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RAW

GUIDE ON CIRCULAR ECONOMY STRATEGIES IN BUSINESS ENVIRONMENT

INTRODUCTION

WASTE: HISTORY AND TRANSFORMATION

In today's rapidly evolving world, the need for sustainable business practices has become more crucial than ever. The concept of circular economy has gained significant attention as a solution to address environmental challenges and create a more sustainable future. However, implementing circular economy strategies in the business environment is no easy task. It requires a fundamental shift in both consumers' and businesses' behaviours, which is often a daunting and complex process.

The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended. In practice, it implies reducing waste to a minimum. When a product reaches the end of its life, its materials are kept within the economy wherever possible thanks to recycling. These can be productively used again and again, thereby creating further value.
This is a departure from the traditional, *linear* economic model, which is based on a take-make-consume-throw away pattern. This model relies on large quantities of cheap, easily accessible materials and energy.

To get to recycling as a process of our time, we should necessarily look at the genesis of waste. Whereas in the old societies waste was extremely scarce and mainly of a biological nature, today waste has a very different character - it can be hazardous, household waste, construction waste, biodegradable and many other types that make it either useless rubbish or a valuable raw material.

The facts speak for themselves when we want to gain insight into the past and present of waste:

PAST:

- 500s BC - **First Waste Act** established by the authorities of the Greek polis Athens. The law stated that waste must be transported at least one mile away from the city gates.
- 1515 - Records from Stafford v. Avon show that **Shakespeare's father was fined** for littering in the street.
- 1757 - In the United States, Benjamin Franklin established the first municipal **street cleaning** service in Philadelphia. Around the same time, American households begin to bury their garbage instead of throwing it out the windows and doors of their homes.
- 1776 - The **first recycling** of metals took place when the statue of King George III in New York was melted down and turned into bullion.
- 1870 – France - Louis Pasteur proved the link between hygiene and public health.
- 1885 - First **incinerator** built in the USA.

- 1904 - First **aluminium recycling** plants open in Cleveland and Chicago.
- The 1930s saw the beginning of the **production of plastics** from petroleum-based chemical products. Plastics production grew slowly over the next 20 years to peak in the 1950s.

PRESENT:

- There are 6 times more plastic particles than zooplankton in the world's oceans.
- If you arrange the plastic cups produced in just 1 day in a straight line, it will circle the Earth along the Equator.
- Today, humanity uses nearly 1 trillion (1,000,000,000,000) polythene bags each year.
- 2.5 billion tonnes of waste are generated each year in the EU.
- Every European produces on average about 500 kg of waste per year.

Changing consumers' and businesses' behaviours at scale is extremely difficult, with studies showing that consumers need help to move from intention to action. ~~n.~~ As we engage in this path towards a more sustainable future, this Guide serves as a stepping stone, facilitating the transformation of intentions into tangible actions. It provides businesses with the knowledge, tools and inspiration to meet the challenges of transitioning to a circular economy, ultimately contributing to a healthier planet and a more resilient business landscape. Together we can reshape our economic systems, foster sustainable growth and create a world where waste is minimised, resources are maximised and the well-being of people and the planet is at the heart of all business decisions.

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1 CHAPTER

RECYCLING FROM CONSUMPTION

VET TRAINERS WORKSHEET:
LEARNING OUTCOMES

Circular Economy Awareness App:

ANDROID

iOS

Chapter 1: Recycling from consumption

This chapter focuses on waste separation as one of the most popular forms of environmental protection. **It enables waste to be recycled so that it can be used again.** Good practices to nudge consumer behaviour to move from intention to action as far as separate waste collection - raising consumer awareness, facilitation, entertainment, visualising outcomes, use of vouchers.

SKILLS:

- Be able to give examples of reusable/recyclable waste
- Be able to identify successful waste management practices
- Be able to provide ideas how to encourage citizens and businesses to separate waste
- Be able to change your behavior toward more sustainable lifestyle andd make better choices

KNOWLEDGE:

- To understand the direct impact on climate change of the waste from consumption.
- To understand what is needed for a resource-efficient, circular, European economy.
- To have knowledge of the most common packaging materials and which of them can be reused or recycled.

ATTITUDES:

- Raise awareness on importance of separate waste collection
- Build habits in the attitudes of the population and businesses
- Nudge consumer behaviour to move from intention to action as far as separate waste collection is concerned

LENGTH OF THE COURSE:

Chapter 1 has 13 pages.

Study duration is appr. 2h.

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CHAPTER 1: RECYCLING FROM CONSUMPTION

INTRODUCTION

The aim

This Chapter focuses on waste separation as one of the most popular forms of environmental protection. Separate waste collection enables waste to be recycled so that it can be used again. The overuse of natural resources, population growth and active commercial activity are stimulating the creation of waste, and one of the most successful ways of dealing with it is recycling. As almost two-thirds of the waste in homes consists of organic components that naturally biodegrade, home composting is the simplest and most effective action we can take to reduce waste and improve soil health at the same time. Introducing composting as nature's way of recycling is another idea this Chapter provides.

The objectives

This Chapter's main objectives are raising awareness on importance of separate waste collection, building habits in the attitudes of the population and businesses and nudging consumer behaviour to move from intention to action as far as separate waste collection is concerned

The rationale

The examples in this Chapter will help you identify successful waste management practices and provide you with ideas how to encourage citizens and businesses to separate waste as to contribute to change of citizens' behavior toward more sustainable lifestyle.

The learning outcomes

In this Chapter you will understand the direct impact on climate change of the waste from consumption. You will gain basic knowledge on the most common packaging materials, which of them can be reused or recycled and understand what is needed for a resource-efficient, circular, European economy.

The duration of the course/study of this chapter:

Approximately 2h

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1. SEPARATE WASTE COLLECTION TRANSFORMS WASTE INTO A RESOURCE WITH A FUTURE

One of the threats to modern society is not only the overconsumption of raw materials, but also the waste created by this consumption. This has a direct impact on climate change, the rate of change of which is too intense and increasingly difficult to control. The overuse of natural resources, population growth and active commercial activity are stimulating the creation of waste, and one of the most successful ways of dealing with it is recycling. The process of recycling raw materials is also a way of limiting the use of natural resources and is a crucial part of the 'circular economy'.

To achieve optimal results in waste management processes, all actors in the chain of production, supply, logistics, consumption and utilization should be involved.

Citizens and households globally are among the largest consumers and generators of non-hazardous waste. One of the many hurdles facing a circular plastics economy is how to get used packaging and materials back from the consumer and into recycling plants, in order to put it back into the supply chain.

Eurostat defines municipal waste as anything collected by local authorities. This means it mainly comes from households, but also includes rubbish from shops, offices and public institutions.

505 kg of municipal waste per capita were generated in the EU in 2020, up nearly 10% since 1995.
48 % of municipal waste in the EU was recycled (material recycling and composting) in 2020.

