

# Effect of Applying Circular Economy Concept on The Printed Apparel Industry

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## KEYWORDS:

Circular Economy - Printed Apparel - Products.

## ABSTRACT:

We are now living in a culture of consumerism, which has resulted in increasing waste of raw materials and waste in all aspects of life in general and in printed apparel in particular so this research aims to increase quality products and reduce waste in addition to encouraging sustainable consumer behavior. In addition to developing the competitive advantage by improving creative solutions to face the obstacles in printed apparel of Egyptian industry and requiring an insight into new economic trends, in addition to investing in human resources and contributing to capital formation, so the research aims to study the impact of applying the concept of the circular economy on the printed apparel industry in Egypt. Research problem The factories in Egypt depends on linear economy, so how to applicate the circular economy within the Egyptian printing textile factories? And How to preserve the environment and spread the culture of the circular economy in Egypt? This Study Aims To Spread the circular economy culture in Egyptian factories of printed apparel instead of the linear economy and Reduce impact on natural ecosystems by determining a scientific methodology through circular economy strategies that can be applied in Egyptian factories of printed apparel. The research follows the analytical descriptive and statistical study.

## □ Introduction

Textile printing and Apparel industry (T&A industry) has the second biggest water consumption compared to other industries (<https://textilefocus.com/reuse-of-wastewater-in-the-textile-industry/24/3/2023>); there are also environmental challenges associated with the biggest energy consumption and toxic chemicals used in producing printed apparel. For instance, the chemicals used in textile production cause damage to the local communities and environment as a whole. In addition, textile waste from production separate into 2 main categories: reusable waste and recyclable waste which dumped in landfills annually (Textile waste mapping in Egypt, 2022). So the companies of textile printing and apparel should try to create solutions to overcome these problems.

Circular economy is one of these solutions. It is an industrial system that restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems, and business models (the world economic forum 2020).

Circular printed apparel defined as clothes, shoes or accessories that are designed, sourced, produced and provided with the intention to be used and circulate responsibly and effectively in society for as long as possible in their most valuable form, and return safely to the biosphere when no longer of human use (iida loiske 2022). H&M group is one of printed apparel companies which depended on circular economy and sustainable fashion that available to everyone today, tomorrow and for all generations. Its vision is to leading the change, Scale innovation, Promote transparency. So the aim of this research is to study the effect of applying circular economy concept on the printed apparel industry.

- circular economy strategies that can be applied in printed apparel for Egyptian factories.

## □ Theoretical Study

### • Fast-fashion of printed apparel products

Throughout the history of the printed apparel industry, some retailers began to increase their demands on their manufacturers, wanting more variety and more fashionable printed clothes. As a result, the previous two-season calendar was changed to mid-season purchasing and then to year-round purchasing.

The primary idea behind fast-fashion printed apparel products is that designers draw inspiration from nature or any other source and translate it into printed apparel products that can be put on the market.

Fast-fashion printed apparel has particular qualities such as busy schedules, small quantities, and quicker development cycles. Nowadays fast fashion has created a requirement for 80 million new items every year. (reinach 2005.)

The first crucial component of printed apparel fast fashion is termed rapid reaction approach. This method entails reacting quickly to print apparel trends and applying them to mainstream items to do this in a timely manner, design times are decreased. Some printed apparel companies, ask specialists to study seasonal patterns in printed apparel and to recognize trends in order to stay current on consumer preferences.

Short lead periods in manufacturing and delivery are another important aspect of fast fashion. This allows for an effective match between supply and demand. Companies like zara, for example, continually monitor their inventory levels in order to adapt to consumer demand. There are two sorts of fast-fashion companies, some businesses are opposed to sustainability and just want to adapt to the increasingly demanding environment. The second type of business attempts to engage and improve sustainable practices in their supply chain to some level. (meichtry 2007.)

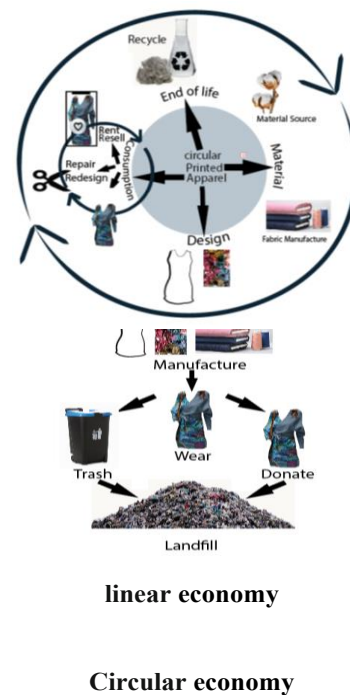
Fabric manufacturing is one of the textile industry's processes. It involves processes such as weaving, bleaching, dyeing, and printing textiles (madhav et al 2018). These phases include a large number of chemicals that are detrimental to the environment and are frequently discharged into the environment. There are solutions to the problems in these

steps, such as using natural dye in cotton dyeing or ways that require less water (payne 2015). Printed apparel manufacturing encompasses all of the procedures required to create an actual printed apparel, including design, production operations such as cutting, sorting, sewing, and post-production processes such as inspection and finishing (apparel network 2015). After the apparel is ready, it is sent to a designer, who then sells it to the final consumer. After being used, the apparel is frequently discarded in a landfill, thereby ending its lifecycle.(dory 2018). Circular Printed Fashion is based on the circular economy idea and is related to the apparel business. It is meant to last longer, to pollute less, to be biodegradable, and to be reused or utilized in the creation of a new product. It is based on the premise that a product's lifetime should be as long as possible, which can be accomplished by properly caring for the product as well as fixing and maintaining it. Furthermore, sharing the products with others so that they are utilized by several individuals during their lives is encouraged. The resource can be reused or recycled.

By redesigning the product or altering it to a totally different product, the resource might be given new life or purpose. Finally, the material was recycled and repurposed in the manufacturing of a new product. If the material cannot be recycled, it should be designed in such a way that it returns to the biosphere by changing into nutrients. As a result, the lifecycle should be ecologically sustainable and contribute to the well-being of humans, the environment, and society as a whole.(muthu 2018).

**• Circular Economy Strategies For Printed Apparel**

Printed Apparel has generally followed a linear business model - take, manufacture, waste. Circular business concepts break this cycle as shown in figure No. (1) to keep clothing in use for extended periods of time and to ensure that they are not discarded once they have served their purpose. Repair, resale, remake, and recycling are all methods for keeping products in circulation for longer while maximizing the value of the resources used to manufacture them.



**Figure No. (1) Linear And Circular Economy Strategies For Printed Apparel**

New technologies are constantly emerging that enable us to rethink our typical manufacturing processes, so helping to decrease the environmental impact associated with production. The objective of this strategy is to replace manufacturing systems with less energy-consuming and smarter technology in order to decrease environmental consequences. Circular printed apparel products can incorporate a variety of circular economy principles throughout the product life cycle, from raw material selection through reuse or recycling. Claxton s, Kent a (2020).

The following subsections identify and discuss four key strategies as shown in figure No. (2) that can aid to make printed apparel products circular.

