project that will be completed in 2023 named “Transition Pathway for the Textiles Ecosystem” and focuses on the how to achieve this goal that has been set by the Textiles Strategy. All these actions bring out the issue of fast fashion

in Europe that is aimed to be eliminated by emphasizing in small or medium size companies with efficient green supply chains. Fast fashion might be the reason of all pressure and negative impact to environment and society of the textile industry. If it's traced back the combination of low cost products produced in the speed of light without any quality control, most of the times under not well paid, poor labor conditions outside Europe increases the consumption and the industry's standards. The European commission aims to minimize these phenomena by supporting innovative businesses that work out of this loop. In addition,, the "Transition Pathway" will agree with shareholders an orientation to efficient manufacturing processes, reuse, repair and new circular business models in the fashion industry sector. At the same time, except the shareholders the European Union encourages all the countries – members to support the reuse and the repair sector at national, regional and also local lever. Proposals that could contribute on this will be the tax reduction and any other measure in favor of companies that follow the reuse and repair model. Financial support for the sector's transition will be given under the program "Horizon Europe 's European Partnerships" in order for the companies to be able to invest on "a common industrial technology roadmap on circularity" as described by the commission . Hiring skilled experts that could support the textile industry in its digitalization and restructure of the supply chain. Just to mention that European action plans are not only focused on the industries but in the end users as well that are also playing a key role by continuing the recycle and the rest of the green procedures that first of all manufacturers should adapt. European Union also sets the limits to the export of textile by following the related regulations regarding such shipments. Export of waste from European countries is allowed under certain conditions and after completing specific procedures like demonstration from the import country od related licenses that prove that they are able to properly manage this amount of waste in a sustainable way. Sustainability concerns the work conditions as well and this is another field where the commission will be focused by embracing gender equality as according to European statistics publishes on the commission's website the 75% of global garment workers are women. International labor standards even for third countries partners will be checked in order for working conditions to be improved where is needed. As per last researches – of European commission – *“ in 2019 European Union was one of the biggest global importers of clothing ... with a combined value of 80 billion euros ”* .

This arises the need of practices to be taken in a global level as well. In order to promote the sustainable progress, European Union has published in 2020 "Global Alliance for Circular Economy and resource Efficiency" and the "United Nations Environment Assembly" in order to agree on a common action plan with international groups such as G7 and G20. According to statistics European companies tend to be more focused on the recycling of polyester, nylon, cotton, wool and polycotton. As a result, to all these new and ongoing regulations that the European Union brings up, companies are exploring circular models in order to comply and to offer attractive products to the European customer that are increasingly environmentally conscious and sustainable oriented day by day. On 2021, a pilot project on behalf of United Nations Industrial Development Organization (UNIDO), funded by the European Union , in collaboration with Nudie Jeans taking place in Tunisia , reveals that energy savings of recycled fibers compared to pure fiber – usually used by industries – were 53 %. In addition, during the same project statistics show that water savings were up to 99 % and chemical savings amounted to 88%. Across Europe, it has started to be spreaded the idea of renting clothes that is an option offered by numerous European industrie.

As per data collected by a survey that took place on 2021, in Germany, Poland and Sweden, it is concluded that “ ... *just over 40% of customers could imagine using fashion rental*”. In parallel, from 2020 big companies such H&M, “Aboutyou” and some of the French Luxury stores like Galleries Lafayette, have started their first steps in entering the resale marker. Furthermore, on August 2021, H&M launched repair and customization facilities services at some of its stores in European countries as France, Germany and Norway. According to Eurostat’ s bellow table published on 2019 in order to highlight the European countries that could offer more opportunities for recycled fashion, Italy – which is the capital of fashion – is the first place. (Eurostat, 2019)Then follows Germany and France.

Country	Textile Waste in 2008 (tons)	Textile Waste in 2018 (tons)	Average textile waste growth (%)
Italy	540,975	519,214	-0.41%
Germany	212,632	338,342	+4.75%
France	391,050	238,999	-4.80%
Belgium	83,578	199,456	+1.85%
Poland	83,578	131,985	+4.68%

*Table 3 5 biggest waste production countries within European Union ( Source: Eurostat 2019)*

The first country in the list – Italy – is only collecting the 15 % of its textile for reuse- , that means that the rest quantity ends up back in the ecosystem with a non-sustainable way. However, it’ s worthy to mention that Italy imports a big number of the global textile in order to reuse it for the second-hand market - which the last years seems to have a great growth. In contrast, Germany has a high collection of textile waste as 75 % of its textile waste is collected in order to be processed and reused in other industries, mainly as insulation material. According to European commission website“50 % of old textiles in Germany are sold as second-hand products globally ” . We would say that Germany is a bright example with Europe that needs to be followed by the rest countries. Unfortunately results for the other countries following in the list are not positive enough as they prove that the majority of the textile waste is not processed in an efficient green way. In conclusion, it seems that it is only the last years that Europe realized the importance and the of a sustainable and circular supply chain in the fashion industry. There are steps done and actions taken but of course there are needed many more practices in order to secure that these practices are applied in all ordinary industries all over Europe. As also mentioned by the Ellen Mac Arthur Foundation – that plays a key role to the transition to the circular economy – there are currently many different ISO standards that set rules and regulations to many different fields and stages of the company’ s production procedures but none of them for recyclability yet.

Regarding upcoming future actions, European Union commits to the establishment of “EU Waste Framework Directive “ that will hopefully require- form countries members to separate the collection of textile waste by 1 of January 2025 under the general goal of achieving “*a fiber to fiber recycling ... that will lead to a new sustainable and circular industry in Europe by 2030*” (McKinsey & Company ,2022). According to Saskia Hedrich’s report published by McKinsey ‘s Company in July 2022 (Hedrich, 2022), Europe will not manage to reach the goal of bring the textile recycling in the required level by 2030 unless actions are taken quickly. Actions that could lead to the successful outcome of this project could be a critical scale across the chain – as textile

recycling can not work at small scale- so there is sufficient feedstock. Collaboration between, government (public institutions) , industry ' s leaders and the investors should be the first one ' s to commit in a highly operational joint effort. Even after being established the circularity in a supply chain could reduce costs and be profitable, there is no doubt that transition and the first period after such an implementation has some extra costs that need to be covered by using related fundings that the European Union should provide.