Of the 300 million metric tons of plastic produced globally each year, only 12% is reused or recycled.

Since 1950, a whopping 8.3 billion metric tons of plastic has been made. But sadly, only 9% of this has been recycled.

Waste separation is one of the most popular forms of environmental protection. **It enables waste to be recycled so that it can be used again.** Nudging consumer behaviour to move from intention to action as far as separate waste collection is concerned may include techniques like raise consumer awareness, make it easy, make it fun, visualise end-results, use vouchers.

Figure 2

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CASE STUDY 1: Municipal Approach

Gabrovo Municipality applies different approaches and mechanisms to solve some of the environmental challenges of the new times. The waste management system requires citizens to separate waste into two main flows - waste for recycling and waste for composting. It started with just two types of containers that were easily identifiable to citizens and it was clearly visible where to dispose of the relevant waste.

Encouraging **separate collection** was a step in the right direction. Currently, the territory of Gabrovo municipality provides for the collection, treatment and recycling of - plastic bottles; metal, glass, paper and plastic packaging; biodegradable waste; textile waste; hazardous waste; wood waste.

The most successful practice of Gabrovo Municipality in waste recycling is the introduction of a **deposit vending system**.

Figure 3 and 4: Gabrovo Municipality, project „Implementation of pilot demonstrational project in the field of waste management on the territory of Gabrovo Municipality"

Providing the system was a key step towards the circular economy. In April 2022 Gabrovo Municipality installed two machines for collecting PET plastic bottles and CANS aluminium cans. The vending machines are positioned in locations with wide public access. **These are the first functioning vending machines for collecting of waste materials in Bulgaria**.

234934 pieces of packaging were handed over and recycled in just 7 months (Fig. 2). Precise separation of materials is made possible by providing a barcode and shape recognition system in the machines. Collected packaging wastes are compacted in the machines and then sent for recycling. After each handover, the machines issue a system receipt with the quantity and type of packaging handed over, which users use to collect points, and the points are converted into rewards in the form of reusable items as well as discount vouchers from shops. Through the deposit system, on the one hand, a very high level of separated and clean waste ready for recycling is achieved and, on the other hand, habits are built in the attitudes of the population.

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3. COMPOSTING OF GREEN AND/OR BIODEGRADABLE WASTE

Composting - the process of breaking down and decomposing biodegradable waste to produce a soil improver - compost. Composting is nature's way of recycling.

Composting is nature's natural way of processing and recycling its organic waste. Home composting is considered the most environmentally friendly way to deal with household biodegradable waste. Almost two-thirds of the waste in homes consists of organic components that naturally biodegrade. Home composting is the simplest and most effective action we can take to reduce waste and improve soil health at the same time. The composting process is the decomposition of waste of plant origin and can be divided into three stages: Decomposition, Transformation and Ripening.

To find out food waste recycling facts and statistics, visit the blog post

https://www.weforum.org/agenda/2022/06/recycling-global-statistics-facts-plastic-paper

Chronic food misallocation and inefficiency have caused food waste to be the largest category of waste. Globally, 40% of the food produced is wasted. The food lost on farms alone could feed every undernourished person in the world four times over. Food waste generates around 10% of global greenhouse gas emissions. Each year, home composting could divert 150 kg of food waste per household from landfills.

Composting is nature's way of recycling

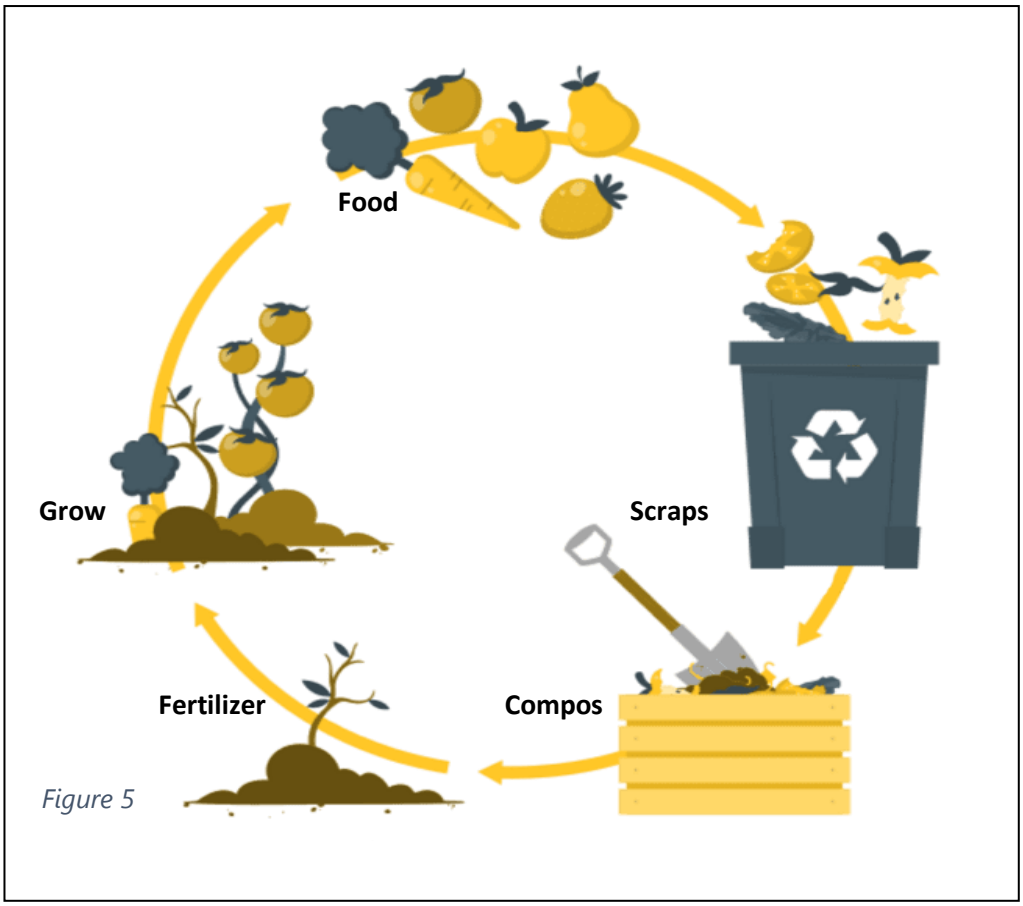

Figure 5

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CASE STUDY 2: Shared Composting

In early 2022 the municipality of Gabrovo established four shared composting zones covering different target groups, with the aim of providing suitable conditions for implementation, monitoring and realisation of composting - in the yard of a kindergarten and a school, in a residential area and near a hotel in a resort.
The composting bins located in the areas are made of wood, with an opening for the biodegradable materials and a door at the bottom of the composter where the ready compost can be easily and conveniently removed. The areas are surrounded by a wooden fence. Manuals which clearly and accurately describe the steps for a successful composting process have been developed for all participants in shared composting.
Observations show that the target groups actively use the shared composting sites. The advantage of this solution is that adults and children can control the composting process themselves and, when the compost is ready, they can use it in their gardens or in flower pots. User satisfaction is further enhanced by the fact that compost significantly increases soil fertility.
An additional advantage of this solution is that it provides an easy way to recycle biodegradable waste and reduces the cost of servicing household waste bins.