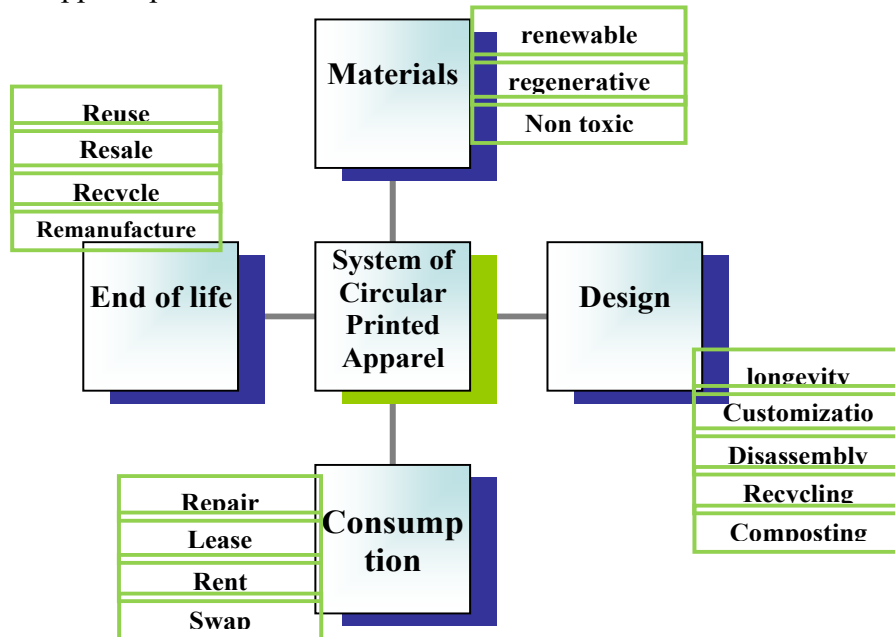


Figure No. (2) System Of Circular Printed Apparel

#### ○ Circular Materials

Resource efficiency focuses on structure resource loops by utilizing fewer resources in product manufacturing. It also aims to make better use of resources and reduce pollution. Material recirculation can result in significant material savings during the manufacturing process to support circularity, raw material intake must be safe and healthy in order to allow for circular processes and avoid negative consequences throughout the product life cycle (2017 Ellen MacArthur foundation). Printed apparel product's resource efficiency may be achieved in three ways: the use of renewable and sustainable raw materials, reduced resource use, and waste minimization.

#### ○ Circular Design

The design step is critical to attaining printed apparel circularity. Designers have the opportunity to choose materials, trimmings, silhouette, colors, quality, design in the traditional design process, and their decisions have a considerable influence on the environmental impact of the product. (Manshoven s 2019) traditional design teams are pushed for fast fashion cycles and revenues, with few opportunities to analysis the environmental consequences of their creations. Better design and reuse may save raw material costs and trash

costs while also establishing new business models and valuable goods. Design for circularity is concerned with making a product appropriate for several life cycles, which is made possible by the original design the purpose of circular design is for products and materials to be replicated in closed loops. Products developed for reusing chosen to be more adaptable when it comes to prolonging garment life. (Niinimäki k, (2018).

#### ○ Circular Consumption

In a linear system, no residual energy is recovered, whereas incineration or recycling recover a little amount of residual energy. Product life extension strives to keep the product in use for as long as feasible through design and operational methods. (Geissdoerfer m, pieroni mpp , pigosso dca, soufani k (2020)

Circular consumption is the most efficient method for reducing the need for fresh materials as well as the energy used in raw material extraction and processing.

Increasing the number of times clothing is worn results in material value capture, waste reduction, pollution reduction, and a reduction in the number of things purchased.. ( Ellen MacArthur foundation (2017).

#### ○ End-Of-Life Circularity

The total fiber input used for printed apparel production, a lot of them landfilled or burnt after usage, and it is anticipated that more than 150 million tons of apparel will be landfilled or cremated by 2050. end-of-life circularity allows More manufacturers are discussing the circular economy, in which enterprises as shown in table No(1) may develop supply chains that recover or recycle the materials needed to generate their products.

companies of printed apparel to divert garments from landfills and capture the value of materials in various forms at different stages by completing resource loops. (bocken nmp, van der grinten b 2016).

More manufacturers are discussing the circular economy, in which enterprises as shown in table No(1) may develop supply chains that recover or recycle the materials needed to generate their products.

**Table No. (1) Examples Of Some Companies Which Use Circular Economy (Company / Aims / Result)**

Company/ area	Aims	Results
<b>Ecoalf / Spanish company</b> ( <a href="http://www.kikilab.it/eng/ecoalf-spain/2/1/2023">http://www.kikilab.it/eng/ecoalf-spain/2/1/2023</a> )	Focused on recycling (mainly Plastic bottles, coffee grounds, used tires, fishing nets and recycled wool and cotton)	Creating high quality Apparel without the need to extract new resources from the environment.
<b>Resetpriority/italiancompany</b> ( <a href="https://www.enicbmed.eu/projects/reset/23/12/2022">https://www.enicbmed.eu/projects/reset/23/12/2022</a> )	Using recycled nylon	Garments made with econyl,100% recycled nylon.
<b>Tonlé / western u.s. State company</b> ( <a href="http://www.globaloppportunityexplorer.org/solutions/fashionfrom-pre-consumer-waste/24/11/2022">http://www.globaloppportunityexplorer.org/solutions/fashionfrom-pre-consumer-waste/24/11/2022</a> )	Use all pre-consumer textile waste, creation of zero-waste fashion collections out of surplus fabric from larger manufacturers, which usually scrap about 11% of the fabric through inefficient cutting patterns	Using recycled raw materials rather than virgin Materials. Make fashionable apparel , achieves zero-waste by combining recycled raw materials.
<b>G-star / netherlands' company</b> ( <a href="http://www.circle-economy.com/wpcontent/uploads/2017/01/v3-publishable-g-star-casestudy-1.pdf /23/11/2022">http://www.circle-economy.com/wpcontent/uploads/2017/01/v3-publishable-g-star-casestudy-1.pdf /23/11/2022</a> )	Create new denim fabrics that can compete with virgin cotton denim on price, quality and aesthetics. A recycled denim fabric with as little as 12% of recycled content has a much lower environmental impact than its virgin equivalent: water consumption can be reduced by 9.8%, energy consumption by 4.2% and co2 emissions by 3.8%.	Try and prove the apparel business and environmental case for high value (textile-to-textile) recycling of denim.
<b>Reshare –</b> ( <a href="http://www.circleeconomy.com/wp-content/uploads/2017/01/reshare-life-cycle-assessmentresults.pdf/2/1/2023">http://www.circleeconomy.com/wp-content/uploads/2017/01/reshare-life-cycle-assessmentresults.pdf/2/1/2023</a> )	Development of a sustainable and safe solution for approximately 600 tons of old military work wears. used work wear of 50:50 cotton/ polyester average composition was mixed with virgin polyester fiber and mechanically	Several tons of old Dutch navy and army uniforms were transformed into new yarns that were used to produce humanitarian aid blankets.
<b>Reblend, A dutch circular Fashion &amp; textiles Agency</b> ( <a href="https://www.circleeconomy.com /23/12/2022">https://www.circleeconomy.com /23/12/2022</a> )	No longer wearable, postconsumer textile waste (>70%) were used in an ecologically friendly process (no water, no additional chemicals, no dyeing) to make yarn and textiles with a minimal negative ecological impact in the project 100% recycled yarns for a new collection of knitted and woven fashion and upholstery products were produced	Show that mixed postconsumer textiles can be recycled into new high-quality products transforming post-consumer textile waste into High quality



H&m collection/ spanish company(Eder-Hansen, j,chalmer,c,tärneberg,s,tochtermann,t, seara,j.,bogert, s, theelen, g., schwarz, s,kristensen, l, jäger, k. (2017). Pulse the fashion industry; global fashion agenda & the Boston consulting group.