## **Research**

## **2. Materials and methods**

### **2.1 Study context: Textile Circularity in Greek fashion industry**

As analyzed in paragraph 1.4.1 until now there are no targets within the European Union for textile collection so there is no obligation for countries members to report on this neither follow any procedure of establishing related systems. There are only 13 European countries that are working on the integration of circularity in fashion ' s industries supply chain and only 4 of them (Austria, France, Belgium, Italy) report annually on the progress, usually supported by non-governmental bodies. Unfortunately, there are no precise figures on the percentage of clothing that end up in landfills in Greece, while according to studies (Agency U. E., 2018), it is estimated that 4.5 percent in USA go there and 3.5 percent in the Western Europe. According to e-kathimerini ' s article published on 2016 and written by Yiannis Elafros, Greek government, taking into consideration the huge amount of waste due to the fashion industry, has introduced the project of recycling the clothes to 18 municipalities that started to place special bins where the public can recycle clothes. This initiative was taken in collaboration with the Greek private company "Recycom" that specializes on recycling issues. According to data from Recycom, they started working on recycling clothes from firms and public in 2012, when this field were unknown both for companies and society (Recycom, n.d.). It ' s important to mention that until this time – since 2012, when this project started – donation was the only action ,which could be considered as a "kind of recycling" , that firms and customers could take in order for a product to be reused and not burnt in landfill. Most of these donations were addressed to charities and church. According to the same article, on 2015 they managed to gather 300 tons of material, in order to forward it to recycling companies in Germany. Mr Vangelis Arapis – a representative of Recycom – states that Greece is still making baby steps on this field, however business seems to been growing. Recycom is the first company – founded in 2012 – active in recycling textile by gathering them and sending them either to charities (clothes that are in a good condition) or to companies that can modify the textile and turn it into new virgin fibers that could be used again. In Greece, there are no such industries that could process mechanical or chemical recycling of textile so most of the companies that decide to recycle clothes or part of them should send them abroad with most of the companies choosing to send them in Germany. According to another research conducted by National Technical University of Athens in 2013, in Athens from end users are generated 100.000 tons of old clothes, where 10 % of this amount is being used again from charities and another 10 % is used by the second-hand markets – is being resold. The rest 80% of textile generated – no matter their condition or their material as maybe some of them are made out of recyclable materials - unfortunately is thrown in

landfill. In addition, according to the analysis of the Greek National Waste management plan of the Greek Ministry of Environment and Energy it turns out that the in Greece (HelEnCo, 2011), textile waste is approximately the 2.2 % of the produced Municipal Solid Waste. Greece along with Romania and Malta are in the last place of countries that recycle their textile as to the majority of it, it ' s not given the opportunity to be reused neither to return to the ecosystem in a sustainable way .Until now , Greece focuses more of its attempts to public regarding the recycling of the clothes and has no such developed initiatives regarding the industries and how they could develop such processes in order to reuse clothes as raw materials. Even the clothes gathered for recycle are sent to Germany – in most of the cases- depending on what it has been agreed with the private recycling companies. The only commitment for companies sending clothing waste aboard in order for it to be processed is that a specific percentage of new quality fibers ready to be used again – according to each agreement – will be returned to the industry. Meanwhile there are numerous companies that have taken the initiative of creating a separate department within the company that works on redesigning and recycling by dyeing cutting, sewing fibers. Most of the companies that work under the scope of circularity in Greece, produce new collections by using as raw materials clothes from the past collections – stock not sold in their warehouse –, samples that eventually were not included in collections, or part of textile that was cut and not used while previous collections were produced (waste). In addition, the past years there were some interested projects taking place in Greece attempting to reduce not only textile waste but waste in general from our country. Fashion designer Vassia Kostara that has her own globally know brand named “Vassia Kostara” in collaboration with the Greek organization “Circular independence” that is active in the upcycling of waste materials –mainly plastic–, created a limited collection that at first was including only beach towels made by 12 tons plastic bottles collected by the Circular Independence organization from beaches of Crete (Kostara, 2019). As this collection had a great impact in both environment and society, customers supported it and due to this huge success, a collection of clothes made by recycled plastic bottles followed on 2021. These bottles were also collected from Greek beaches and coastal areas, then turned into flakes and from flakes they have been processed to RPET fabric in order to be used for clothes production.



*Picture 4: Stages of transition ocean plastic into fibers (Source : [www.parley.tv](http://www.parley.tv) )*

Another practice that is followed in Greece from fashion industries – as the last step in converting their production cycle into a more earth friendly - is system of starting the production once the order is received which eliminates the possibility of stock. The majority of Greek local brands as it is also stated in their society responsibility section of their warehouse focus their attention in reducing their stock levels by improving forecasting practices regarding the markets demand. Unfortunately, there are no exact data and statistics regarding the companies manufacturing clothes in Greece. In order for a product to be considered as “made in Greece” it’s necessary that the last part of its production procedure to be completed in Greece. Taking into consideration this , the possibility of controlling and setting the standards for a sustainable supply chain - using recyclable raw materials , green practices during manufacturing like making products that last and can be reused again and the rest of the decisions - is not 100 % up to the Greek company but also depends on the manufacturing site and the country where it ‘s located as regulations differ from country to county , continent to continent . This makes the progress of closing the loop of take – make – waste harder for companies that do not run inhouse the whole procedure. According to data on the internet - mainly companies ‘websites that state that clothes are manufacturing in Greece – there are more than 250 companies that manufacture clothing in the country. 75 % out of these companies that are working in the Greek fashion industry are including in their website a section related to their sustainable vision. This is a high percentage, promising that Greek industries are willing to get closer and adopt green practices in order to integrate to a circular way of production. However, less than the 10% of these companies mention exact practices followed in order to make the end product sustainable and the whole process having an as much as possible impact to the environment. So, the answer is still unknow when it comes to the question of which is the perception, knowledge of the Greek companies in the field of clothing regarding the sustainability and the Circular economy, which are the practices that they are already following and in which extra practice it would be more luckily to invest. These are questions that this research aims to answer. Of course, challenges and reasons that making this integration from the linear to the circular model hard to apply is another interesting field that will be discussed throughout this research.

## 2.2 Research Design

In order to answer below mentioned questions the research was split into two parts.

<b>Research Questions</b>
Do Greek fashion industries consider their supply chains sustainable?
What is a sustainable supply chain for them?
Which sustainable/ circular actions have they already adopted throughout the supply chain?
At which stage of the production process do they focus their sustainable strategies?
To which stage they would like to invest / improve its sustainability?
Would they be interested in the integration from a linear to a circular supply chain?
Which are the inhibiting factors of the change into a circular supply chain ?

*Table 4 Research’s questions*



At the first part I contacted 219 Greek fashion industries in order to examine their interest in participating in this research. The contact was completed via email for the 78 % of the companies – for which email info where available and correspondence was successfully delivered. For the rest of the companies the first approach was done via their business page in social media. After identifying the brands, I organized them into a database in order to send them an initial introductory email explaining the project and its goal and inviting them to firstly answer a questionnaire. This phenomenon – as it is related to perception and efforts for integration – it could be “better” investigated through an interview with the people who face these challenges every day Valentine, 2005. So apart from the quantitative results of the questionnaire, the main data of the survey consists of interviews with production managers, CEOs, the founder of the brand, either employees in charge of green initiatives and company ‘s sustainability completed via phone calls. The sample of the research as it will be analyzed below includes very small and small companies working on the field of clothing – providing clothes and accessories for women, men and children. In this research, I included companies that define themselves as sustainable – according to info on their website – but also companies that do not have any related mention regarding green practices. All the communication, via emails, calls and questions/ answers on the questionnaire was in Greek in order to enable the easier and more accurate resource of responses.