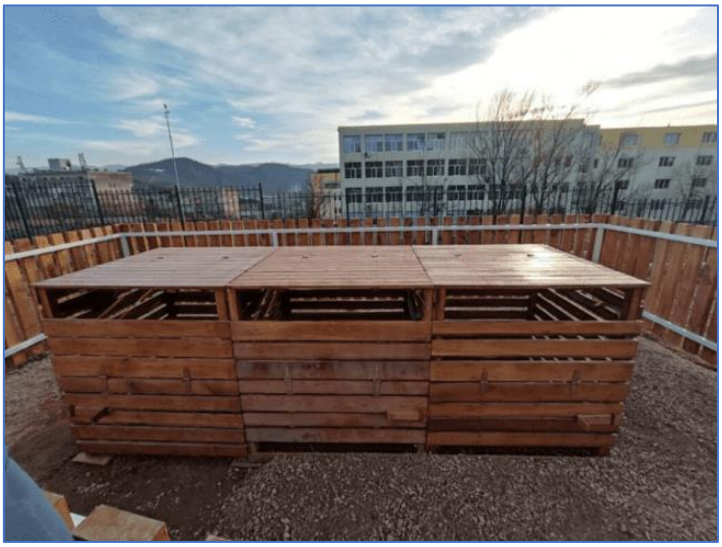

Figure 6. Gabrovo Municipality, project „Implementation of pilot demonstrational project in the field of waste management on the territory of Gabrovo Municipality"

There is a Regional non-hazardous Waste Disposal Site where composting process is carried out using anaerobic technology and involves the processing of leaves, branches, grasses, organic vegetable and fruit waste coming from vegetable shops and companies processing similar products. Citizens can hand in their vegetable waste from the household, yard waste, etc.

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4. BUSINESSES EFFORTS TO ENHANCE RECYCLING FROM CONSUMPTION

Resources are finite, but human ingenuity is not!

The role of business is crucial to the efficiency of waste management processes.

An analysis by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (Germany) shows "The most common packaging materials are glass, paper, cardboard, plastic, tin, aluminium and wood" (https://www.bmuv.de/en/topics/water-resources-waste/circular-economy/types-of-waste-waste-flows/packaging-waste).

Paper and cardboard account for the largest share of packaging, with plastic and glass a close second. In figures, the graph looks like this:
In 2020, packaging waste generated is estimated at 177.2 kg per capita in the EU. This amount varies between 66.0 kg per capita in Croatia and 225.8 kg per capita in Germany. In 2020, paper and cardboard (41.2%), plastic (19.5%), glass (19.1%), wood (15.1%) and metal (5.0%) are the most common types of packaging waste in the EU. Other materials represent 0.1% of the total packaging waste generated in 2020.

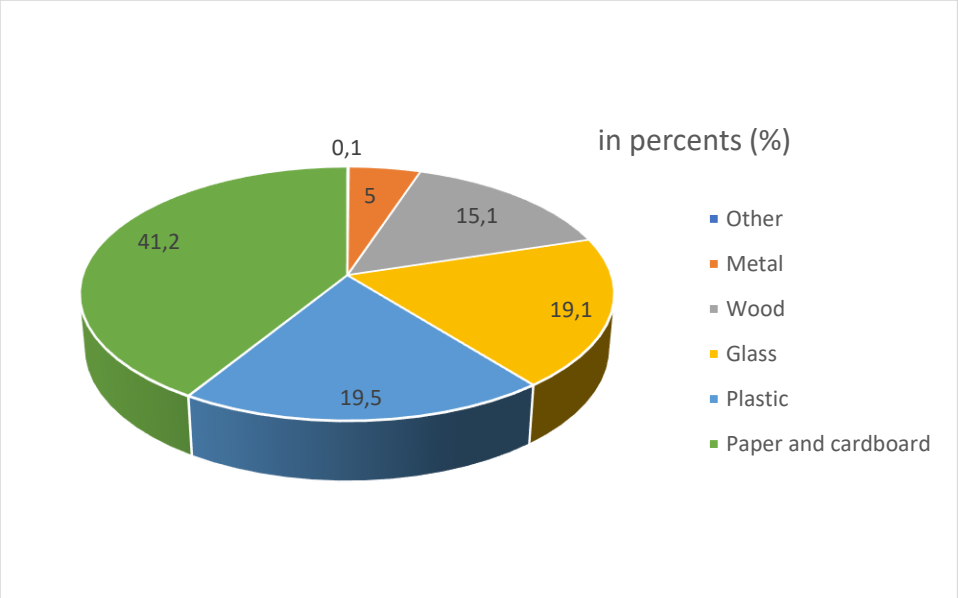

Figure 7

Packaging waste generated by packing material, EU estimate, 2020 (%)
Source: Eurostat

The problem with packaging arises because of the transience of its use and its increasingly local use due to people's desire to make their daily lives easier. Thus, reusable packaging is being replaced by disposable packaging. Thus, regardless of the type of packaged good, waste is generated from its packaging.

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The Centre for Sustainable Circuits identifies the problem of plastic packaging in the following way: plastics are a product of human innovation as they are light, durable, resistant to decay, cheap and mouldable. This innovation comes at a price - Plastic packaging is extremely wasteful and impacts the Earth's ecosystems on which we depend. **Due to poor product design and lack of policy infrastructure**, the majority of plastic waste is sent to landfills or dumped into the environment. 9.2 billion tonnes of plastic are produced, of which only 9% is recycled properly.