The brand has partnered with i:co, a solutions provider for clothing and footwear reuse and recycling. Its facility in Germany receives 25 to 30 truckloads a day from collection bins at H&M stores. The brand has similar facilities in the US and India. In 2016, H&M collected nearly 16,000 tons of garments, a 29% increase from the previous year.

Sustainability initiative With the highest awareness amongst customers. Many stores reported positive feedback, both in terms of handling processes and customer reactions

### • Reverse Supply Chain Intelligence For Printing Apparel Consumer

Another component of the service that focuses on the post-consumer phase of apparel printing product is reverse supply chain intelligence. Every material in circular of printed apparel product's database has a closed-loop recycler. It is assigned to each outfit that passes the circularity test.ID - a code indicating that the product is acceptable for chemical fiber-to-fiber recycling. The ID is affixed to clothes as a woven label and enables for item monitoring. The labels can be ordered separately or from a recognized source. End users, as well as sorting and recycling organizations, may scan the ID, which takes them to the consumer interface. The interface allows consumer to view printing apparel whole history (product content, material composition, care instructions and production network). There are many possibilities for upgrading, reusing, or recycling printing clothing. Consumers are told how and where to return items at the moment of disposal via a sorting guide that is part of the circular textile printing product's ID. It also helps sorting firms locate the appropriate textile recycler from the circular Textile printing product's network as shown in figure No(3). (kirsi niimaki 2018).



Figure No.(3)circularity test.ID

<https://poshmark.com/listing/hm-a-circular-design-story>

### • Circular Design Software For Printed apparel Designer

Circular design software is a digital solution aimed at the pre-consumer stage of the textile printing apparel value chain. It enables textile printing enterprises to create circular and sustainable textiles in an efficient manner. The program includes three supportive resources, beginning with circular design guidelines, which give textile printing designers with hands-on instructions of how to apply various circular design techniques to their products. Designers may search the circular material database for materials that have been authorized by the circular partner network. Textile printing apparel designers can contact material suppliers through the software, request for sample swatches and place their orders directly to suppliers. Through the platform, it is also possible to create the final production documents. In the end, circularity check shows if the designed product is recyclable with the chosen materials as shown in figure No. (4) Sometimes , however, it occurs

that products such as functional clothing do not fulfill the requirements of any closed-loop recycler. In such cases circular Textile printing apparel can link the customer brand with mechanical recycler. (kirsi niimaki 2018).



Figure No.(4)Circularity Test.ID

**An analytical study:**

**H&M Group Progressing Towards A Circular Economy In Printing Apparel Manufacturing.**

H&M Group, which was founded in 1947 in Sweden, is today the world's second biggest fashion corporation. COS, MONKI, WEEKDAY, & other stories, H&M have over 4,800 physical shops in 75 markets by 2020, with online shopping available in 54 countries. The company employs about 153,000 people directly, with over 1.6 million individuals working in the whole value chain. In 2016, H&M group officially stated its intention to create a circular corporation and achieve carbon neutrality by 2040. It has previously launched apparel and textile collection service in several of its locations at the time. (<https://ellenmacarthurfoundation.org/circular-examples/hm-group/28/11/2020>)

H&M group's strategy to develop a 'circular ecosystem' rests on the following three pillars as shown in figure No. (5) especially in Netherlands, France, and Italy (<https://sustainabilitymag.com/sustainability/how-countries-are-leading-build-a-circular-economy-eu-sustainability-regenerative/1/1/2023>) :

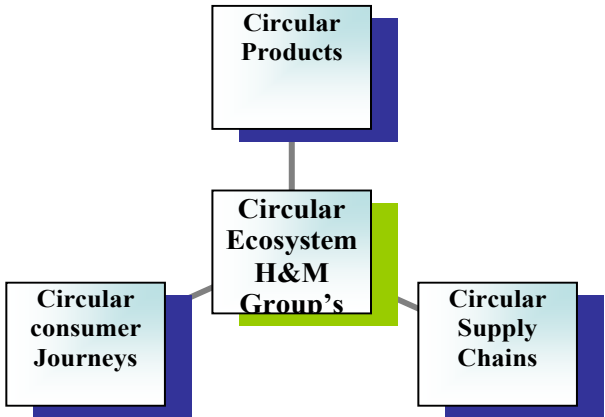


Figure No. (5) System Of Circular Ecosystem H&M Group

- Circular products: creating products that are made to last, from safe, recycled and more sustainably sourced materials (i.e. Either naturally grown, cultivated or created using renewable processes) that can recirculate multiple times.
  - Circular supply chains: fuelling systems that recirculate products and support circular production processes and material flows.
  - Circular consumer journeys: providing accessible ways to experience and engage in circular fashion where products are used more, repaired, reused, and recycled.
- <https://ellenmacarthurfoundation.org/circular-examples/hm-group/12/12/2022>



since H&M group started garment collecting programme, they have received over 140,000 tonnes of textiles. Here are some examples of how they repurpose textiles collected in their stores and collections, such as arket used post-then used instead of fabric rolls.

consumer denim to create unique pieces as shown in figure No. (6). Reclaimed garments were cut into patches and sewn together to form large sheets of irregular fabric shapes, which were

Figure No. (6) arket circular printing garment  
(<https://www.ebay.com/itm/385003351285>)

H&M group is dedicated to procuring raw materials in a sustainable manner that considers both social and environmental implications. All materials have an influence on the environment, beginning with their manufacture and ending with their disposal. To lessen our environmental effect, they aim to have 100% of their materials recycled or supplied in a more sustainable manner by 2030, and 30% recycled by 2025 as shown in figure No.(7)

(<https://hmgroupp.com/sustainability/circularity-and-climate/materials/>)

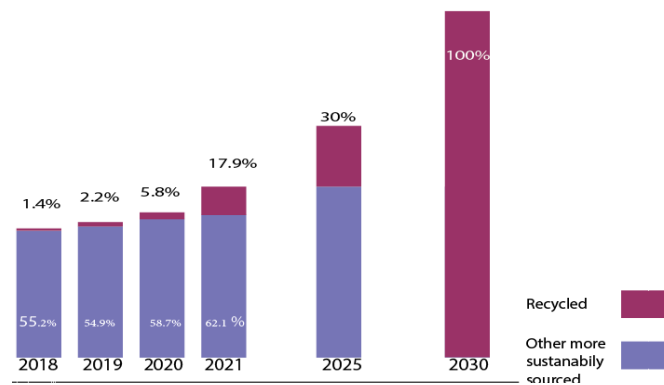


figure No. (7) Recycled Or Other More Sustainably Sourced Materials Of H&M Group

Textile printing apparel are made today from a wide range of different circular materials. Traditional materials such as cotton, linen and leather are still sourced from plants and animals. But most clothes are more likely to be made of recycling materials as shown in table No.(2).