### **2.2.1 Questionnaire**

Questionnaires are one of the cheapest, fastest and reliable tools to be used in order to investigate an issue. Each questionnaire consists of a series of questions with the purpose of collecting information from a specific sample of people. However, the challenge of using a questionnaire while carrying out a research is that responders may not be sincere as most of them tend to be socially acceptable and present a positive, nicer view of the current situation or of point that is being investigated.

In this case, at the first part of the research, the questionnaire was sent via email to 219 Greek industries in the field of fashion and it was requested to be replied by the person in charge of sustainable / green initiatives or any other employee, manager or founder that has the full overview of processes throughout the supply chain (from buying to selling). Unfortunately, the response rate was really low as answers received only from 25.57 % of the companies – equals to 56 companies- even if reminders were sent via emails and calls were done in order to convince them to participate in the research. Details of the companies that took part in the first part of the research will not be mentioned due to the privacy policy of GDPR. The questionnaire included both closed and open type questions in order for the research to conclude in both quantitative and qualitative results. The main goal of the questionnaire was to investigate whether the Greek fashion industry is aware regarding the circular processes and if some of them have already implemented such practices into stages of their supply chain and of course which is the percentage of the companies that is already working under this scope.

### **2.2.2. Interviews**

At the second part, after receiving a positive answer regarding filling in the questionnaire, I invited all the 56 companies that responded in my questionnaire- into a short conversation via the phone in order to analyze procedures followed in details. I got a positive feedback from 9 of the people

that were representing the company as employees, managers or CEOs, that is a response rate of 16,07 %. Personal data of the respondents and names of the brand are not mentioned respecting privacy policy of GDPR. Below table summarizes the general description of the interviewers.

<b>Interviewee</b>	<b>Position</b>	<b>Industry segment</b>	<b>Size of firm</b>	<b>Location</b>
<b>Brand 1</b>	Co - Founder	Women clothing & accessories	Micro- sized	Thessaloniki
<b>Brand 2</b>	Founder	Women clothing & accessories	Micro- sized	Thessaloniki
<b>Brand 3</b>	Production Manager	Women Clothing	Small - sized	Athens
<b>Brand 4</b>	Co - founder	Women & men clothing	Micro - sized	Thessaloniki
<b>Brand 5</b>	Quality control employee	Women & Men underwear	Small - sized	Athens
<b>Brand 6</b>	Founder	Women clothing	Micro - sized	Thessaloniki
<b>Brand 7</b>	Founder	Women clothing & accessories	Small - sized	Athens
<b>Brand 8</b>	Head of Design department	Women Clothing & accessories	Micro - sized	Athens
<b>Brand 9</b>	CEO & co - founder	Women clothing & accessories	Micro - sized	Thessaloniki

*Table 5 Research participants*

Approximately duration of each interview was 30 minutes. Interviews were not recorded as the discussion was completed via phone calls, where the option of recording was not possible, however notes were taken in each of the points of discussion in order to write my research and conclusions. All the interviewers were informed and agreed with the use of their statements and information that they shared in order to fulfill my research. Interviews were split into three parts. The first one was consisted by general typical questions like the years of experience in fashion industry, the company's size , main products and role of the interviewee in the company. The second part of the interview was focusing on the sustainable or circular economy policies that are already followed by the company and at which stage of the brand's supply chain these policies are applied The third part of the interview aimed to highlight the challenges faced in order to implement such processes, in case the company already working on them or the threats / reasons why the company didn't implement any of these practices yet. Of course, during all parts, there was time for open discussion where general issues regarding country's opportunities and support was mentioned. As analyzed in the literature overview, circular's economy main goal is eliminated the linear model that is currently followed by most of the industries and focuses on the principles of take, make and waste. The research was conducted in order to find out the way in which Greek industries in the field of fashion industry manage these three stages of their supply chains and whether sustainable or circular practices have been already adopted or there is the willingness and the interest from the companies to insert them in order to close the take – make – waste loop. So, interview's responses

were also organized under these three main principles. This kind of approach assists in sorting the answers into themes for analysis and theory building (Cope, 2005) . In this way it was easier to identify to which stage each brand' s practice is connected and at which stage the challenges or even the difficulties are higher. This part 's results are presented in paragraph 3.2.

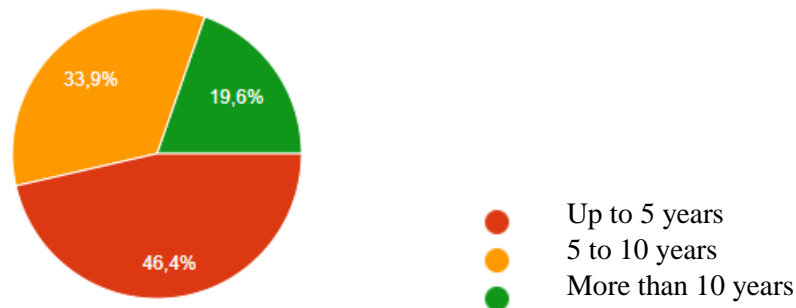
### 3.Results

#### 3.1 Questionnaire results

As no data of the participates – companies will be shared the first two questions aimed to provide some demographic data so we have a clearer vision of the profile of the businesses that answered the questionnaire.

It comes out that 46.4% of the companies can be considered as startups or new entries in the industry as their presence is up to 5 years. Then it follows companies that working on the field for 5 to 10 years with the percentage of 33.9 % while the lower percentage of 19.6 % is noticed for companies that are active for more than 10 years. Data also presented in the below pie:

**How many years is the industry active in the field of fashion?**



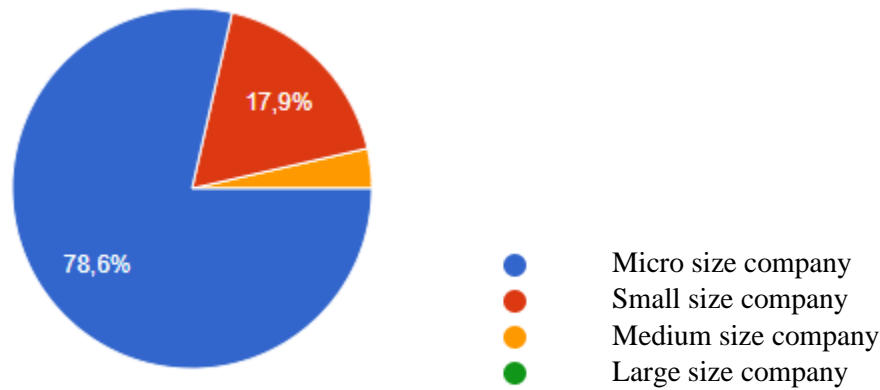
*Figure 2 Years of presence in Fashion Industry of research participants*

Regarding the company' s size, we find out that 78.6 % of the companies are micro sized which is the major percentage and only 17.9 % of the brands are considered small size industries. There is just a percentage of 3.6 % that refers to medium size companies. There is no large size company participating in this research. It's needed to highlight the criteria of each category as per below table:

Size	Number of Employees	Annual revenue
Micro	< 10	< 2 million
Small	< 50	< 10 million
Medium	50 - 249	10- 43 million
Large	> 250	> 50 million

