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Circular Economy in reference to Theory and Practice

- Experience of Different Companies -

الاقتصاد الدائري بين النظرية والتطبيق–عرض لتجارب بعض الشركات–

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Abstract :

This research paper aims to determine methods that production companies should undertake in order to control the inflation of waste as well as the unreasonable exploitation of natural resources.

The study concluded that the best solution in getting rid of this problem is to move from linear (unidirectional) economic model i.e: production-consumption- elimination, towards circular economic model which is based on "cradle-to-cradle" principle i.e: production- consumption- recycling-production. This principle allows the production of goods whose parts are all recyclable.

Several experiments of companies that designed their products according to "cradle-to-cradle" principle have been exposed. This is through selecting two sectors; the office furniture industry (Orange box and Steelcase companies), and fabric industry (i Collect and Teriva companies).

Keywords: circular economy – cradle-to-cradle –waste recycling – natural resources renewal..

ملخص :

تهدف هذه الورقة البحثية إلى تحديد السبل والطرق التي يتعين على المؤسسات الانتاجية انتهاجها بغية التحكم في الحجم الضخم للنفايات وكذا الاستغلال غير العقلاني للموارد الطبيعية.

وتوصلت الدراسة إلى أن الحل الوحيد للتخلص أو التقليل من هذه النفايات هو الانتقال من نموذج الاقتصاد الخطي (أحادي الاتجاه) والمتمثل في: الانتاج – الاستهلاك – التخلص، إلى نموذج الاقتصاد الدائري الذي يعتمد على تبني مبدأ "من المهد إلى المهد"، والمتمثل في: الانتاج – الاستهلاك – التدوير – الانتاج...، حيث يسمح هذا المبدأ بإنتاج سلع كل أجزائها قابلة لإعادة التدوير.

وتم عرض مجموعة من التجارب لشركات قامت بتصميم منتجاتها وفقا لمبدأ من المهد إلى المهد، من خلال اختيار قطاعين هما قطاع انتاج الأثاث المكتبي (شركتي Orange Box و Steelcase) وقطاع انتاج الاقمشة (شركتي Collect و Trevira).

الكلمات المفتاحية: الاقتصاد الدائري، من المهد إلى المهد، تدوير النفايات، تجديد الموارد الطبيعية

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INTRODUCTION:

The growing problem of waste in the world and its harmful effects on the environmental and social levels in general led to the appearance of bodies calling for the necessity of finding a radical and decisive solution that guarantees the right of current and future generations to live in a clean environment.

In the course of time, methods for disposing of waste, starting from backfilling, burning and throwing in seas and oceans, have evolved, but this has exacerbated the problem due to the negative side effects of these methods. Thus, new attempts have been made to manage the waste such as trying to reduce it at the beginning, i.e. to manufacture goods that do not produce waste - or produce less waste - reuse it after repairing, part use, or recycling it.

However, even if these modern methods come with positive results, the volume of waste is constantly increasing. This is due to the steady growing of the world's population, as well as their endless needs and the efforts of productive institutions to satisfy them in various ways. The latter also depend on the traditional unidirectional production method, whose cycle ends once the consumer finishes to use it. This also led to a large depletion of natural resources, and their exploitation in irrational ways. This is why proposing new ideas and approaches that would not only eliminate the waste problem in the world but also preserve the natural resources from disappearance is still open.

The research problem:

Based on the above, the research problem is as follows:

Can circular economy be considered a strategic alternative to linear economy in solving the problems of waste inflation and scarcity of resources?

Importance of the study:

The importance of the study stems from the importance of the presented subject, as waste has become a real inconvenience for the peoples of the world because of its side effects on the environment and society in general, not to mention the irrational exploitation of natural resources. Hence, it has become necessary to search for effective ways to control this problem.

Objectives of the study:

This study aims to achieve a number of objectives:

Find the difference between the linear and circular economy models.