(https://supplychain.edf.org/resources/sustainability-101-packaging-waste-the-problem/)

Global plastic production, million tones 2013

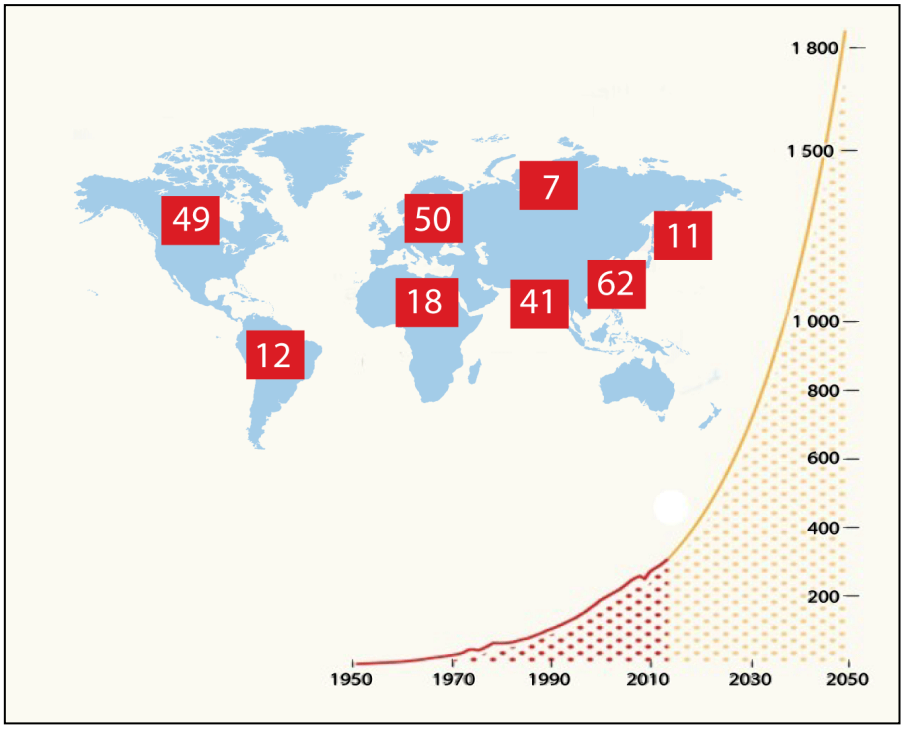

Figure 8

We should remember that plastic is not biodegradable; every piece of plastic ever produced is still on this planet. Companies continue to make heavy use of single-use plastics. The chart shows the projected fourfold increase in tonnage of plastic production by 2 050.

Packaging has several main functions - to protect items during delivery, for marketing and aesthetic purposes, and to contain information required by legislation. Thus, in addition to the packaging, the presence of a label is mandatory, which is another obstacle to the subsequent processing and recycling of packaging, as the material used is heterogeneous. Most packaging for consumer goods, such as food, beverages, cleaning products, shampoo, etc., is used only once before being discarded. Many people and companies simply throw away packaging without a second thought, especially if the packaging is not designed to be reused or recycled.

The main ways in which businesses can support recycling processes are - designing and manufacturing recyclable goods, establishing policies for using products made from or containing recycled materials.

CASE STUDY 3: SMART WASTE CONTAINERS

New containers for separate collection of recyclable waste allow citizens to dispose of unneeded plastic and paper waste in two coloured containers, which are equipped with built-in fill, temperature and location sensors.

The "smart" containers are part of the BinkyPal series, developed by Senstate Technologies AD with the support of Gabrovo Municipality.

The two containers are designed for different types of waste, and the built-in sensors transmit real-time information on the filled volume, allowing different types of reports and analyses on waste collection and disposal. The BinkyPal IoT model is designed for plastic waste, which is easily disposed of through the circular opening of the container. It is powered by a rechargeable battery and an ultrasonic sensor measures the filled volume.

The BinkyPal solar compact is a park container for paper and cardboard waste. Opening is via a pedal located at the bottom of the container. It is equipped with a compact solar panel protected by a durable glass dome. A press is provided in this model to reduce the volume of waste and an optical sensor measures the fill.

Innovative waste containers are another technological solution aimed at the efficient treatment of urban waste and its subsequent recycling.

Figure 9

The BinkyPal series, which includes (left to right) the BinkyPal double fill, BinkyPal solar compact and BinkyPal IoT models. BinkyPal was developed by the Gabrovo-based company Senstate Technologies AD with financial support from Gabrovo Municipality.

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5. ADVICE FROM EXPERTS

"For our society to accomplish a sustainability balance, we need to gradually achieve the inclusion of all social groups in the ideas of sustainable living and thinking"

Svetoslav Mateev.
Founder and CEO Senstate Technologies, EnvTech Company

Advices from the expert:

1. *Sustainability cannot be a definition. It evolves over time and depends on demographics, mindset and many other factors. To achieve sustainability in the long run, you need to constantly take steering actions following the emerging challenges;*

2. *Ground up your model for the social benefit first, and changing lives for better. This business model is much more sustainable than just setting some numbers in the spreadsheet of your marketing, sales and business plan;*

3. *Leverage all modern technologies to improve the decision making, which will certainly lead to a noticeable impact on the environment and the community.*

"Recycling saves natural resources. And this saves natural Blue Planet."

Denitsa Koleva.
Ecologist with 10 years of experience in Gabrovo Municipality and municipal enterprise "Regional landfill for non-hazardous waste",
Now: engineer – systems for improvement of processes in CERATIZIT Bulgaria AG

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Advices from the expert:

1. *Optimize your processes to lower the production waste, that way you will lower the costs for utilization.*
2. *Use electronic instruments for document management, lowering the quantity of paper in the office will help protecting the environment, as well as you.*
3. *Focus on separate collection of the waste, generated from your activities, recycling prevents the usage of natural resources.*

"Play a fair game with the nature"

Todor Popov,

Director of Administrative, Legal and Information Services at Gabrovo Municipality
over 5 years of experience in project management and implementation in the field of sustainable management, energy efficiency and waste management

Advices from the expert:

1. *Invest in increasing your knowledge and that of others about different resources and their presence in your daily life - so you can take adequate measures to reduce the harmful impacts of your activities.*
2. *Monitor the whole life cycle of goods and services - so you will have an overview of where the goods come from and where they go once you no longer need them. This will improve your waste management processes and you can turn waste into a resource.*
3. *People are very, consumerist and 'lazy', this makes them difficult to control, so make processes convenient, easy to implement and accessible to everyone.*

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6. SELF-DIAGNOSIS

A few questions to ask yourself…

1. **Do I dispose of everything I have used (from plastic bottles to refrigerators) properly, so it can be recycled?**

2. **How much trash did I throw away today? Am I committed to produce as little waste as I can?**

3. **Before you buy something new, do you ask yourself: do I really need this? Can I borrow or rent this if I will only use it a few times? Can this be repaired or re-used? Can this be repurposed or recycled?**

4. **Do I know my municipality's policies on recycling and do I follow them?**

7. REFERENCES

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2

CHAPTER

RECYCLING FROM MANUFACTURING. REFURBISHING/REMANUFACTURE (UP-CYCLING)

VET TRAINERS' WORKSHEET:
LEARNING OUTCOMES

Circular Economy Awareness App:

ANDROID

iOS

Chapter 2: Recycling from manufacturing refurbishment/remanufacturing

This chapter focuses on explaining basic knowledge of **waste management. The** chapter includes concrete examples of the **recycling of waste collected separately** or the reuse of waste materials in a way that preserves their original composition and function.

SKILLS:

- Be able to develop independent thinking
- Be able to work with practical knowledge
- To gain the ability to make independent and responsible decisions on professional issues.