*Table 6 Company's categories*

Size results are also presented in the following pie :

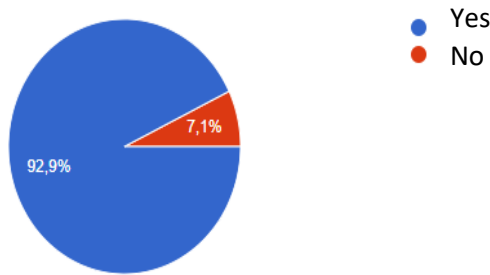


*Figure 3 Companies size of research participants*

The above results reconfirm finding on the internet and previous researches results regarding the size of industries/ companies in Greece and also data regarding the development of fashion industries. As per annual report on European SMEs (Comission, 2021) , in Greece the 99.9 % of the companies are considered to be small or medium size. Unfortunately, there are not exact data regarding the percentage that applies in the field of fashion industries. Reports and articles published the last years also prove that there is a great in Greece in the Greek fashions industry from 2017 till today, with new industries significant increase on 2021 according to the yearly report of fashion e- commerce. Despite the presence of Covid-19 pandemic, 2021 has been a profitable year for the Greek fashion industry where a 20 % of increase of sales was noticed especially because of the significant develop of the e- commerce.

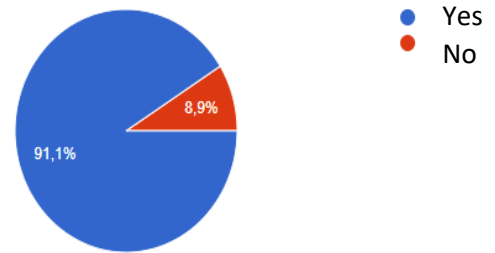
The second part of the questionnaire was focused on the awareness and perceptive of the Greek companies regarding the meaning of circularity, their interest for a sustainable or circular model in comparison with the linear one. In order to examine the results, closed type questions were asked. 92.9 % that equals to the fact that 52 out of the 56 companies state that are aware about the concept of circularity in supply chain while the 91.1 % states that would be thinking of integrating into a circular supply chain.

**Are you aware about the meaning of circularity in the supply chain?**



*Figure 5 Circularity awareness of the research*

**Would you think the integration to a circular supply chain?**

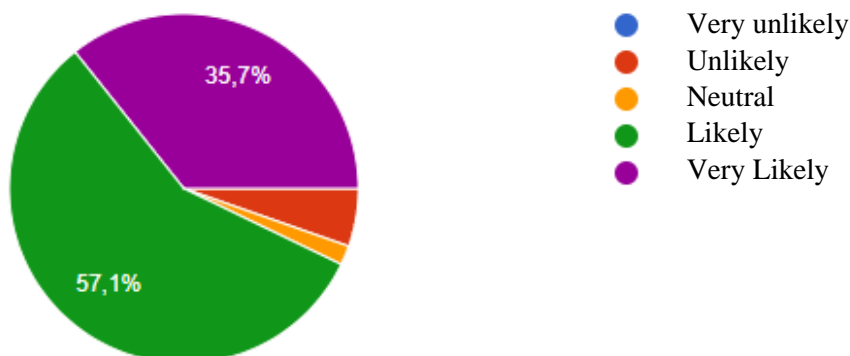


*Figure 4 Perception regarding integration to a circular supply chain*

Above results are quite optimistic as they show up a Greek fashion industry that is up to date regarding the global trend of adopting green circular processes. The main question that arises and will be clearer where we reach the part of action that have been taken is whether circularity is just a thought and a knowledge on a theoretical frame or is only concerning the companies in action.

Sustainability is also a concept for which industries seem to be aware of, with the 100 % of the companies giving a positive answer to this question. When asked whether the circularity could increase the sustainability of a supply chain most of the companies understand the correlation and only a small percentage believes that circularity would not have such a positive impact to the supply chain 's sustainability as presented in below diagram.

**Do you believe that circularity could increase sustainability of the supply chain?**

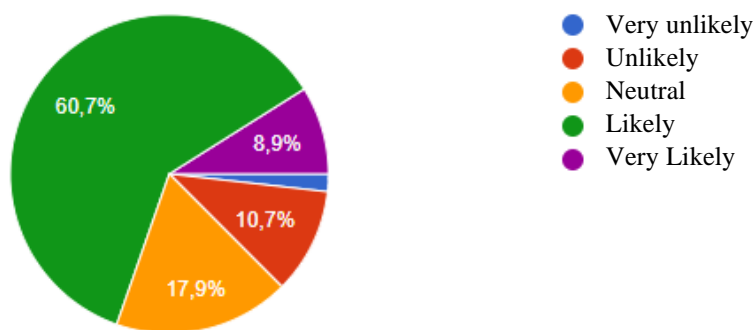


*Figure 6 Correlation between Sustainability and Circularity in supply chain*

Regarding the impact that a circular supply chain would have to the end customer the majority of the companies (76.8 %) believes that it would be a positive one while the rest 23.2 % states that it would be a neutral one. None of the companies gave a negative answer regarding the relationship of circularity and end customers.

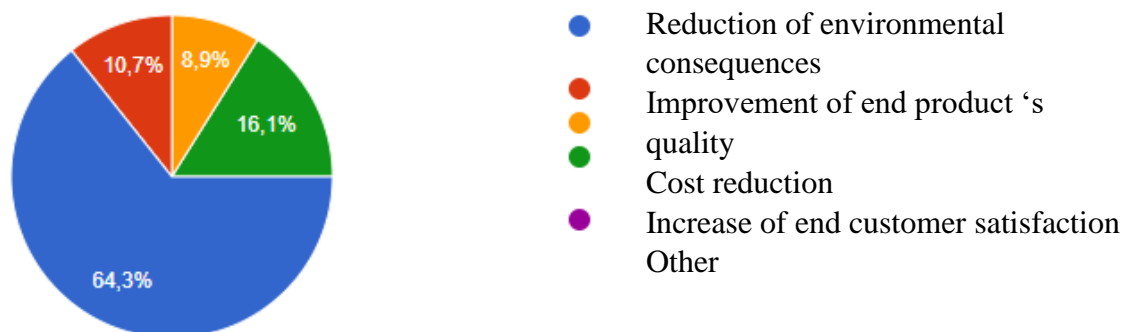
When it comes to the comparison of the linear and the circular supply chain, most of the companies state that circular supply chain has the advantage over the linear one. The biggest advantage that the brands localize between these two models is the reduce of the environmental consequences, spotted by the 64.3 % of the firms. Then, its comes the fact of the increase of the customer's satisfaction when a product is produced under a circular model.