Highlighting the circular economy's approach and its effectiveness in reducing waste.

Presentation of the experiences of some institutions that have adopted the circular economy approach.

Structure of the study:

To tackle all aspects of the subject, the research has been divided into two main axes. The first dealt with the circular economy approach, the principles on which it is based and the extent to which it is effective in solving the problem of waste and scarcity of resources. The second is a presentation of the experiences of some

institutions that tried to adopt this approach and how efficient it was in achieving their goals.

CIRCULAR ECONOMY: THE STRATEGIC ALTERNATIVE:

Circular economy is considered a relatively old trend, but it has been developed by providing it with a scientific term and basic principles upon which it is based. It is a concept that falls within the framework of sustainable development and takes place within industrial systems that seek to limit as much waste as possible. It is a response to the bitter current situation of natural environment, having its resources randomly exploited and the waste invading it, resulting from the irrational and inefficient use of these resources.

Introduction to circular economy:

In this section, we tackle the concept of circular economy, as well as its benefiting advantages.

Definition:

There are a set of definitions that have attempted to give an accurate description of the circular economy. They are as follows:

According to the United Nations, circular economy is "a system of production, exchange and sharing that enables social progress, preservation of natural capital and economic development," (nation, 2018) a definition also approved by the Brundtland Commission.

The President of the Institute of Circular Economy François Michel Lambert defines it as "a system that transfers waste into recycled raw materials for product design or other uses. In other words, there is no longer any waste that industrial and natural systems cannot fully recycle, and this is of course a great achievement in competitiveness of industries that control their raw material flow (Lambert, 2018)" .

As for Edwin Zakai, director of Studies Center for Sustainable Development (Brussels), he defines circular economy as the opposite of mono-economy, since the traditional (mono) economy is for production and consumption, then waste. The principle of circular economy is, however, to recycle the product or its components to return them to the chain.

Based on these definitions, we conclude that circular economy works on keeping raw materials and products in production chains for as long as possible. It aims to eliminate waste in our industrial systems, making them less dependent on extracting limited resource reserves. This concept will enable companies to take advantage of new valuable sources, and will also help to create flexible markets and supply chains capable of achieving long-term sustainable prosperity.

The role of design in a circular economy is pivotal, as companies have to work with designers to develop new designs of life-cycle products and services, and this process will likely involve broader cooperation with major stakeholder groups such as material experts, chemical scientists, manufacturers, and workers in recycling field. The Great Recovery Project proposes four design models that can operate within a

circular economy system: a design for seniority; rental / service design; industrial reuse design; and material restoration design (RSA, June 2013 , p. 7) .
Circular economy also focuses on sharing material resources through a more cooperative consumption model, where customers pay their money to use the product rather than own it (job economics). Companies sell the right to use their products through leasing or access arrangements, which allows them to retain ownership of these goods throughout the life cycle. Actually, these companies increase the performance of the goods through maintenance, repair and reuse.

Cradle-to-cradle term by Walter Stahel:

Walter Stahel is among the founders of circular economy. He has provided full explanation on the content of this approach. Stahel claims that the concept of circular economy dates back to the year 1976. It has different goals from production economy in the sense that it works to preserve the value of products, manage inventory and natural, human, manufactured and financial capital (Stahel, 2013, p. 435) .
This term was coined in the late 1970s as a "correction" of the world view, summarized by the phrase "from cradle to grave," according to which the life cycle of products is not really cyclical, because, with the end of their use, they are put in landfills.

However, the phrase "from cradle to grave" is not necessarily the inevitable outcome of consumption and economic activity, but it can be seen as a fundamental problem in design and planning. Quite the opposite, proper planning according to the laws of nature would make lethal production and consumption harms a life force. Cradle-to-cradle design aims to maintain technical and biological work cycles so that the latter may affect human health and the environment in a positive, long-term impact. Planning according to these principles is a proven planning that can be measured and operated.