KNOWLEDGE:

- To understand the life cycle of a producto.
- To understand how does a product become waste and then become a product again through material recovery or reuse.
- To acquire sufficient theoretical and practical knowledge of recycling.

ATTITUDES:

- To put to good use the knowledge acquired either in urban care and management companies, municipal offices, waste recycling and reuse operators, in the relevant departments of county government offices or as a member of civil associations.

LENGTH OF THE COURSE:

Chapter 2 has 12 pages

Study duration is appr. 1.5h

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CHAPTER 2: RECYCLING FROM MANUFACTURING REFURBISHMENT/REMANUFACTURING

INTRODUCTION

The aim

The aim of the module is to provide basic knowledge of waste management, as well as concrete examples of the recycling of waste collected separately or the reuse of waste materials in a way that preserves their original composition and function.

The objectives

In this chapter you will learn the difference between waste and rubbish, and between reuse and recycling. It is essential that individuals and the industry act and behave in a more environmentally conscious way to reduce and reuse waste.

The rationale

This chapter will take you through 3 examples of practical approaches to recycling and remanufacturing. The first case study illustrates the recycling potential of polystyrene foam in the construction industry, while the second and third examples show the practice of recycling plastics and paper in an industrial environment.

The learning outcomes

Recycling aims to convert materials that become waste into raw materials and produce secondary, recyclable materials that help reduce the use of natural materials. In the shift from a linear to a circular economy model, everyone has a role to play, from product designers to sellers and consumers. We need to move to an environmentally friendly and truly sustainable model of production processes.

The duration of the course/study of this chapter:

Approximately 1,5h

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1. THEORETICAL PART

If we talk about the basics of waste management, we should first clarify the most important terms. What is waste and what is garbage? It is an important question, as many people confuse the two. Materials that have become useless at the place of their origin and whose owner wants to get rid of them are considered **waste**, yet they still contain usable, valuable material and/or energy. **Garbage** is a material that has become useless and its owner cannot or does not want to use it anymore.

Figure 1. Recycling logo

Garbage is removed from the cycle of the economy, as it does not contain material and/or energy that can be used economically and is stored and dumped in a mixed manner. Important terms include **reuse**. After the product becomes waste, it is used for the same purpose, preserving its original form and function.

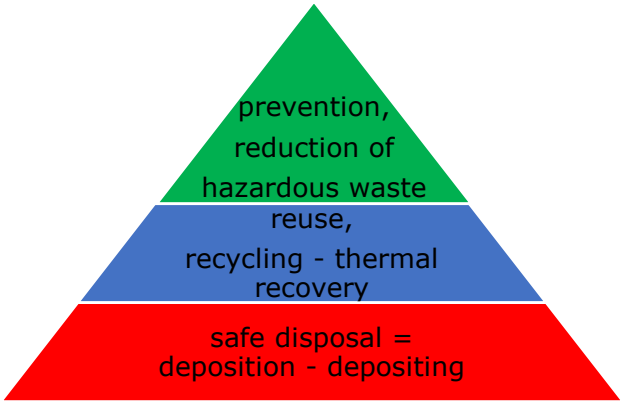

Figure 2. The purpose of waste management system

For example, a PET bottle is made from a PET bottle in the same way, shortening the process of producing the product, saving raw materials and energy. **Recycling** is similar to the previous concept, but with an essential difference (Figure 1). After the given product becomes waste, secondary materials or products with a different function are produced, which also help to reduce the use of raw materials. A set of activities and procedures aimed at reducing the hazardous effect of waste, preventing and excluding environmental pollution, and returning it to production or consumption. The priorities and target system of waste management are the following in order of importance: prevention of the generation of waste; reducing the danger of waste, reuse, recycling, thermal utilisation, and finally disposal (*Figure* 2).

On the following pages, we present reuse technologies also used in our country that can contribute to meeting the 55% target. The following case studies concern the plastic and paper waste that dominates our everyday consumer lives, as well as polystyrene, which is challenging in many ways.

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CASE STUDY 1: Waste polystyrene reconsidered in the construction industry

Polystyrene (PS / EPS = expanded polystyrene) is good from a thermal and vapor technology standpoint, and its thermal insulation capacity does not diminish over time. It is a widely used polymerization plastic. When burned, toxic substances are produced. Polystyrene thermal insulation materials and other foamed plastics used for the safe transport of larger products are produced in large quantities. Since their it's weight is extremely low and it's volume is large, compared to other municipal waste, it can only be collected, transported and stored at an extremely high cost. Many people consider polystyrene-type materials (e.g. Nikecell, styrofoam, graphite polystyrene sheet) to be harmful to the environment. Because of the above-mentioned properties, waste management actors often stay away from polystyrene, its collection, transport and possibly further treatment. However, the Bonn-based Building Materials Environmental Protection Organization (ECO) classified polystyrene as an exceptionally environmentally friendly building material among thermal insulation materials, considering its entire life cycle. The recycling of used polystyrene foam now has many uses. Among other things, it can be used as a surfboard body, lightweight concrete, brick pore-forming material, heat-insulating plaster additives and without the presence of other pollutants, as a soil conditioner for agricultural purposes. Advertising signs, plastic flower pots and other useful objects can also be created from polystyrene that becomes redundant (Austrotherm 2019). PS plastic waste containing contaminants that are not suitable for recycling can be used as fuel, primarily in the cement industry.

Figure 3. Blik POLY 2000 polystyrene compactor (Source: industry-plaza.com)

It appears in significant volumes when purchasing larger electronic devices, furniture and other equipment. It is not possible to selectively collect separately, because the current selective waste collection methods do not even provide an opportunity for this, and the collection containers would fill up with it very quickly. The non-thermoplastic, cross-linked PS waste can also be used in shredded or ground form as a filler mostly in construction products (Csukat and Rácz 2002). Shredding and then compacting large polystyrene foams and turning them into denser polystyrene bricks is becoming more and more popular among the Hungarian waste management companies. This enables more space-saving storage and easier transport. The POLY 2000 compactor can be an excellent solution for efficient and quick compaction of EPS waste (Figure 3). In automatic mode, the equipment can shred and compress expanded polystyrene with a compression efficiency of 30:1 (*Figure 4*). The POLY 2000 device requires little space, operates with low consumption and has a user-friendly design (hulladekpres.hu 2018).