**Do you believe that the circular supply chain has an advantage over the linear one?**



*Figure 7 Perception regarding the advantages of circular supply chain*

**Which of the following do you consider as the main advantage of the circular supply chain over the linear one?**

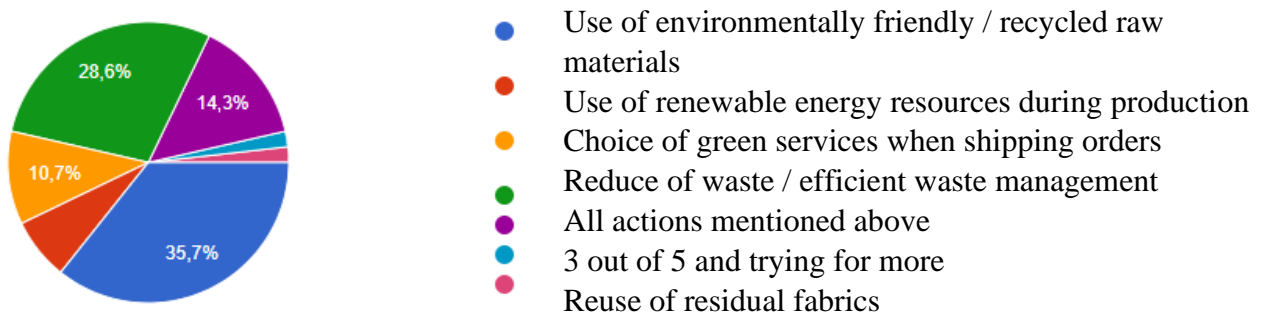


*Figure 8 Main advantages of a circular supply chain*

The third part of the questionnaire moved from the theoretical frame to the actions. Actions that have been already taken by the company and those that is more luckily to be taken on the new future as companies asked regarding the fields possible to invest in.

At the first stage companies asked regarding green – circular practices that are already implemented during their production process. Results show that the practice that most of the companies have already adopted is the use of environmentally friendly raw materials. This principle is implemented in the supply chain of the 35.7 % of the companies that participated in the research.

**Which of the following actions have been already adopted by the company?**

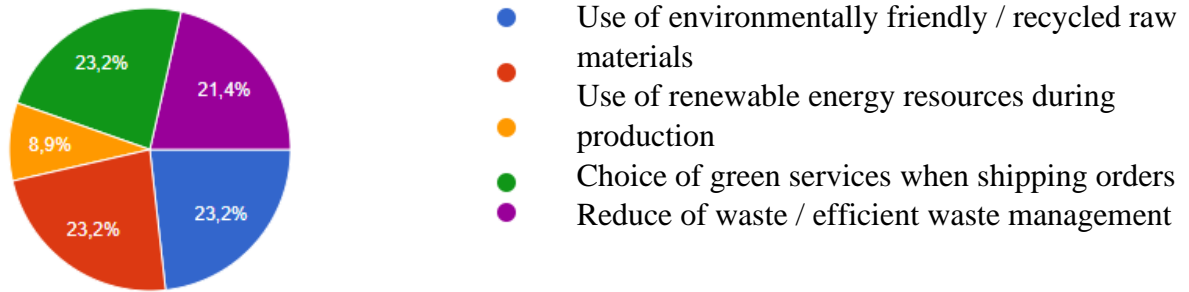


*Figure 9 Circular actions already adopted by the company*

After paying attention to the raw material used, the second most popular action for Greek industries is Reduction of waste and the efficient waste management. What another company mentions is the reuse of residuals of the fabrics which is also included in the waste management project.

When it comes to actions that the company would consider to implement, environmentally friendly – recycled raw materials and waste management gather again the highest percentages. This reveal that even for the companies that are not following such strategies their major concern is to start investing on them. In this question, it is also high the interest regarding renewable resources during production while 21.4 % of the companies would like to invest in all such actions.

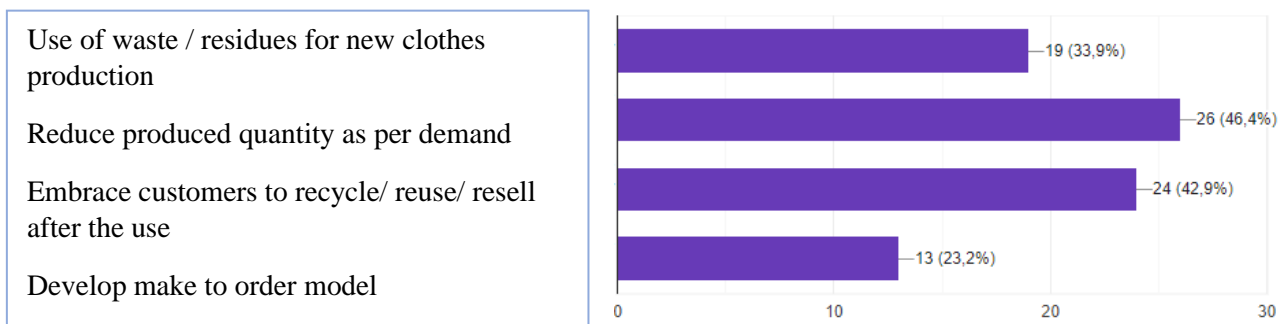
**Which of the following actions would you like to adopt (in case it hasn't been already implemented)?**



*Figure 10 Circular actions to be adopted in the near future*

As waste management and waste reduction is a huge "project" for each company that includes many different actions, it was needed a supplementary question in order to specify how each company is handling this part. Responses regarding different approaches are presented below:

**Which of the following actions have you adopted in order to properly manage / reduce waste?**



*Figure 11 Waste management in supply chain of participants*

The second most popular way of waste management includes products that could be recycled, reused and maintain their value in order to be resold from the end customers. Then it follows the possibility of using upcycled material of the residues from last collections in order to produce new clothes that is supported by 33.9 % while the less popular option is to switch to the make to order model.

In order to close the third part of the questionnaire that was referring to actions used or actions that could be adopted in the future and after summing up a positive feedback regarding circularity the companies asked about reasons that prevent – or not making that easy – the decision of implementing a circular supply chain.

**Which are the deterrent factors of implementing a circular model?**



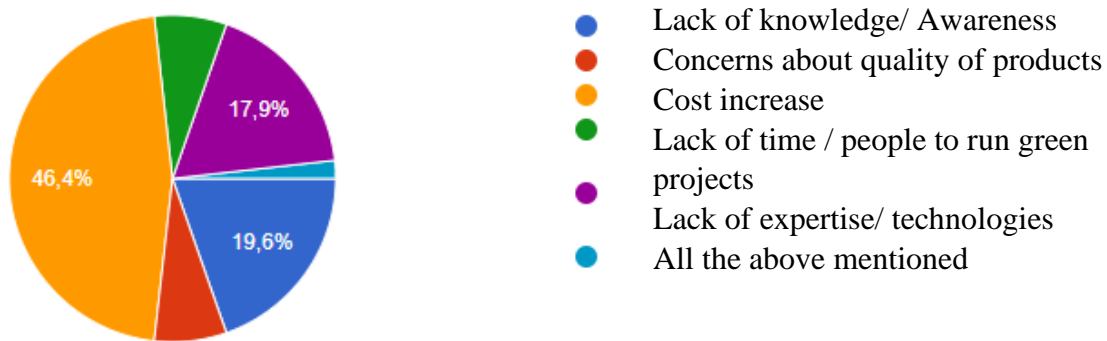


Figure 12 Deterrent factors in integration to a circular supply chain

According to above responses the most important factor that 46.4 % of the companies take into consideration and have not proceed yet with the integration into a circular model is the cost increase that might occur after changing and redesigning all processes under the scope of circularity. Then there is the fact that not many data and information are available especially in Greece as supported by the 19.6 % where the linear model is the dominant one while there is also a lack of expertise and technologies.