Table No. (2) Sources Of Circular Materials Of H&M Group

Material	Recycling of	Result
Lyocell	Natural resources requiring little	More sustainable option than cotton.
Fsc natural rubber	Well-managed rubber trees.	Renewable and recyclable material that requires little energy and few chemicals to produce.
Organic jute	Bark of the white jute plant	It requires little water, no chemical pesticides or fertilizers
Organic linen	Flax plants	A beautiful and durable material better health and high quality, linen without any genetically modified fibres.
Recycled cashmere	Post-consumer and post-industrial waste	Save raw materials, use fewer chemicals, water and land
Recycled down and feathers	Old blankets, pillows or cushions.	Use fewer chemicals, water and can be used in the same applications as virgin down.
Recycled plastic	Pet plastic drinks bottles, plastic bags and other plastic containers	Repurpose plastic waste and incorporate it into new fashion pieces is a great way of avoiding harm to our planet.
Recycled polyamide	Old fishing nets and carpets	Saving natural resources and reducing what ends up in landfills
Recycled silver	All above-ground sources which could be industrial scrap	All the negative impacts of mining are avoided and a lot of energy is saved.



• **Post-Consumer Textile Printing Circular Apparel Collecting**

H&M group offer customers printing apparel collecting points in almost all stores. After receiving the prelove items, they hand them over to one of their partners. Then sort and recirculate the printed apparel according to their condition, such as rewear – apparel that can be worn again will be sold as second-hand clothes, repurposed – old clothes and textiles will be turned into other products, such as cleaning cloths , recycle – everything that can't be resold or reused will be turned into textile fibers for use in new textile products.

• **Circular Economy Of Printed apparel In Egypt**

The successive transformations in the conditions of societies imposed a new challenge, and among these challenges is the rapid change in consumption habits and culture in Egyptian society in light of the flood of printed apparel products as a result of the processes of progress

and technology. The Egyptian people's passion of consuming has grown enormously. Consumption has become a daily culture and a social tradition. As a result, the environment was subjected to fierce attacks by human, which led to its destruction and a major imbalance in the ecological balance, which threatens wild and marine life, as well as air, soil and some creatures to annihilation. Environmental problems have been studied from many sides, including various international bodies to protect the environment, including what is called the protection of wildlife. The presence of human in that system has needs and requirements that must be adapted to serve the environment without pollutants or without harm or improvement to that environment. And this will come by confirming the role of different ways as shown in table No. (3) in that episode to be directed in it and play a role in this ecological through control its various elements.

**Table No. (3) Challenges And Solutions Identified Through The Practices Of Circular Printed Apparel In Egypt**

Design for circularity	Challenges	Solutions
Consumer	Lacking knowledge of best disposal practices of printed apparel. - unpredictable of the final look of the printed product - user behavior of using circular products.	Educating consumers about advantages of circular economy of printed apparel By different ways of advertising. Reverse supply chain intelligence (customer interface, circular fashion.ID,sorting guide).
Factory owners	Factory owners are not aware of the nature and characteristics of the circular economy market. Missing take-back systems	Establishing departments by the specialized authorities to educate factory owners and provide all necessary information. Reverse supply chain intelligence (customer interface, circular fashion. ID,sorting guide)
Materials	Demands for printed apparel sustainability under time and price pressure Lacking recyclable materials	Circular design software (guidelines, material database, circularity check) Changing mindset in design and using scientific research to develop material
Policy	Lacking knowledge of sustainable /circular printed apparel design strategies Management & reprocessing of textiles Patenting	Educating designers with the latest circular economy methods Open source ideology

according to the european organization for the circular economy, it functions as an economic development engine for textile printing circular apparel in Egypt as shown in figure No.(8).

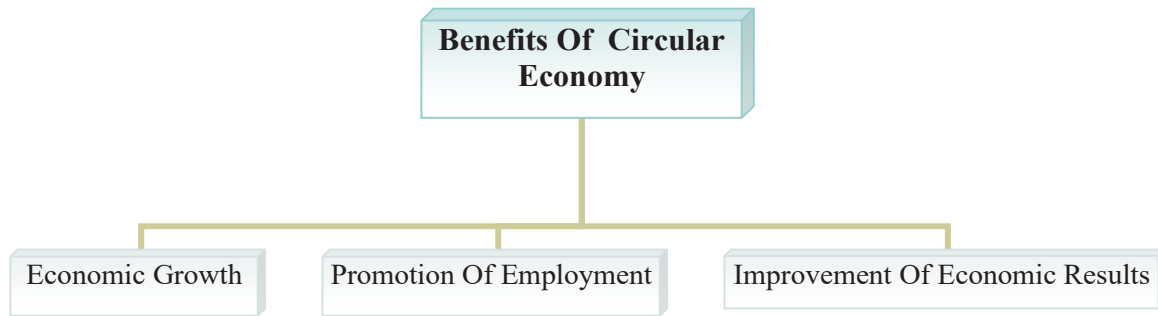


Figure No . (8) Benefit Of Application Circular Economy In Egypt

#### ○ **First Benefit**

Economic growth is produced from lower manufacturing costs, more usage of input goods, and higher income from circular productive activities. Everything that has a direct impact on the global economy's demand, supply, and pricing has a positive impact on economic growth.

Ellen Macarthur foundation defines these effects as an increase in spending and savings that would increase families' income and purchasing power due to the long lifespan of products and the reduction of material costs, which would no longer require all of them to be extracted, but modified, repaired, or transformed.

#### ○ **Second Benefit**

As spending increased owing to reduced prices in all sectors due to decreased production costs, this would imply an intense labour force in terms of high-quality recycling activities and better-qualified positions in terms of product retransformation or remanufacturing.

This leads to increased work possibilities, which are not restricted to the aforementioned product remanufacturing and company expansion, because the job prospects offered by a circular economic model are very broad and diversified.

These new employment would be created as a result of new logistical advances, increased creativity in research and development, entrepreneurial activities, the formation of new medium and small businesses prepared to embrace this circular business model, or as a result of a new economy centered on services.

#### ○ **Third Benefit**

This leads to increased work possibilities, which are not restricted to the aforementioned product remanufacturing and company expansion, because the job prospects offered by a circular economic model are very broad and diversified.

These new employment would be created as a result of new logistical advances, increased creativity in research and development, entrepreneurial activities, the formation of new medium and small businesses prepared to embrace this circular business model, or as a result of a new economy centred on services. (elandar et al., 2017; palm et al., 2014).

As a result, recycled fibers need to be mixed with virgin fiber when producing new textiles. The maximum share of recycled cotton fibers in new cotton clothing is currently about 30 per cent, while recycled denim in jeans products amounts to 50 per cent (hnst, 2019).

Up to 50 per cent recycled cotton is also used in some blended yarns, in which cotton is mixed with synthetic fibres such as recycled pet or nylon. Some applications of recycled polyester fibers, such as duvet filling, contain about 50 per cent recycled content (watson et al., 2017). Other recycled fibers are widely used in insulation materials for automotive upholstery etc. (pitkänen, 2019). Overall, at present options for recycling end-of life technical textiles are quite limited, and significant volumes of them are directed to energy recovery.