Figure 4. The already compressed polystyrene bricks (Source: directindustry.com)

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Léka Estrich Kft., operating in Délegyháza (Hungary), primarily specializes in the production of special types of concrete and has gained extensive experience in their production. These include lightweight concrete, heat-insulating concrete, high-strength and wear-resistant concrete, as well as non-sparking concrete. Lightweight concrete is concrete with a high pore content, where three different methods are used to reduce bulk density (Balázs 1994). One form of lightweight concrete is polystyrene concrete (*Figure 5*), the price of which largely depends on the amount of material used. The additives of polystyrene concrete are polystyrene grains, whose density in the raw material is between 200 and 1000 kg/m^3. The additive for polystyrene concrete is therefore expanded polystyrene pearls or waste-type expanded polystyrene foam packaging material. During the heat-treated swelling process, the pearls obtain their original grain size of approx. 40 times that, i.e. the diameter typically between 2-5 mm. Polystyrene beads enrich and lighten the concrete at the same time, thereby accumulating many beneficial properties (konnyu-beton.hu 2022).

Figure 5. Polystyrene concrete slabs (Source: konnyu-beton.hu)

In general, lightweight concrete, including polystyrene concrete, is characterized by the following advantageous properties: low bulk density (up to 1200 kg/m^3) and low particle density (up to 2000 kg/m^3), pressure resistance, thermal insulation, mechanical and chemical resistance, fire resistance, frost resistance, and shape retention. Another advantage of polystyrene beads is that the boards are less susceptible to cracking, as the water absorption capacity of the additive is minimal. This also results in greater shrinkage (Fenyvesi 2012). Among its versatile areas of use, we mention only a few: step-resistant thermal insulation of attic floors, slab filling (*Figure 6*), floor heating, thermal insulation underlay for swimming pools, and thermal insulation layers for flat roofs (konnyu-beton.hu 2022). The use of polystyrene concrete has many advantages:

- it improves the building structure's thermal insulation capacity and heat attenuation,
- favorably influences the vapor diffusion function of the building structure
- it is not combustible (unlike the EPS sheets themselves), therefore the fire resistance of the building structure improves
- when used on a flat roof, it ensures the appropriate slope of the rainwater seal and a rigid, solid base
- its water absorption is low, so it is not a frost hazard (konnyu-beton.hu 2022).

Figure 6. Slab filling polystyrene with concrete (Source: konnyu-beton.hu)

Overall, due to both the beneficial properties of concrete slabs containing varying proportions of polystyrene beads and the tangible positives of recycling polystyrene in this way (lower transport and storage costs, less CO_2 emissions), it should be encouraged to be used in the construction industry.

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2. RECYCLING OF PLASTIC WASTE

Plastic waste causes a significant environmental problem worldwide and significantly burdens the waste management system. Plastics are gaining ground worldwide; an increasing proportion of packaging is also made of plastic materials. Plastics look similar on the outside, but their chemical structure and raw materials are very different. Their very diverse composition makes recycling difficult. Their significant environmental impact, microplastics, and their very long decomposition time should encourage us to reuse and/or recycle as much as possible. In the European Union, between 2009 and 2019, the production of plastic waste per person increased by 24%, which is equivalent to an increase of 6.7 kilograms per person. Meanwhile, the volume of recycled plastic increased even faster, by 50%. During this period, the amount of plastic packaging waste also increased significantly in absolute terms. In the EU, **around 41% of plastic packaging waste was recycled in 2019**; In Hungary, this rate was only 33% (Eurostat 2021). Hungarian municipal waste contained an average of 11.8 percent by weight of plastic components. This value increased to 15.9% in 2012 (Ronkay et al. 2014).

CASE STUDY 2: Durable egg box made of PET bottles

The purely Hungarian-owned Jász-Plasztik Kft., founded in 1990, has grown into a giant company employing around 5,000 people. Among the company's diversified activities, the utilization of plastic waste plays an important role. The company's goal is to develop its waste utilization activities on its own R&D base, and to be able to test the development results in the context of test plant production. The results can be used directly in manufacturing production and waste recovery activities. Egg boxes are made from 100% recycled PET raw material (labeled and printed) for European markets at the factory in Nagyréde. The egg containers are produced after the cleaning and grinding process of 4 tons of PET bottles per hour. In addition, the company's plastic recycling repertoire includes LDPE/HDPE film, with a capacity of 1.5 tons per hour (jp.hu 2022). Plastics are processed, among other things, at the company's sites in Nyíregyháza (*Figure 7*) and Jászberény. In order to be able to process it again, the generated plastic waste must be brought to a suitable condition from the point of view of production, using different preparation procedures. During the preparation process, the physical properties of waste primarily change (Ronkay et al. 2014). In the case of the company, the raw material is provided from PET bottles that have become waste and are collected selectively.

Figure 7. Jász-Plasztik Kft. Nyíregyháza manual (Source: nyiregyhaza.hu 2022)

It is difficult to separate the plastic waste received from the public by material type, as they have a diverse composition, their material composition is often undetectable with the naked eye, and they are contaminated to varying degrees. The separation

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process is therefore lengthy and can often only be carried out in several steps. If there is a large amount of dust or other dirt on the surface of the plastic waste, it may be necessary to wash and clean it before processing the waste. Mechanical handling processes are usually preceded by manual sorting. This ensures the removal of dirt and metal waste, as well as sorting by color in the case of PET bottles and by material in the case of other plastic waste. Magnetizable metal waste is removed automatically, using a magnetic separator.

The operation of shredding with the help of cutting shear or a grinder is typical for the pretreatment of PET bottles of suitable strength on the sorting belt. PET bottles are thermoplastics; they melt at high temperatures, 160-300°C, which makes it easier to create the secondary product. Plastic agglomerates of roughly the same size made from PET bottles of a given color are fed into the so-called extruder machine. The plastic waste is fed through the device's feeding hopper, then passes through the heated cylinder body with the help of a rotating extruder screw, while it melts. The homogeneous molten material is pressed out of the equipment in the form of many parallel threads. These soft fibers are cooled and the solidified thin fibers can then be cut to the same size and appearance (*Figure 8*) (Ronkay et al. 2014). This is how we finally get regranulates, reinforced with other additives and made more resistant, which are secondary raw materials for the production of plastic products. Egg cartons can be produced from these regranulate "grains" by injection molding. Automatic machines have produced more than 20 million egg cartons made of recycled plastic in the Jász Plasztik factory in Nagyréde, which employs nearly 100 people (Pásztor 2013).

Figure 8. Regranulates made from PET bottles (Source: jp.hu 2022)

A high-volume of products can be produced quickly and efficiently with injection molding. The advantage is that while the extruder can only produce a product with an unchanged cross-section in an infinite length, injection molding can produce complex 3D products of any shape, in batch mode, or even completely waste-free. As with the extruder, injection tools are not universal in injection molding, i.e. only one type of product can be produced with one mold (Ronkay et al. 2014).

In today's unsustainable world, plastic recycling has become an indispensable tool for the circular economy. The circular economy is a sustainable model in which tools and objects that have reached the end of their use are either made suitable for reuse or reprocessed and utilized as secondary raw materials. This model focuses on the recycling of materials and energy (Tátraaljai and Pukánszky 2020).