### 3.2. Interviews results

#### 3.2.1 Take

As already analyzed in previous content, the first part of the production material is considered the stage “take”. At this stage are including the purchases of raw materials and processes like dyeing, washing and sewing textiles. This part of production has a great effect on the sustainability of the company and the end product as it defines a lot the possibility of the product to be recycled whether the raw materials allow this and also the residues that each kind of material released on the environment during its manufacturing process.

Even if 6 out of the 9 companies – this is a rate of 66.66 % - agreed that raw materials and the part of “taking” plays the most significant role in order to achieve a sustainable supply chain, only 1 of the companies – Brand 7 - are using existing upcycled textiles in its design. To be more specific, as the founder mentioned “... our focus is in the use of fabrics from Vintage or second-hand clothes. The leading role is taking by Denim which a durable material regarding time, use and fashion trends”. The rest of the brands are relying on buying new raw materials for new collections and justify their sustainability concerns at this part of the supply chain, stating other reasons. For example, CoFounder of Brand 2, states that “High attention is given so all products to be made from 100 % natural materials. We use cotton, linen, rayon and modal and for all of them we work exclusively with certified suppliers and we aim for all textiles to have OEKOTEX standard 100. Regarding dyeing process, we only use colors that have been certified by the Global Organic Textile Standards. Procurement department works closely with our suppliers and our goal is developing long terms partnerships with those who follows the standards of sustainability and transparency”. Co-founder of brand 1 – that is only producing knitwear – shares “Our main material is wool which biodegrades naturally even if it’s known that its production it’s not sustainable. For example, bigger companies, where economical support is bigger – can search

and measure the carbon emission from suppliers while for us there is not the time neither the capacity to do so... We don 't have many alternatives to replace our main material in order to be closer to circularity so we are trying in other ways ... ”. Head of design of brand 8, after admitting that they totally understand importance of using recyclable raw materials continues with the fact that “.. after many trials and years - as we also need a product to be proper for the use – we managed to produce our main product (with highest demand) from 78 % recycled polyamide and non-toxic paints and this is already a big progress ... this is not possible at the point for all products but company continuously trying to improve and replace fibers”. Production manager of brand 3 states that the company doesn't have any data regarding the way in which textile are produced from the suppliers and they just check quality and design factors before they buy them. Furthermore, the production manager of brand 3, continues that “... company is being sustainable in a social way by purchasing the majority of the raw materials from Greek suppliers – whether this is possible as not all of the textiles can be found in Greece so importing in some cases is the only solution”. Other industry presented a different approach to circularity, with the quality control employee of brand 5 stating “At this point there are not available enough natural fibres in order to proceed with our designs so we choose to invest and stay focused on durable materials”. Interviewees of brands 3 and 9 concluded in the same point that in terms of circularity where a product should be able to be used for more times, it 's important for their industries to choose high quality textiles that will offer a durable product and also investing in the design that will keep the product being desirable by the end user . In addition, CEO & co- founder of brand 9 notices “ promotion of slow fashion is our asset – even if it can not compete the fast fashion in regards to the costs, of both the company and the end consumer” . So we conclude that companies define sustainability and circular practices regarding the first stage of raw materials in a different way with the majority of them (4 out of 9) to agree that making the product as initially planned and designed by using 100 % natural fibers is not always possible due to materials availability in the market or due to highly increased cost. When people representing the 9 companies were asked about why do they pay that attention to the resource of raw materials, brands 2 and 7 mentioned their vision to improve their impact to the environment and society while the rest 7 brands mentioned that this makes the product more attractive to the end customer and demand is increased. Interviewees frequently mentioned that customers relate environmental disasters like extreme temperatures with fashion's industry impact and the circular model during the last year started to turning into a trend (they are also mention vegan preferences from a big percentage of public). We end up that consumer's pression and their consumer behavior matters in order to motivate the industries to integrate to circularity.

### **3.2.2 Make**

The second part of the manufacturing procedure that consists of designing and running all operational processes in order to complete the production of the end product is considered as the “make” stage. In order to check the possibility of implementing circular principles we should first consider production processes and their relationship. The first question addressed to the interviewees at this part, was regarding their thoughts about changing the design and *production and put it under the scope for circularity*. All the 9 brands agreed on the fact that “ *designing for circularity is a huge challenge* ” as mentioned by representer of brand 2. It seems that orienting the production in this way is a really big step for most of them to make as 7 out of 9 brands agree

on the point that customer will appreciate a sustainable product but this will not be the first criteria in order to buy it. This creates many doubts to the management teams of the brands to find out whether such a change is finally worthy in terms of costs and increase of the demand. Founder of brand 4 concludes that for customer it's more the design that matters rather than the sustainability and she continues saying “ .. *if the product doesn't meet requirements or doesn't follow the trend ,it will not be bought again even if its sustainable*” . Production manager of brand 3 also mentions that she believes that customers prefer staying safe in materials and textiles that are already used to and are suitable for them. Employee of brand 9 mentions “... *integration to a circular supply chain for us is like starting from zero... It's not a single stage that is needed to change but each decision taken* ”. Another approach is described by the representer of Brand 5 as she states “ *for us circularity is producing a cloth that will not lose its value at the second-hand market. Investing on design even if increases the cost makes the product last for a long time... when the first user feels like it's done with it there is the option of reselling it or even pass it to a friend because the product still has value and it doesn't make sense to throw it ...* ” In order to support this statement she continues by sharing an example “... *when we see older ladies wearing clothes from previous collections saying that their daughters gave it to them or when we hear two sisters saying to each other “buy it and when you will get bored of it , I will wear it” then this is circularity*”. Founder of brand 6 puts on the table another aspect mentioning that main competitor of all Greek local industries is fast fashion, he notices that “*sustainability is a way to compete but as long as this doesn't significantly affect the cost – as we already cannot compete fast fashion in regards to the cost – and also as long as sustainability is a reason for the customers to buy it instead of a product coming from fast fashion industries*”. Founder of brand 7, that is already following circular practices, brings up the need of putting some effort regarding the elimination of seasonal collections. She believes that getting into the loop of changing several collections during a year we embrace the idea that “*fashion needs constant renewal which is also what the fast fashion supports* ”. For their brand is important that collections and pieces of each collection will be as much as needed while efforts will be focused on production of products that could be used during most of the seasons and events. As she mentions “versatile clothes ” should be the new trend. At the second part of the interview it was analyzed the aspect of being ethical regarding the labor management and working conditions. Founder of brand 6 is optimistic while stating “ ..*this is something we can compete fast fashion for sure*” The most accurate and to the point notice regarding this point was made by interviewee of brand 5 who mentions that customers some times complain about the high cost of clothes produced by Greek industries compared to the cost of kind of the same product that they could buy from big fashion chains and she continues “*the answer about this cost difference is nothing more than quality materials and people who are getting paid for what they are working for* ” All nine companies agree on respecting workers rights regarding salaries, working hours and security staff as per country 's standards . Founder of brand 7 says that “ *Luckily compared to under developing countries they are standards and audits followed in Greek industries even if we are far from perfect* ”. 4 out of 9 companies refer to fast fashion industries in Countries such as Bangladesh, China and Thailand and their employees that work “*under modern slavery* ” stating that fashion is one of the biggest industries that support this kind of conditions while “*customers refuse to see the truth* ” as the interviewee of brand 9 says. The last points of the second part of the interviews were green practices in packing and transportation / shipping of