The major barrier to high-quality textile recycling is their diverse mix of materials, coatings, dyes and nonwoven. Mechanical recycling of mixed fibers does not return a product of the same quality as the original. When recycling polycotton for example, a separate fractionation step is required to separate the cotton from the pet. This can be done chemically by depolymerizing or dissolving one of the components while maintaining the other. Such chemical recycling, however, needs more development and its environmental impacts further investigated (sandin and peters, 2018)

#### □ **Applied study**

**A- For H&M Printed Apparel Consumers**

After complete analytical study of H&M products to determine the most important strategies of the circular economy applied by it, a set of questionnaires were designed and distributed to a sample of consumers especially in Netherlands, France, and Italy to verify the extent of the application of these strategies and their impact on the development of the printed apparel industry.

○ **Study Methodology**

The study used the descriptive analytical approach, as the descriptive approach was used for assessing the impact of the environmental dimensions of the circular economy represented in reshaping the concept of the product - making the environmental orientation profitable - the clarity of the relationship between price and cost - eliminating or reducing the concept of waste - according to their personal characteristics as follows:

○ **Demographic Distribution Of Consumers:**

Most of the consumers are holders of a bachelor's degree, as their number reached (23 consumer, with a percentage of 76%. This indicates that the study population of circular printed apparel products consumers, the majority of whom hold a first university degree it was also found that most of the consumers are high-income

raising the concept of production efficiency as well as the analytical approach for the purpose of measuring the impact of using the circular economy on the printed apparel industry.

○ **Study Sample**

The study consists of printed apparel H&M consumers in Netherlands, France, and Italy as an example of a company applying circular economy strategies., a representative random sample was taken, and the researcher distributed (38) electronic questionnaires to those included in the study. (35) questionnaires were retrieved from them, and after checking the retrieved questionnaires five questionnaires were excluded because they were not valid for statistical analysis due to not answering some of the questions contained in them, and then the number of questionnaires valid for statistical analysis became thirty. They were distributed

(20) consumer, with a percentage of (68%), and that most of the consumers spend more than four hours in shopping, as their number reached (18) consumer, with a percentage of (60%), and all these percentages are higher than other percentages of the consumers study sample, as shown in table no (4) and chart No.(1).

**Table No. (4) Demographic Distribution Of H&M Consumers**

Personal characteristic	Categories	Number	Percentage
Degree	BA	23	76%
	Msc/phd	3	10%
	Pre-university	4	14%
	Total	30	100%
Income level	Low	5	16%
	Medium	5	16%
	High	20	68%
	Total	30	100%
Shopping time	Less than two hours	2	%6
	From 2-4 hours	10	%34
	More than 4 hours	18	%60
	Total	30	%100

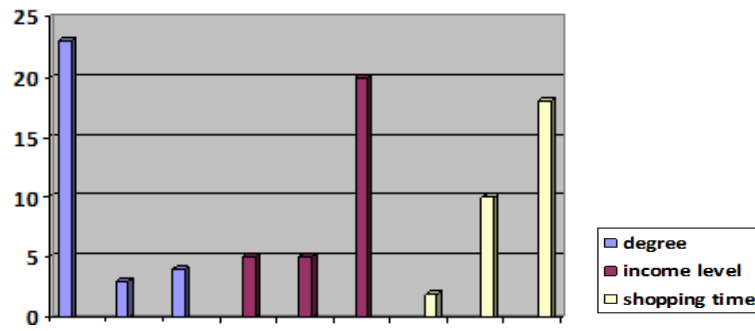


Chart No. (1) Demographic Distribution Of H&M Consumers

#### ○ Data Collection Sources

- To achieve the purposes of the research, which aims to reduce impact on natural ecosystems by determining a scientific methodology through circular economy strategies that can be applied in printed apparel factories, the study relied on the following sources for the purpose of data collection, which are as follows:

#### ○ The Theoretical Framework Of The Research:

Identified circular economy strategies for printed apparel an analytical study then the h&m group Represented in degree, income level, and the shopping time they spend on purchasing these products.

**Secondly** the dependent variable is the possibility of overcoming the obstacles of the Choosing the questionnaire scale: a five-point likert scale was adopted for the purpose of conducting the study, as it is one of the most used scales for describing and analyzing the responses of the study sample, for its ease of

Poor agreement level	Medium agreement level	High agreement level
1-2.33	3.66- 2.34	5- 3.68

Table No. (5) Agreement Level

#### ○ Validity Of The Questionnaire

For the purpose of checking the face validity of the questionnaires, it was presented to a group of experts and arbitrators with experience and knowledge in the field of textiles, scientific research methodology and applied statistics in

#### ○ Stability Of The Questionnaires:

To verify the stability of the study tool, cronbach's alpha reliability coefficient was used, in order to calculate the stability coefficients for the study variables to measure the internal consistency of the questionnaire items, as the reliability percentage for the total tool was 91.8%, and the following table No.(6) shows that:

Main and sub-variables	The number of paragraphs	Cronbach alpha
Dimensions of circular economy	20	91.8%

progressing towards a circular economy in textile printing and apparel manufacturing.

#### ○ Questionnaires:

The questionnaire was designed for the purpose of measuring the impact of using circular economy on printed apparel industry so that it covers all the axes dealt with the theoretical framework of the research. The stages of designing the study tool were clarified, and the questionnaire in its final form included the following parts:

**First**, the personal and functional characteristics of circular economy products consumers for printed textiles, which are printed apparel industry. The study tool in its final form consisted of 20 items, which is directed to consumers of printed apparel. The researcher did the following

understanding and the balance of its scores. The study is according to the likert scale, where the three levels of the degree of agreement are as shown in table No.(5).

order to benefit from their experiences, which makes the questionnaire more accurate and objective in measurement, and the number of arbitrators reached seven arbitrators as it is shown in appendix No. (1).

Table No. (6) Stability Of The Questionnaires

o Executed Actions:

After completing the formulation of the study tool (questionnaire) and verifying its validity and stability, it was distributed to the selected samples, and the valid data for statistical analysis were entered into the spss program for the purpose of processing it statistically and obtaining results related to answering the study questions and testing its hypotheses.

o Statistical Methods Used For Data Analysis Purposes:

After completing the process of collecting data of the variables required for the study, it was

o The Results Of The Statistical Analysis And Testing The Hypotheses Of The Study

Is there an effect of applying environmental strategies associated with circular economy on

entered into the excel program to obtain the results related to answering the study questions and testing its hypotheses. Some statistical methods available in the statistical packages for social sciences were also applied spss in order to process the data statistically, some descriptive statistical methods were used as follows:

- Replication tables
- percentages
- arithmetic mean
- standard deviation
- Cronbach's alpha coefficient

the development of the printed apparel industry? The arithmetic mean, standard deviation, and evaluation level were calculated on the likert scale to provide consumers with the study variables as follows :

Table No. (7) Arithmetic Means And Standard Deviations Of Circular Economy Strategies Associated With Printed Textile Products For H&M Consumers

Measurement phrases	Arithmetic mean	Standard deviation	Relative importance	Evaluation level
Reshaping the concept of the product	3.95	0.99	2	High
Making environmental orientation profitable	3.76	0.71	3	High
Clarity of the relationship between price and cost	3.98	0.708	1	High
Eliminate or reduce the concept of waste	3.75	0.705	4	High
Raise the concept of production efficiency	3.70	0.92	5	High