Within this context, it is worth founding economic systems that use pure, healthy and nutritious materials, or materials that are always recyclable, which can enrich the various forms of life on Earth.

Also, the application of this approach is only through cycles, where the cycle begins with use and then recycling or restoration of goods, distribution, then we return to use. Ideally, recycling and waste should become materials used to produce and manufacture new goods. But the circular economy is not used alone, there is always a complementary industrial economy that is based on the production of goods and devices from new materials.

Stahel identified the goals of circular economy in the following points (Schroeder, Anggraeni, & Weber, 2018, p. 4):

Circular economy preserves inventory value and relatively maintains existing technologies.

It allows the product to be reused, repaired and recycled within the context of what is known as the most profitable small cycle.

Extending product longevity is the main strategy that leads to less waste and production.

Paying attention to inventory and existing goods leads to labour intensification and reducing resources consumption.

The cost of the repaired product is 40 percent lower than the cost of purchasing a new one.

Advantages of circular economy:

Circular economy has operational and strategic benefits at the micro and macro levels with enormous potential for innovation, job creation and economic growth. Adopting this concept allows:

Reducing linear consumption, as:

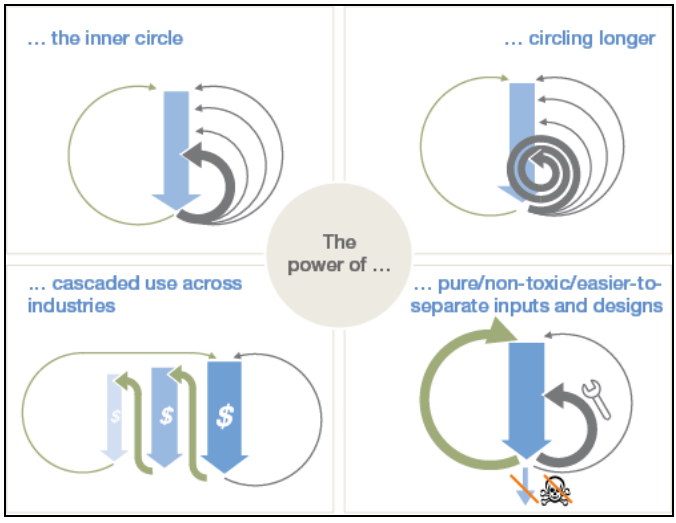
In modern industries, there are still opportunities to increase efficiency, but gains over time take a declining trend and are not sufficient to achieve competitive advantages.

The inevitable result of industrial progress is the massive depletion of natural resources, which has negatively affected the reputation of institutions.

Slow growth of agricultural production compared to previous decades, and the decrease in land fertility, led to the decrease in the nutritional value of agricultural products.

Creating a new value: as the circular economy creates new sources of value, the essence of which is to benefit from the price difference that exists between recycled resources (primary resources resulting from recycling) and virgin ones. The following figure shows these sources**:**

Fig.1: Sources of Value Creation for the Circular Economy



Source: Ellen MacArthur, Dominic Waughray, **Towards the Circular Economy: Accelerating the scale-up across global supply chains,** report prepared in collaboration with the Ellen MacArthur Foundation and McKinsey & Company, Published by World Economic Forum, Geneva, Switzerland, January 2014. p.16.

These sources are explained as follows:

Inner circle: refers to minimizing materials use compared to the linear production system. The more renewals and remanufacturing operations increase, the higher potential savings on the shares of material, labor, energy and capital.

Circling longer: refers to maximizing consecutive cycles (whether it is repair, reuse, or full remanufacturing) in each product life cycle.

Cascaded use of resources: refers to the diversifying use across the value chain, as when clothing is reused first second-hand apparel, then crosses to the furniture industry as a fiber-fill in upholstery (furniture-making industry), and the fiber-fill is later reused in stone wool insulation[1] (which is used as sound insulation and a tool to prevent the spread of fire…).