orders. It 's really optimistic that 100 % of the interviewees mention that recyclable material is used for packing all orders. As per last regulations plastic has been replaced by paper bags and further more many of the companies take this one step further and try to offer innovating solutions. Founder of brand 2, is really proud *“for the paper boxes that have the same print as some clothes of our collection ... our aim is to be reused for other reasons and not to be thrown or just recycled”*. Production manager of brand 3 says that *“ packaging is not only made by 100 % recycled materials but this is also written on it as a reminder to the end customer that this can be recycled”*. Meanwhile , they all end up that not necessary components of the packing has been removed so they reduce cost and environmental impact as well. While awareness and actions regarding this stage seem to be high, Green practices regarding the shipping of the orders is almost at zero. Only one of the brands – brand 7- pays attention on the matter. As mentioned, *“staying focused on the being conscious concept”* they choose DHL green service which tries to eliminate CO2 emissions during the transportation by optimizing transport routes etc. Brand 3 says that they were not informed about such an option but in case the courier could offer it and the cost difference was not that high they would be interested to check.

### **3.2.3 Waste**

The last but still important part of the production procedure is the waste management. This part includes the non-used textile, samples, the items not sold and all textile that will end up recycling or in the worst case scenario in the landfill. The third part of the interview was split into two aspects. The first one was referred to practices that the business are following in order to reduce its waste and the second one how do they finally manage the waste that occurs. Regarding the first part of action that will eliminate waste, it seems that there are no much innovating practices adopted as all of the answers were summed up in the same point of reducing pieces per collection. Representative of brand 5 states *“Our last collection was the first one in which we didn't produce for second time even pieces that were sold out the first day of launch”*. Production manager of brand 3 says that they don't want to switch to a make to order model but they are trying to keep it a brand of “limited collections”. In contrast, brand 1 follows the make-to-order strategy in order both to reduce costs and waste. According to the co-founder *“there is no physical store so customers check the samples that we sew and placing their orders. All products are 100% handmade so by the time the order is received we start with its production”*. The companies were also asked about offering repair services or clothing take back programs in order to re-sell them or reuse them as raw materials. None of them are currently working with such options however 3 out of the 9 companies agreed that repairing service it's a nice idea easy to be adopted as it is not necessary to involve extra cost and new department within the company but they could take advantage of external companies that already working on the field. Regarding reselling, all of them had doubts regarding the interest of customers for buying second hand clothes as there are already stores focused only in this kind of market. Co-founder of brand 4 believes that *“Idea of second-hand clothes is more famous abroad than in Greece”*. Meantime, Quality control employee of brand 6 thinks that for high quality and more expensive clothes *“it is more beneficial for the end user to resell it on his own once he doesn't use it anymore”* rather than return it to the store in order to be resold. Regarding take back clothes policy, Co-founder of brand 9 states *“This strategy is mainly followed by big companies in the sector of fast fashion. It could be applied in local industries but we prefer to invest more to ensure that our products last longer and there is no need*

*to use them for a short time and then return them back*". The Greek industries neither seem ready to proceed with rental strategies. As founder of brand 2 mentions, there is a big effort given *"to add emotional value to the products and make customers want to buy it"* so renting a cloth it would be in contrast with this goal. The rest of the companies stated that rental policy for them could be used when the value of the product is high and it will be used just for a few times during a short time of period like bridal stuff or children's clothes so they conclude that this option doesn't match with what their business stands for. Moving to the second part of the "waste" stage, firms were asked how they finally manage the quantity of waste that the company has. Starting from brand 1 that it is an almost zero waste company, co-founder sums up that all items are produced after the orders arrival, there is just one material used for all of them and even the samples are being sold so the quantity that is finally thrown is almost zero. None of the 9 brands work with any company that recycles textile that means that all of the waste ends in landfill. As all of them mentioned they are trying their best in order to reduce this waste as much as possible. Brand 3, 4 and 6 admitted that they were not aware for the option of giving the waste to a recycling company in order for them to send it to factories that could process and re produce new fibers but this *"sounds a great idea to work with"* as production manager of brand 3 mentioned. For instance, Brand 3, 8 and 5 mention that textile not used for example for the production of a dress, is used in order to produce a smaller product like a headband, a scrunchie or even notebooks (using the textile at the front page). Brand 5 continues saying that when the quantity of waste of a specific fabric is too small in order to be used for a product (like those that mentioned above) that will be sold, for each collection they create keychains that they give *"as a gift to our customers along with their purchases"*. Another approach from brand 3, is using the residues of textile while packing in order to avoid the bubbles. In this way they offer a part of non-used textile to the customer for them to decide whether it could be used. It is worthy to mention that 4 out of 9 companies mentioned that they don't know if there are bins where they could recycle their waste, *"in the same way we recycle glass for example"* as production manager of brand 3 adds.

### **3.2.4 Discussion**

As mentioned before, during the interviews there was time for open discussion and general concerns. From the majority of the companies, was mentioned that in Greece there is not enough information regarding the circularity in the supply chain. There are no actions or programs from the government in order to support by providing funds or even information and expertise on the sector. Awareness of industries and also of customers should be increased as they will be the motivation and the pressure for the companies to adopt circular practices. Companies feel that there is not enough knowledge in order for them to adopt an inhouse department that would process upcycling materials and waste into fibers ready to be used as raw materials. Combined to this fact their main concern also involves the cost increase in this case. *"Re-designing not only clothes but all processes from zero under the scope of circularity will significantly increase the cost and we can not be sure that even if we invest on this, this cost will be absorbed by future demand"* as Brand 3 production manager believes. Another reason that makes this transition difficult for more of the companies is the fact that 8 out of 9 companies do not have a person or a department responsible for green sustainable initiatives. This responsibility is involved in the tasks of design team, production management or the founder of the brand. For brand 3, green projects are not involved

in someone's job description. As they mention, *“we work as a team... if someone has a green idea it would be more than welcome to think about it”*.

## Conclusions

By examining the linear model of take – make – waste model that is currently used by the most companies in fashion industry, we notice that brands are doing some efforts in order to adopt sustainability – oriented practices in some of the production stages that, according to their point of view matches, with the Circular Economy mindset. Even if actions have been taken and baby steps have been completed, if we check out these practices in details, there are many questions that are arising and need to be answered before we proceed with the statement that circularity has been implemented in the Greek fashion industry. The following outline summarizes circular practices that have been already implemented in the Greek fashion industry in each stage and practices that need to be developed.