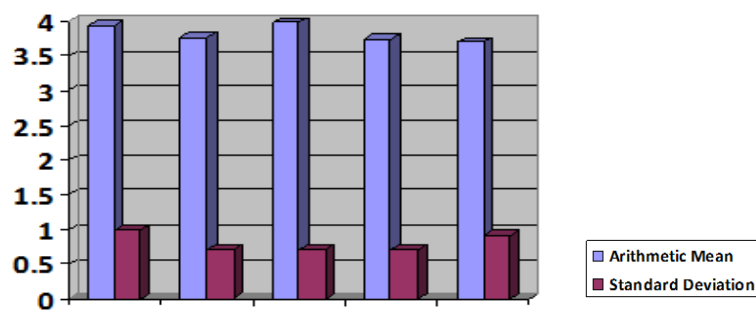


Chart No. (2) Arithmetic Means And Standard Deviations Of Circular Economy Strategies Associated With Printed Textile Products For H&M Consumers

The description of arithmetic means and standard deviations of circular economy strategies associated with consumers of circular economy printed apparel products, the results



have been shown in a table No. (7 ) and a chart No.(2) that the third variable related to the clarity of the relationship between price and cost has ranked first in the list of consumers' evaluation priorities with an arithmetic mean of 3.98 and a standard deviation 0.708 while the

fifth variable related to raising the concept of production efficiency came in the fifth and final rank from the point of view of consumers, with an arithmetic mean of 3.70 and a standard deviation of 0.92.

The answers of question was positive, and the following is a detailed table No.(8) for the paragraphs of each of the variables related to the user and general average:

**Table No.(8)Table For The Paragraphs Of Each Of The Variables Related To The User And General Average For H&M Consumers:**

Measurement phrases	Arithmetic mean	Standard deviation	Relative importance	Evaluation level	Overall average	Over all standard deviation
<b>Reshaping the concept of the product</b>						
The raw materials used in the production process within h&m are not harmful to the environment	3.9333	0.69149	4	High	3.95	0.99
H&m works not to waste raw materials used in production	4.1000	0.80301	1	High		
H&m produces environmentally friendly products	3.9667	0.76489	2	High		
H&m preserves and sustains resources by applying the circular economy concept	3.9667	0.76489	3	High		
<b>Making environmental orientation profitable</b>						
H&m develops its products based on the philosophy of not harming the environment	3.8000	0.71438	3	High	3.76	0.71
H&m conducts research and development to improve its products to be less harmful to the environment	3.5333	0.50742	5	High		
H&m achieves a competitive advantage among other factories by using circular economy	3.6000	0.72397	4	High		
H&m increases customer loyalty by adopting the circular economy philosophy	3.8333	1.05318	2	High		
Circular economy strategy works to increase profits h&m company	4.1333	0.62881	1	High		
<b>Clarity of the relationship between price and cost</b>						
H&m sets prices based on the cost of raw materials used with a profit margin	3.9667	0.61495	3	High	3.98	0.708

H&m sets the prices of its products based on the real value of those products	3.8000	0.84690	5	High		
H&m sets the prices of its products, taking into consideration the consumer's income	4.1000	0.88474	2	High		
H&m product prices Is always lower than competitors' prices	4.2000	0.61026	1	High		
H&m bears the costs of protecting the environment, which is reflected in the high prices of its products	3.9000	0.60743	4	High		
<b>Eliminate or reduce the concept of waste</b>						
H&m uses advanced technology to reduce waste	3.5667	1.10433	4	High	3.75	0.705
H&m products are low or no waste	3.6667	0.47946	3	High		
H&m uses clean energy to reduce its waste	4.1000	0.88474	1	High		
H&m works to reduce or eliminate its waste, out of its belief in its social responsibility towards consumers	3.8333	0.37905	2	High		
<b>Raise the concept of production efficiency</b>						
H&m works to raise production efficiency in order to eliminate or reduce waste	3.8333	0.83391	1	High	3.7	0.92
H&m is one of the market leaders in the circular economy	3.5667	1.00630	2	High		

## B- Egyptian Printed Apparel Factories Consumers

After complete analytical study of Egyptian printed apparel factories products to determine the most important strategies of the circular economy applied by it, a set of questionnaires were designed and distributed to a sample of consumers especially in Egypt to verify the extent of the application of these strategies and their impact on the development of the printed apparel industry.

### o Study Methodology

The study used the descriptive analytical approach, as the descriptive approach was used for assessing the impact of the environmental

dimensions of the circular economy represented in reshaping the concept of the product - making the environmental orientation profitable - the clarity of the relationship between price and cost - eliminating or reducing the concept of waste - raising the concept of production efficiency as well as the analytical approach for the purpose of measuring the impact of using the circular economy on the printed apparel industry.

### o Study Sample

The study consists of printed apparel consumers in Egypt as an example of a company applying circular economy strategies, a representative

random sample was taken, and the researcher distributed (30) electronic questionnaires to those included in the study. They were distributed according to their personal characteristics as follows:

○ **Demographic Distribution Of Consumers:**

Most of the consumers are holders of a bachelor's degree, as their number reached (23) consumer , with a percentage of 76%. This indicates that the study population of circular printed apparel products consumers, the majority

of whom hold a first university degree it was also found that most of the consumers are high-income

(20) consumer , with a percentage of (68%), and that most of the consumers spend more than four hours in shopping, as their number reached (18) consumer , with a percentage of (60%), and all these percentages are higher than other percentages of the consumers study sample, as shown in table No. (9) and chart No.(3).

Table No. (9) Demographic Distribution Of Egyptian Printed Apparel Factories Consumers

Personal characteristic	Categories	Number	Percentage
<b>Degree</b>	Ba	4	14%
	Msc/phd	3	10%
	Pre-university	23	76%
	Total	30	100%
<b>Income level</b>	Low	5	16%
	Medium	5	16%
	High	20	68%
	Total	30	100%
<b>Shopping time</b>	Less than two hours	2	%6
	From 2-4 hours	18	%60
	More than 4 hours	10	%34
	Total	30	%100

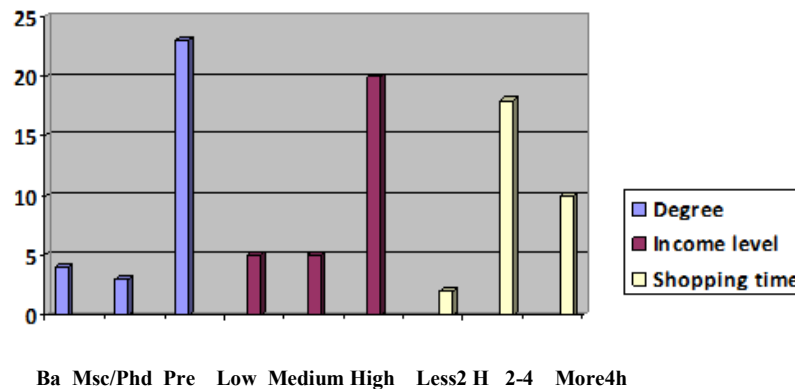


Chart No. (3) Demographic Distribution Of Egyptian Printed Apparel Factories Consumers

○ **Data Collection Sources**

To achieve the purposes of the research, which aims to reduce impact on natural ecosystems by determining a scientific methodology through circular economy strategies that can be applied in printed apparel factories in Egypt , the study relied on the following sources for the purpose of data collection, which are as follows:

○ **The Theoretical Framework Of The Research:**

an analytical study to Identify circular economy strategies of Egyptian printed apparel factories .