Pure inputs: indicate that the more the material used is pure and toxin-free, the easier it is to maintain its value during collection and distribution, especially technical materials. This helps to extend its product longevity.

A profitable economic opportunity: adopting a circular economy contributes to the following:

Improving land productivity and soil health: land degradation costs around $ 40 billion annually worldwide, not mentioning the hidden costs of increasing fertilizer use, biodiversity loss, and unique landscape loss as well. However, working with the principle of circular economy through anaerobic digestion[2] or fertilization will reduce the use of food additives and lead to higher land productivity, reduce losses in the nutritional value chain and return nutrients to the soil, thus enhancing the value of land and soil as sources.

Providing the largest amount of net resources: circular economy is an opportunity to provide net material costs from € 340 to 380 billion per year at the European Union level, and from $ 520 to 630 billion per year at the level of the United States. Auto sector benefits most from this feature, followed by the machinery and equipment sector (MacArthur & Waughray, January 2014, p. 14).

Reducing the risks of price fluctuations and supply risks: net material provision will cause a shift in the cost curve for many raw materials, especially steel, as global net material savings can reach more than 100 million tons of iron ore in 2025 if applied to the most consuming sectors of iron (i.e. in auto, machining and other transportation sectors that consume a lot of steel, which is about 40% of the demand). Thus, it is very likely to reduce demand-based volatility (MacArthur & Waughray, January 2014).

[1] **Insulated wool** is a fiber made from natural or synthetic metals. Insulation wool is used with high efficiency in applications of thermal insulation, sound insulation and preventing the spread of fire. It provides all these advantages at the same time, because it is characterized by a very low thermal conductivity factor and a high ability to absorb the sound waves falling on it.

[2] **Anaerobic digestion** or digestion without oxygen is a naturally biodegradable process of organic matter in the absence of oxygen. It is the method used to produce biogas from biodegradable organic materials using microorganisms in the absence of oxygen.

Innovation: replacing unidirectional products, i.e. with a linear model (production, consumption, disposal) with circular products (production, consumption, recycling, production), is a strong prompt for proposing new ideas and creating modern business mechanisms that allow achieving competitive advantages for companies let alone developing the economy.

Possibility of creating job opportunities: creating new products according to the circular economy approach means opening new companies and factories. Thus, creating job opportunities, and eliminating the unemployment obsession.

Principles of circular economy:

Linear economic model relies on extraction - production - consumption - disposal, and this model never calls for the expectation of a prosperous future. Consequently, there must be a transition to a circular economic model that mainly revolves around the absence of extravagance and extends the period of products longevity while reducing negative impacts on the environment. This is the goal of circular economy, which takes into account 3 main areas:

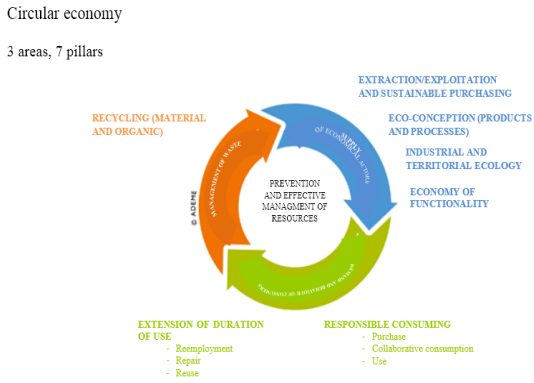
Production and presentation of goods and services.

Consumption by demand and consumer behavior.

Waste management with priority for recycling, which allows the circle to be closed.

Circular economy through these areas is based on 7 pillars as shown in the following figure:

Fig.2: Principles of Circular **Economy**



Source : Economie circulaire**,** view the website : http://www.ademe.fr/expertises/economie-circulaire, consulted on March 13th, 2018 (author's translation).