3. REMANUFACTURING FROM PAPER

The collection and recycling of residential paper waste is relatively stable in the EU. Even decades ago, for example, school paper collection worked well as a tool of environmental education. In the reuse and recycling of paper waste, the infrastructure

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of domestic waste processing has never encountered such obstacles as in the case of plastic waste in the early 2000s, or nowadays in the case of glass waste. The production of paper is an activity with a heavy environmental burden, as, among other things, large amounts of water and additives are used. The most important problem is, of course, the destruction of forests, with which the primary raw material needs are met.

The production of paper requires vegetable fibers, which are mostly extracted from wood and wheat straw. These raw materials are called primary fibers, while those produced from paper waste or textiles are called secondary fibers. In paper recycling, packaging paper production is at the forefront, cardboard and corrugated paper products (e.g. boxes, paper bags) are produced almost entirely (95-98%) from paper waste. In households, sanitary papers (toilet paper, handkerchiefs, hand towels), writing paper, notebooks, and egg trays can also be made from recycled paper. After the waste is mechanically torn and broken down into fibers, gypsum and water are added, pressed, and dried to produce environmentally friendly plasterboard sheets, which are widely used in the construction industry.

Figure 9. The rolled-up paper raw material (greendex.hu 2022)

The first step in the processing of the logs delivered to the paper processing plant is the preparation of the wood pulp. This starts with stripping off the bark, which is done with the help of debarking machines. These steps are of course omitted if waste paper bales are received as production raw materials. A large amount of water is added to the shredded wood or waste paper. In addition to water, the wood is pulped with various chemical substances, and the color of the paper to be produced is bleached with chlorine or hydrogen peroxide. In the work phase of sieving, the liquid paper is transferred to the cylinder row with the help of a sieve cloth, where the water is extracted from the paper with the help of different press cylinders. This is where the thickness of the paper is set, and the material begins to dry as a result of water loss. As a final step, the paper is stretched, dried and rolled up (*Figure* 9). This is how it becomes economically transportable as a raw material (Szebenyi 2021).

The selectively collected municipal paper waste is first sent to a waste sorting facility, where various inappropriate materials (plastic filmand/or metals) are removed by manual or mechanical sorting. It is then compacted into bales weighing hundreds of kilograms and transported to paper mills for recycling. Packaging and other "soft" papers, as well as paper cartons are sorted in the sorting plants, so that paper bales with the right composition already arrive at the processing plants. The cardboard itself can of course be made by reusing cardboard waste.

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CASE STUDY 3: Cardboard furniture

Cardboard furniture (Figures *10* and *11*) has many advantages over traditional furniture. It is very light, flexible, stable, easy to design and recycle, and last but not least, cheap. Since it is lightweight, moving or rearranging this furniture is much easier compared to traditional furniture. Another advantage is being able to use paint, pencil, etc. to easily make it unique. Cardboard is made from 77% recycled paper.

Figure 10. Office furniture made of cardboard (onemusic.hu 2022)

The cardboards from which the furniture is made are manufactured specifically for this, thus nothing is stored in them beforehand, so they do not get dirty. Their use should only be avoided in the kitchen and the bathroom. They can easily get wet in wet places; in this case, their load-bearing capacity is reduced, and spots can form, at which point both the stains come for where they have been soaked and then dried. For similar reasons, special attention should be paid to drinks and cleaning with copious amounts of water should also be avoided.

Figure 11. Office furniture made from recycled cardboard (divany.hu 2022)

Cardboard furniture is characterized by simple design and functionality. These pieces of furniture do not lose their shape and hold even after many years of use, the chairs have a load capacity of 150 kg. The products are available flat-packed and folded, so they can be easily transported and mobilized during exhibitions. The entire surface of the products can be printedon, so that completely unique graphic designs can beprinted on the surface as requested by the customer (ookpress.hu 2022). Hand-made cardboard furniture is custom-made at several domestic small businesses. The use of paper furniture in the construction of unique exhibition stands is breaking new ground and conveys a new lifestyle. The production of cardboard products and their presentation at events promote both environmental awareness and sustainability.

4. ADVICE FROM EXPERTS

" With effective insulation, we help not only the environment, but also our wallet: our heating and cooling costs are reduced, so the insulation pays for itself quickly, not to mention the comfort of our home."

Gabor Takács
managing director
TaGa Mérnöki Kft., Hungary

Advices from the expert:

1. Polystyrene products help protect our planet's climate, and we build a sustainable future with environmentally conscious buildings.

2. The lightweight concrete additive is a surface-treated expanded polystyrene bead. This admixture is used to produce lightweight concrete with good thermal insulation and adequate strength using cement and water.

3. Waste polystyrene can be collected uneconomically due to its large volume. However, with the increase in energy costs, the value of all raw materials - which can contribute to the energy modernization of buildings - increases significantly. Polystyrene is definitely such a material.

"The future of our descendants depends to a large extent on how we process the waste generated by consumer society"

Csaba Patkós
institute director
Department of Social Geography and Regional Development EKKE

.

Advices from the expert:

1. The goal is to be able to process as much of the waste produced by the consumer society as possible, not just to consider it as garbage, but as a

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secondary raw material and therefore a value, and to transform it into a product again.

"If eco-sustainability, innovation, and of course uniqueness are important to you, then you should definitely try paper furniture."

Tamás Misik
assistant professor
Károly Eszterházy Catholic University
Department of Environmental Science and Landscape Ecology

Advices from the expert:

1. The share of paper and cardboard waste in municipal waste is constantly increasing. Therefore, all environmentally conscious solutions that aim to turn paper and cardboard into products repeatedly should be supported and followed.

2. Uncontaminated black and white paper waste can be composted together with garden and kitchen green waste, so we have the option of recycling it at the point of origin. With on-site composting, the CO 2 emissions resulting from the transport of waste will be zero.

3. The life cycle of paper products can be significantly extended, as they can be recycled 5-7 times without significant deterioration in quality. Products made from paper and cardboard waste have a very wide range and availability for consumers. All of these can be tangible positive examples for those who are skeptical of selective collection. Let's set an example by buying such products.

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5. SELF-DIAGNOSIS

A few questions to ask yourself…

1. **Why is it worth recycling waste into the production cycle?**

2. **Why is the collection and storage of residential polystyrene waste a big challenge for waste management?**

3. **What are the reasons for increasing the recycling rate of plastics?**

4. **Why is it of particular importance that as much selectively collected paper waste as possible be returned to the production process?**

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RAW

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3

CHAPTER

MANAGERIAL PRACTICES FOR CIRCULAR ECONOMY BUSINESS MODELS

VET TRAINERS WORKSHEET:
LEARNING OUTCOMES

Circular Economy Awareness App:

ANDROID

iOS

Chapter 3: Managerial practices for circular economy business models

This chapter focuses on **circular economy as a new production and consumption model** that ensures sustainable growth over time. It presents the tools which can drive the optimization of resources, reduce the consumption of raw materials, and recover waste by recycling or giving it a second life as a new product.