	Already implemented	Need to be implemented
<b>TAKE</b>	Use of natural fibers where possible. Use of high-quality materials that make a durable product. Long term collaboration with local suppliers.	Use upcycled materials. Quantify the environmental impact of production of raw materials. Reduce environmental impact of chemicals used in dyeing.
<b>MAKE</b>	Design products that maintain value in the second-hand market. Design products that will be used many times for a long time period and pass to different users. Use of recycled packaging/ remove not necessary components.	Transition from seasonal to seasonless collections. Use renewable resources of energy to production. Use green services for shipping orders.
<b>WASTE</b>	Reduction of collections / items produced by collection as per demand. Produce smaller items from textile not used for bigger ones. Produce gifts for customers from waste textile.	Collaboration with recycling companies. Creation of inhouse recycling department. Repair Services. Resell / Second hand clothes. Take – back clothes program.

*Table 7 Actions that are or need to be implemented in the supply chain*

We also conclude that data from the questionnaire 's answers are matching with the data that the companies shared during the interviews. Following up the table 4 – included in chapter 2.4 – where main questions of the research were presented , below answers from the majority of the firms to these questions are summed up.

The first two points that we would like to investigate were the awareness of sustainability and circularity in the supply chain and whether the industries consider their supply chains sustainable. It's noticed that there is high awareness of the concept of the sustainability and circularity in fashion industry , however the Greek firms tend to “translate” these models into a different way . The research reveals that for the biggest part of the companies that participated in the research – 7

out of 9 companies – sustainability and circularity in supply chain are synonymous with the fact that they are not supporting the trend of fast fashion. 6 out of the 9 companies that were interviewed are considering their supply chains “sustainable” and the most frequent answers on the question “how do you support this” were the fact that they don’t produce huge amount of clothes, they pay attention while buying the raw materials and also produce products that last and can be used more than once. In terms of the supply chain management these strategies are included in the of the stage of procurement and production and could characterize a supply chain sustainable. The triple bottom suggested by (Carter & Rogers, 2008) includes intersection of social, environmental and economic performance. It was a common point of interviewees that the way in which all involved parties are treated is in accordance with the principles of social sustainability and this is another criteria that brings the supply chain closer to the sustainability.

The question of which of the sustainable/ circular actions have been already adopted is answered by the data presented in table 7 where also future actions that should be implemented are presented.

Based on the answers received via the questionnaire and during the interviews as well regarding the actions that have been implemented, we can conclude which are the stages of the supply chain where the companies are more focused on in order to make their supply chain more sustainable. They tend to be more focused on the supply planning and production planning rather than the distribution planning as throughout the interviews (and the questionnaire as well) it was noticed that most of them (7 out of 9 companies) were not even aware about green logistics practices. So, summing up results from both parts of the research, companies are focusing more their attention in the take and waste stage with most of the companies mentioning they have adopted green practices mostly in regard to the raw materials used and the waste management. Furthermore, responses of the questionnaire are also in accordance with the interviews regarding the stage of “waste” where the majority of Greek industries seem to approach by reducing the produced quantity / collections according to the demand.

This research also aimed to highlight the stages of the supply chains of Greek companies in fashion industries where more green actions and practices could be implemented. There is a common point in the waste management field there are many more strategies that could be followed. As mentioned, industries invest on the production planning and put all their effort regarding reducing waste at this stage without taking into consideration options that could be take advantage of after producing the end product and also the waste. Recycling, second hand markets/ reselling and repairing are areas for which industries are not investing and neither express a big interest to get more involved with.

In general, we see that even circularity is an interesting project that the companies think that they could take advantage from, they still have their doubts whether such a change would have a positive or neutral impact to the end customer. As it comes up, this fact affects a lot their point of view regarding the integrations from a linear to the circular supply chain. Responses at the questionnaire were not 100% positive and also statements during the interviews prove that companies are not sure if circularity would be a reason for a customer to buy a product. However

taking into consideration the environmental affects as well ,all of the 9 companies that participated in the interview and 91.1 % of the companies that answered the questionnaire are interested in an integration to a circular supply chain.

There is a big difference between expressing an interest and taking the decision of such a change . The doubts regarding the customer's perception of preferring a product made under a circular supply chain is an important inhibiting factor. Before changing the design and production of their products, firms should assure that this will positively affect the customer's behavior. In addition , the lack of technology – especially regarding processing reused materials – combined with the lack of information and lack of support ( economical support, people specialized in the field, marketing campaigns) are reasons that prevent this integration from a linear to a circular supply chain as mentioned by the participants.

Fashion industry largely lacks the technology needed to produce new garments from old materials (Paras, Gurteza, & Varshneya, 2019) and for sure this is also coming out from the current research. Taking into consideration that even for Europe the project of integration circularity into the supply chain is a new one we should recognize the importance of the actions that have been taken in Greece. Of course, it is far from perfect however it is really optimistic the fact that companies have expressed their interest. It's important for everyone to change the perception regarding consumption of clothes. For instance, it doesn't make much difference whether customers are using sustainable products (that follow all circularity requirements) in the way they use clothes from fast fashion. In addition, support from government Is needed both in terms of foundation and also in terms of awareness. Greek government needs to take advantage of European programs for industries and give them the opportunity to walk towards circularity. All interviewees were optimistic about the circularity and its potential of creating a more sustainable fashion industry. They can see the correlation and the positive impact not only regarding the environment but for the business its self that will manage to satisfy more the end customers, increase demand and profitability by closing the loop of make – take – waste and integrating to a circular supply chain.

### **Suggestions for further research**

The major limitation of the existing study is that circularity in Greece and especially when it comes to fashion is on a primary level so data on the network was really limited. However, this fact should motivate more researches in this field in order for more details to be offered.

My proposal for future research would be a paper embracing the need and the challenges of developing an ISO regarding the circularity – that currently doesn't exist.

In addition, chemical recycling is still under process for many materials as mentioned before and for sure there Is enough space for investigating the potential of this kind of recycling. Further existing methods of processing textile could be analyzed or even the need of developing a new process so we could recycle materials for which recycling is not an option at the moment.

One of the main outcomes for several researches that this study comes to reconfirm is the lack of technologies regarding the process and production of new clothes by using old materials. These technologies needed for sure should be investigated and the possibility of sharing this expertise



among other industries in the world as well. This could be done in global, European or even national level. As mentioned in Greece there is no industry that works on recycling of textile. All organizations that recycle clothes – like Recycom – work with companies abroad.

I also highly recommend a research on customer's perception regarding buying goods that have been produced through a circular supply chain. There are many aspects referring to quality, pricing and environmental points that should be checked. The current recent proves that industries doubt about the willingness of the customer to replace the quality or pay an extra amount in order to use a “circular product”. Before they proceed with this implementation, a research regarding the customer's behavior will be necessary.

As circularity in supply chain is no longer a trend but a necessity, the possibility of such an integration in other industries ( i.e. constructive ) could be investigated.

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