The abovementioned pillars are presented as follows:

Sustainable supply: includes exploitation, extraction and purchase, which is the use of natural resources in an effective and ideal way, by reducing waste of exploiting energy and metal resources in mines and factories, exploiting waste in agricultural and

forestry fields, as well as in renewable and non-renewable resources and energies (Ademe, 2018) .

Noting the steady growth of global consumption, specialists expected that by the year 2050, the consumption of natural resources will have been increased to 183 billion tons compared to 85 billion tons today (Ademe, 2018).

This is sounding the alarm about future generations concerning their right to these resources. In fact, the optimal use of the latter is the only solution, by identifying the needs accurately and avoiding extravagance. The various areas for optimal use are the following:

Optimum use of oilfields.

Optimum use of renewable resources and taking into account the extent of their ability to renew.

Reducing negative impacts on the environment during exploitation.

Reforming the areas where the various natural resources were extracted.

Benefiting as much as possible from recycled raw materials, which have less environmental impact compared to virgin materials.

Industrial and regional environment:

It is also called industrial coexistence, meaning that the exchange of resources between companies (energy, material...) is stimulated. It is a practical approach that is considered to be on a certain geographical scale (industrial zone, industrial conglomerate, administration ....) and whatever type of activity, the negative impact of these activities on the environment can be reduced by trying to decrease the used flows (resources, energy, individuals...) through the contribution of productive institutions in the infrastructure and perhaps the emergence of intermediary activities between these institutions.

In actual terms, this approach can lead the waste of a given institution to become the raw material for another one, or the heat emitted from the smoke of a factory becomes an energy resource for a neighboring one. For instance, in France, 95 companies exchanged efforts and resources under the principle of industrial coexistence. The waste resulting from the manufacture of solid PVC[3], as well as used coffee bags, were converted into covers for hemp plantations and into large bags for waste collection which are 100% recycled products.

Environmental design:

This term was first introduced to the world in 2002 when the ISO / TR 14062 standard was issued, which defined environmental design as being the introduction of the environmental dimension into product design and development (Eco conception, 2018).

[3] **PVC** is a thermoplastic polymer obtained by polymerization of vinyl chloride monomer. It comes in powder form, to which, depending on its end use, are added various adjuvants: lubricants, stabilizers, plasticizers, fillers, etc.

When an institution uses the concept of an environmentally designed product, it must provide real and tangible evidence that its products are environmentally designed, and the information that must be provided in the product is:
Definition of environmental design (as per Resolution 125/2009).
Determine what the environmentally designed part is, i.e. the product, packaging or components.
The main environmental features of the product / packaging.
The extent of the product's impact on the environment.
The environmental design of the products also allows the opening of new innovation hubs that benefit the institution in three main ways:
Heritage: it raises the value of society.
Customer: it meets his needs and expectations by producing innovative goods.
Ethical value: by adopting standards of social responsibility by the institution.

Employment Economics:

It is an idea based on converting the principle of selling the product to the principle of selling the use of the product. This allows separating the added value from energy consumption and raw materials (economie de fonctionnalite, 2018).
For example, if a person wants to buy a washing machine, he will pay for it to the supplier and then it becomes his property. However, he must also pay the electricity bill for its operation as well as water, soap, and maintenance bill if necessary. In this way, knowing the real cost of washing clothes is complicated. On the contrary, the supplier can suggest washing service instead of selling the washing machine, so the consumer directly pays the bill of washing his clothes to the supplier, thus controlling more the cost of washing.
Concerning other damaged household electromagnetic and photocopying devices for example, manufacturers may enter into a deal with their owners to return them as soon as they are damaged, in return for a specific amount of money, with a view to recycling them.
Employment economics have benefits for the institution and society in general, including (Economie de fonctionnalité, 2018):

For the institution:

Reducing dependency on supply problems (raw materials, scarcity problem...).
Good control over product life cycle.
Gain a competitive advantage.
Gain customer loyalty.
Strict control of the way the products are used.