○ **Questionnaires:**

The questionnaire was designed for the purpose of measuring the impact of using circular economy on printed apparel industry so that it covers all the axes dealt with the theoretical framework of the research. The stages of designing the study tool were clarified, and the questionnaire in its final form included the following parts:

**First**, the personal and functional characteristics of circular economy products consumers for printed textiles, which are represented in degree, income level, and the shopping time they spend on purchasing these products.

Choosing the questionnaire scale: a five-point likert scale was adopted for the purpose of conducting the study, as it is one of the most study is according to the likert scale, where the three levels of the degree of agreement are as follows in table No.(10)

**Table No. (10) Agreement Level**

Poor agreement level	Medium agreement level	High agreement level
1-2.33	3.66- 2.34	5- 3.68

○ **Validity Of The Questionnaire**

For the purpose of checking the face validity of the questionnaires, it was presented to a group of experts and arbitrators with experience and knowledge in the field of textiles, scientific research methodology and applied statistics in order to benefit from their experiences, which makes the questionnaire more accurate and objective in measurement, and the number of arbitrators reached seven arbitrators as it is shown in appendix No. (2).

**Table No(11) Stability of the Questionnaires**

Main and sub-variables	The number of paragraphs	Cronbach alpha
Dimensions of circular economy	20	91.8%

○ **Executed Actions:**

After completing the formulation of the study tool (questionnaire) and verifying its validity and stability, it was distributed to the selected samples, and the valid data for statistical analysis were entered into the spss program for the purpose of processing it statistically and obtaining results related to answering the study questions and testing its hypotheses.

○ **Statistical Methods Used For Data Analysis Purposes:**

After completing the process of collecting data of the variables required for the study, it was entered into the excel program to obtain the results related to answering the study questions and testing its hypotheses. Some statistical methods available in the statistical packages for social sciences were also applied spss in order to

**Secondly**,The dependent variable is the possibility of overcoming the obstacles of the printed apparel industry. The study tool in its final form consisted of 20 items which is directed to consumers of printed apparel. The researcher did the following used scales for describing and analyzing the responses of the study sample, for its ease of understanding and the balance of its scores. The

○ **Stability Of The Questionnaires:**

To verify the stability of the study tool, cronbach's alpha reliability coefficient was used, in order to calculate the stability coefficients for the study variables to measure the internal consistency of the questionnaire items, as the reliability percentage for the total tool was 91.8%, and the following table shows in table No.(11)

process the data statistically, some descriptive statistical methods were used as follows:

- Replication tables
- percentages
- arithmetic mean
- standard deviation
- Cronbach's alpha coefficient

○ **Second: The Results Of The Statistical Analysis And Testing The Hypotheses Of The Study**

Is there an effect of applying environmental strategies associated with circular economy on the development of the printed apparel industry, the arithmetic mean, standard deviation, and evaluation level were calculated on the likert scale to provide consumers with the study variables as follows in table No.(12) and chart No.(5):

Table No. (12) Arithmetic Means And Standard Deviations Of Circular Economy Strategies Associated With Printed Textile Products For Egyptian Printed Apparel Factories Consumers

Measurement Phrases	Arithmetic Mean	Standard Deviation	Relative Importance	Evaluation Level
Reshaping the concept of the product	1.5917	0.2994	1	Low
Making environmental orientation profitable	1.3669	0.2555	3	Low
Clarity of the relationship between price and cost	1.4297	0.2560	2	Low
Eliminate or reduce the concept of waste	1.1026	0.1985	5	Low
Raise the concept of production efficiency	1.1973	0.2927	4	Low

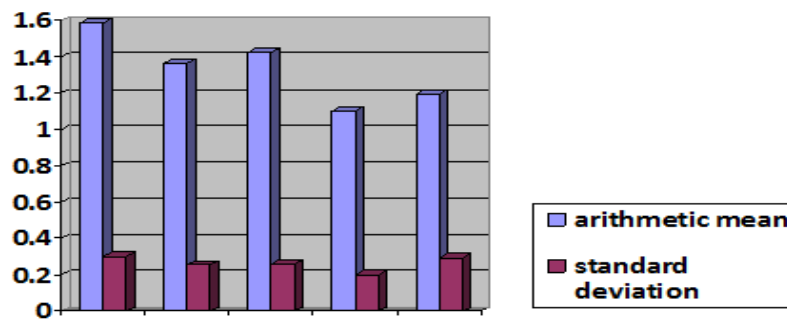


Chart No. (4) Arithmetic Means And Standard Deviations Of Circular Economy Strategies Associated With Printed Textile Products For Egyptian Printed Apparel Factories Consumers

The description of arithmetic means and standard deviations of circular economy strategies associated with consumers of circular economy printed apparel products, the results have been shown in a table No. (12) and a chart No. (4) that the first variable related to reshaping the concept of the product has ranked first in the list of consumers' evaluation priorities with an arithmetic mean of 1.5917 and a standard deviation 0.2994 while the fifth variable related to eliminate or reduce the concept of waste came in the fifth and final rank from the point of view of consumers, with an arithmetic mean of 1.1026 and a standard deviation of 0.1985. The answers of question was poor agreement level, and the following table No. (13) is a detailed table for the paragraphs of each of the variables related to the user and general average:

Table No.(13)Table For The Paragraphs Of Each Of The Variables Related To The User And General Average For Egyptian Printed Apparel Factories Consumers

Measurement phrases	Arithmetic mean	Standard deviation	Relative importance	Evaluation level	Overall average	Over all standard deviation
<b>Reshaping The Concept Of The Product</b>						
The raw materials used in the production process within printed apparel	1.9333	0.3398	2	Low	1.5917	0.2994



companies are not harmful to the environment						
Printed apparel companies worknot to waste raw materials used in production	1.1000	0.2154	4	Low		
Printed apparel companies produce environmentally friendly products	2. 1002	0.4049	1	Low		
Printed apparel companies preserve and sustain resources by applying the circular economy concept	1.2333	0.2377	3	Low		
<b>Making Environmental Orientation Profitable</b>						
Printed apparel companies develop its products based on the philosophy of not harming the environment	1.9333	0.3634	1	Low	1.3669	0.2555
Printed apparel companies conduct research and development to improve its products to be less harmful to the environment	1.7233	0.2474	2	Low		
Printed apparel companies achieve a competitive advantage among other factories by using circular economy	1.1333	0.2278	3	Low		
Printed apparel companies increase customer loyalty by adopting the circular economy philosophy	1.0433	0.2866	4	Low		
Circular economy strategy works to increase profits printed apparel companies company	1.0013	0.1523	5	Low		
<b>Clarity Of The Relationship Between Price And Cost</b>						
Printed apparel companies set prices based on the cost of raw materials used with a profit margin	1.2333	0.1911	3	Low	1.4297	0.2560
Printed apparel companies set the prices of its products based on the real value of those products	1.1333	0.2525	5	Low		
Printed apparel companies set the prices of its products, taking into consideration the consumer 's income	1.8333	0.3955	1	Low		