Regarding the environment and society:

Reducing usage and maintenance costs.
Extending the products longevity.
Reducing energy consumption and natural resources.
Creating non-delocalized jobs and services.

Responsible consumption:

A responsible consumer is a consumer with deep environmental and health awareness who deals mainly with reliance on the values he believes in. These values push him not only to avoid buying products whose dubious environmental orientation, but also not consuming goods that are harmful to the environment. It is a behavior related to the fact that resources are limited, and it is compatible with civil commitment to the quality of personal and collective life. In addition to considering the environmental and health aspect in an individual's consumer behavior, the social aspect is also important. This is by choosing the products of institutions that respect working conditions, conform to international laws, compatible with the culture of society, and having societal goals such as achieving social justice (Golob & al, 2018). Responsible consumption is based on several principles (Cacheiro, Stefanoto, & Zinder, 2010, p.5) :

Benefit principle: that is, to avoid buying products that do not correspond to the real needs, in order to reduce excessive consumption and depletion of natural resources;

Prevention principle: testing products / services that have the least possible harm to the environment, health and society;

Efficiency principle: taking into account the use of more economical means for natural resources, energy and appropriate conditions for work in the production process;

Quality principle: preference for products that have a long longevity, as the least possible resource and energy is used, the least possible waste is used.

Integration principle: the promotion of trade methods that achieve integration between producer, distributor and consumer, to ensure the equitable distribution of wealth.

Extending the usage period: the consumer can extend the longevity of the product in three different ways:

Repair: by repairing or changing the damaged part of the product and then reusing it

Give or sell it to another person: the original owner gives the product or sells it to another person, then it will start a new longevity.

Reuse: when the owner disposes of the product and discards it in waste, another party recovers, repairs, restores, and then reuses it.

Recycling:

It is a waste treatment system to create new resources that allow the production of new goods without resorting to the use of virgin material. It is the process of recycling and using waste, whether domestic, industrial or agricultural, by classifying and separating the waste based on the raw materials found in them, and then recycling each material separately and reproducing new goods (Oldenziel & Weber, 2013).

The idea of recycling began during the First and Second World War, as countries suffered from severe shortages in some basic materials such as rubber and plastic. This prompted them to collect these resources from waste for reuse, and then the recycling process became one of the most important methods of managing the

disposal of waste as well as a source of production. It is a strategy that is ranked third after prevention (downstream) and reuse.

Based on the above, we conclude that the circular economy is a method of production and not only an idea or a trend. This is why, in real situation, it may clash with the extent to which it is applied by productive institutions in all their economic activities.

EXPERIENCE OF DIFFERENT COMPANIES THAT HAVE ADOPTED THE CIRCULAR ECONOMY PRINCIPLE:

This axis is dedicated to presenting the experiences of some companies that adopted the "cradle-to-cradle" philosophy. Although there are many of these companies, they are few comparing to the huge number of those who are still adopting the linear (unidirectional) production model.

Office Furniture Industry:

Orange Box company experience in making ARA chair:

Orange Box is one of the pioneering companies in the office furniture industry (offices, chairs, tables...) established in 2002. Its headquarters is in London (orangebox, 2018). The company's design philosophy is based on the use of fewer materials to create sustainable products that are easy to dismantle and recover for recycling.

The company introduced its new product, which is the chair named ARA. Actually, it was manufactured and developed according to the philosophy of "cradle-to-cradle", meaning that it is a product that has a completely closed longevity. Most of the materials (98%) used to make this chair are almost recyclable. The company is committed to evaluating each chemical compound of raw materials to ensure that upon expiration, it can be reused in the production cycle with a view to manufacturing new high-quality products, provided that these components are also toxin-free that can cause harm to human health or the environment if they were launched into the air.