Printed apparel companies product prices Is always lower than competitors' prices	1.7354	0.2521	2	Low		
Printed apparel companies bear the costs of protecting the environment, which is reflected in the high prices of its products	1.2133	0.1889	4	Low		
<b>Eliminate Or Reduce The Concept Of Waste</b>						
Printed apparel companies use advanced technology to reduce waste	1.0130	0.3136	4	Low	1.1026	0.1985
Printed apparel companies products are low or no waste	1.0213	0.1335	3	Low		
Printed apparel companies use clean energy to reduce its waste	1.1206	0.2418	1	Low		
Printed apparel companies work to reduce or eliminate its waste, out of its belief in its social responsibility towards consumers	1.0638	0.1051	2	Low		
<b>Raise The Concept Of Production Efficiency</b>						
Printed apparel companies work to raise production efficiency in order to eliminate or reduce waste	1.3933	0.3030	1	Low	1.1973	0.2927
Printed apparel companies are one of the market leaders in the circular economy	1.0013	0.2825	2	Low		

#### □ Results

- The circular economy is the best alternative to the linear economy, which results in Reducing the demand for raw materials and using recycled or leftover materials.
- Reducing climate-changing carbon emissions: because less energy is used to obtain and process new raw materials and this results in a reduction in carbon emissions. It also keeps potentially methane-releasing waste away from landfill sites.
- After analytical study and results statistical analysis of the questionnaire:
  - The extent to which the circular economy policy is applied to textile printing products for H&M factories , It was found that it applied the circular economy policy at a high level.

- The extent to which the circular economy policy is applied to textile printing products in the Egyptian factories was found to be applied at a weak level due to Challenges which facing factory owners and consumers And the study gives Solutions to compete local and international.
  - For Industrial Organizations The Competent authorities establish a specialist committee to investigate and manage the transition to a circular economy for products in general and textile printing products in particular.
  - For academic Developing and updating the curricula of the Faculty of Applied Arts in general and the Department of Textile Printing, Dyeing and Finishing in particular, as the requirements of the industrial community to

solve industrial problems and introducing sciences related to the circular economy and its applications in the study plan so that a textile printing designer can be updated with technological development, and for researchers Conducting several studies related to the subject of the study using other variables.

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• **Appendix (1)**

Banha university  
Faculty of applied arts  
Printing ,dyeing and finishing textile

○ **A Questionnaire For H&M Printed Apparel Consumers**

The questionnaire was designed as a measuring tool for the research variables, entitled "**The Effect Of Applying Circular Economy Concept On The Printed Apparel Industry**", from DR/\_\_\_\_\_ you are kindly requested to read it and express your opinion by putting (√) in front of what you appropriate from your point of view.

i extend my thanks and appreciation in advance to your excellency for your kind cooperation in completing the relevant scientific study.

Name			
Date			
Degree	Pre-university	BA	Msc/phd
Income level	Low	Medium	High
Shopping time	Less than two hours	From 2-4 hours	More than 4 hours

Measurement phrases	Excellent	Very good	Good	Acceptable	Poor	Comments
<b>Reshaping The Concept Of The Product</b>						
The raw materials used in the production process within printed apparel companies are not harmful to the environment						
Printed apparel companies worknot to waste raw materials used in production						
Printed apparel companies produce environmentally friendly products						
Printed apparel companies preserve and sustain resources by applying the circular economy concept						
<b>Making Environmental Orientation Profitable</b>						
Printed apparel companies develop its products based on the philosophy of not harming the environment						
Printed apparel companies conduct research and development to improve its products to be less harmful to the environment						
Printed apparel companies achieve a competitive advantage among other						

factories by using circular economy  
Printed apparel companies increase customer loyalty by adopting the circular economy philosophy  
Circular economy strategy works to increase profits printed apparel companies company

#### Clarity Of The Relationship Between Price And Cost

Printed apparel companies set prices based on the cost of raw materials used with a profit margin  
Printed apparel companies set the prices of its products based on the real value of those products  
Printed apparel companies set the prices of its products, taking into consideration the consumer 's income  
Printed apparel companies product prices Is always lower than competitors' prices  
Printed apparel companies bear the costs of protecting the environment, which is reflected in the high prices of its products

#### Eliminate Or Reduce The Concept Of Waste

Printed apparel companies use advanced technology to reduce waste  
Printed apparel companies products are low or no waste  
Printed apparel companies use clean energy to reduce its waste  
Printed apparel companies work to reduce or eliminate its waste, out of its belief in its social responsibility towards consumers

#### Raise The Concept Of Production Efficiency

Printed apparel companies work to raise production efficiency in order to eliminate or reduce waste  
Printed apparel companies are one of the market leaders in the circular economy

#### • Appendix (2)



Banha university  
Faculty of applied arts  
Printing ,dyeing and finishing textile

○ **A Questionnaire For Egyptian Printed Apparel Factories Consumers**

The questionnaire was designed as a measuring tool for the research variables, entitled "**the effect of applying circular economy concept on the printed apparel industry**", from DR/ \_\_\_\_\_

you are kindly requested to read it and express your opinion by putting (√) in front of what you appropriate from your point of view.

i extend my thanks and appreciation in advance to your excellency for your kind cooperation in completing the relevant scientific study.

<b>Name</b>			
<b>Date</b>			
<b>Degree</b>	Pre-university	BA	Msc/phd
<b>Income level</b>	Low	Medium	High
<b>Shopping time</b>	Less than two hours	From 2-4 hours	More than 4 hours

Measurement phrases	Excellent	Very good	Good	Acceptable	Poor	Comments
<b>Reshaping The Concept Of The Product</b>						
The raw materials used in the production process within printed apparel companies are not harmful to the environment						
Printed apparel companies worknot to waste raw materials used in production						
Printed apparel companies produce environmentally friendly products						
Printed apparel companies preserve and sustain resources by applying the circular economy concept						
<b>Making Environmental Orientation Profitable</b>						
Printed apparel companies develop its products based on the philosophy of not harming the environment						
Printed apparel companies conduct research and development to improve its products to be less harmful to the environment						
Printed apparel companies achieve a competitive advantage among other factories by using circular economy						
Printed apparel companies increase customer loyalty by						

adopting the circular economy philosophy  
Circular economy strategy works to increase profits  
printed apparel companies company

#### Clarity Of The Relationship Between Price And Cost

Printed apparel companies set prices based on the cost of raw materials used with a profit margin  
Printed apparel companies set the prices of its products based on the real value of those products  
Printed apparel companies set the prices of its products, taking into consideration the consumer 's income  
Printed apparel companies product prices  
Is always lower than competitors' prices  
Printed apparel companies bear the costs of protecting the environment, which is reflected in the high prices of its products

#### Eliminate Or Reduce The Concept Of Waste

Printed apparel companies use advanced technology to reduce waste  
Printed apparel companies products are low or no waste  
Printed apparel companies use clean energy to reduce its waste  
Printed apparel companies work to reduce or eliminate its waste, out of its belief in its social responsibility towards consumers

#### Raise The Concept Of Production Efficiency

Printed apparel companies work to raise production efficiency in order to eliminate or reduce waste  
Printed apparel companies are one of the market leaders in the circular economy