The company has devised solutions and technologies to handle expired or unwanted products. This is by building a recycling facility in South Wales, Britain, operating in accordance with the cradle-to-cradle principle. To recover its damaged products from consumers, it has made an offer called "free download" to the effect that all damaged or unwanted ARA chairs are shipped and carried to the factory for free. In this way it can repair, resell or recycle them and create new raw materials (Heinemann & al, 2018, p. 40).

Steelcase experience in manufacturing Think chair:

It is another company specialized in the manufacture of office furniture, established more than a century ago, having its headquarters in the State of Michigan, the United States of America (steelcase, 2018). It has manufactured the Think chair under the slogan "Future Focused", based on the cradle-to-cradle principle. 41% of its weight is made of renewable material. The advantage of this chair is that customers themselves can remanufacture and dismantle it using simple hand tools.

When the chair reaches the disposal stage, the company recovers it and extracts the materials that can be used to make new products, for example (Heinemann & al, 2018, p. 44):

ACETAL: a type of hard and tough plastic, which is reused to make pen cases, toys and plumbing tools.

Aluminum: it can be reintroduced into the automotive and kitchen appliances industry.

Nylon: used to make hair combs, and can also be reused as covers for new chairs.

Polyethylene: this material can be reused to make carpets and rugs.

Polyurethane: this material can be used in manufacturing electric washing machines and coffee makers.

Iron: it will definitely make many products.

Zinc: it can be reused to make door handles, bathtubs, etc.

Fabrics Industry:

i Collect clothes and shoes recycling company:

It is a company specialized in collecting and recycling wear-and-tear, namely used clothes and shoes. It is usually abbreviated as I:CO and has three main headquarters: Germany, USA and India (spirit, 2018). Its collection for used clothes and shoes takes place in more than 60 countries around the world. They are sorted into groups: whether to be reused or recycled, in order to ensure maximum benefit from them. This company started based on the fact that approximately 150 million tons of clothes and shoes are sold around the world annually. Most of them end up in landfills or are incinerated instead of being reused or recycled. This leads to wasting valuable resources and causes harm to the environment. The main reasons for this include low consumer awareness and lack of collection structures in many countries (spirit, 2018). This company works on establishing partnerships with the largest clothing manufacturers in the world, such as: (H&M, Levi's, Adidas, Puma, C&A) (icollect, 2018), by providing special boxes in the stores selling these brands, where customers collect their used clothes and shoes, and put them in. In return, the company sets up discounts for new clothes, which makes the customer feel that he is saving money and has a good impression about the environment. Then it recycles and transforms them into new second-handed clothes. If this cannot be done, it turns them into carpets, blankets or papers for decoration.

Trevira Textile company:

It is a company specialized in the manufacture of various clothes made of polyester fibers (all types of clothing and work clothes of high quality for companies, private and public entities, official uniforms for security and military institutions), established in 1956 in Germany (Trevira, 2018). It is considered one of the environmentally friendly companies, as its products are fully recyclable. The company delivers a written instruction to the customer informing him of the product's ability to be re-manufactured under the slogan: “cradle to the factory gate”. The company stipulates

that the fabrics it will recycle are clean, dry, pollution-free and dyeing, and must also be subject to trademark testing (i.e. identifying them via the trademark accreditation number registered at Trevira) (Trevira, 2018).

These expired fabrics are converted into either energy-saving insulation materials, automotive molds or ropes. In the event that it is not possible to recycle the damaged fabrics into new products, the company uses the high energy of polyester to produce energy.

CONCLUSION:

After exerting continuous efforts and various experiences by experts and economists to control the huge volume of waste, the circular economy approach provided a fundamental solution to this dilemma, which is mainly based on the "cradle-to-cradle" principle. This is by producing goods that can be recycled 100%, that is, completely without producing waste. This allows preserving natural resources as the parts of damaged products are reused as new primary resources. Therefore, the adoption of the circular economy approach allows solving the waste problem and the dilemma of depleting natural resources at the same time. The only remaining issue is the extent to which productive institutions are ready to adopt them, not to mention the role of States and governments in encouraging them.

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