SKILLS:

- Be able to identify the concept of circular economy
- Be able to explain the difference between linear and circular economy
- Be able to give the examples of the business models for the circular economy

KNOWLEDGE:

- To understand the main concepts of circular economy
- To understand how economy models relate to waste management
- To have basic knowledge of the of tools that can help you implement a new business model

ATTITUDES:

- Raise awareness on circular economy in your business
- Develop the motivation and a commitment to the protection of environment
- Value a sense of responsibility for your actions in your business

LENGTH OF THE COURSE:

Chapter 3 has 12 pages.

Study duration is appr. 2h.

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CHAPTER 3: MANAGERIAL PRACTICES FOR CIRCULAR ECONOMY BUSINESS MODELS

INTRODUCTION

The aim

The aim of Chapter 3 is to raise awareness of circular economy among employees of chambers of commerce, regional development agencies, local authorities, and centres for entrepreneurship development, with the focus on the tools that can help you implement a new business model. In addition, will help foster the cooperation between municipalities and entrepreneurs in achieving the common goals: eliminate waste and pollution, circulate products and materials (at their highest value), and regenerate nature.

The objectives

This chapter focuses on the Circular economy as a new production and consumption model that ensures sustainable growth over time. It presents the tools which can drive the optimization of resources, reduce the consumption of raw materials, and recover waste by recycling or giving it a second life as a new product.

The rationale

The main aim of the circular economy is to make the most of the material resources available to us by applying three basic principles: reduce, reuse and recycle. In this way, the life cycle of products is extended, waste is used and a more efficient and sustainable production model is established over time. The balance between progress and sustainability is maintained.

The learning outcomes

Thanks to this chapter, you will learn the main concepts of circular economy and understand how economy models relate to waste management. You will also explore the examples of the business models for the circular economy and the tools which can drive the changes.

The duration of the course/study of this chapter:

Approximately 2h

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1. TOWARDS CIRCULAR ECONOMY

The traditional type of business model, prevailing both in Europe, as well as globally, is called the linear model. It is estimated that currently about 92% of the world's industry runs within this model[1]. Despite its continuous economic efficiency, the linear model encounters more and more difficulties related to obtaining and ensuring constant supplies of eligible raw materials.

The linear model, in simple terms, is an economic model, which consists of extracting raw materials from which goods are produced. Subsequently, these goods (products) are used and thrown away. This is a model that has been with us since the beginning of the industrial revolution. It is hard to imagine, however, that the pioneers of the new economic systems at that time could have predicted to what extent this system would develop, and at the same time how much waste it would create and how quickly it would contribute to the resource depletion. Nowadays, it is known that this system, straight from the industrial revolution does not work, due to the exhaustion of strategic natural resources, as well as the amount of waste and garbage generated. The time has come to construct new systems and business models adequate to our times.

An alternative system is the circular economy business model (CEBM). This model, which is garnering more and more attention from the scientific and business communities, seeks to address the issues of its predecessor by securing a permanent and reliable access to raw materials. In doing so, it improves business processes, creates enterprises with an innovative way of operating and increases their operational safety, while protecting the natural environment[2]. Currently, around 8% of the world's industry operates under this system.

Figure 1. https://pixabay.com/pl/photos/thermal-power-station-moscow-rosja-3895097/

To attain economic, environmental and social benefits, companies must create new business models that decouple economic growth from raw material inputs by using a

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circular approach. In a circular economy, products and resources are used for as long as possible, for example by reusing or repairing products – rather than throwing them away.

The idea of a circular economy is a challenge but, at the same time, a huge opportunity for business. The actions that should be taken are necessary in the light of worrying analyses indicating the depletion of natural resources, and more importantly, changes in the environment negatively affecting human life and health. Experts point out that the transformation of the economy, in the transitional period, which often means inconvenience to market participants, will not result in constraints in consumption and growth of enterprises in the long run. New business models, based on the circular economy model, will result in the creation of new opportunities for enterprises. Currently, most entrepreneurs declare that they implement circular economy solutions to comply with applicable regulations. However, the optimal situation will come when the implementation of circular economy solutions will be more effective for enterprises or at least cost- and quality-neutral. According to experts, this will happen in the near future with the development of technology and solutions for the circular economy.

CASE STUDY 1: Press Containers in Dąbrowa Górnicza City

Increased waste production is a huge challenge for local governments, which are responsible for waste management. Not only is the quantity of recycling important, but also the purity of the raw material obtained, the logistics and the storage of the collected waste. Therefore, looking for new solutions and investing them now may turn out to be an ideal support for the entire waste management process in the near future.

At the end of 2020, a pilot programme was carried out in Dąbrowa Górnicza to equip the local PSZOK (Selective Waste Collection Point) with a press container for the collection of paper and cardboard. What is a press container? It is a device that combines storage (container) and mechanical (press) functions. In this case, the waste is thrown into the baling chamber through the chute, and then the hydraulic system - or any other system that allows crushing - compacts the material collected in the chamber.

The biggest challenge was to convince people to accept the project and to popularise it among the residents. Thanks to the information campaign, more and more people began to use the press container, which directly contributed to:

- obtaining a larger amount of good quality raw material - the collected paper and cardboard, thanks to the closed form of the press container, are not exposed to weather conditions,
- limiting the number of containers standing in one place for collecting paper and cardboard - thanks to waste compaction, one container holds more waste than a standard container,

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- limiting the number of journeys of waste collection vehicles to an average of one journey per month, while increasing the weight of the raw material obtained (on average 1.2 tons of paper and cardboard per journey).

Thanks to the implementation of the pilot programme and the achieved effects, a total of three press containers are currently installed in Dąbrowa Górnicza, which support waste management in the commune.

Figure 2. https://unsplash.com/photos/WYd_PkCa1BY

2. BUSINESS MODELS FOR THE CIRCULAR ECONOMY

A circular economy business model (CEBM) enables regeneration of finite natural resources and keeps products, components and materials from degradation. Despite the fact that many systems of this type have already been created, they all focus on ways to extend the life of products, their sharing or dematerialisation. We will present seven business models that are in line with the guidelines of the European Commission, as well as research and the proposal of the EU R2 π project.

- Circular raw materials

At the production stage of the circular economy cycle, we can find the circular raw materials model. It consists in basing production on circular raw materials, *i.e.*, those that can be used in a closed circuit. In other words, such raw materials that are recycled or renewable and at the same time can be returned to technical or biological cycles. An example of such a model is virtualisation, *i.e.*, replacing a real product and service with a virtual product or service available online.

- Recovery of by-products

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By-product recovery is a business model where residual or secondary products of one process (or value chain) become inputs for another process (or value chain). That is, what is waste for one producer may be a valuable raw material for another. By creating entire ecosystems of companies cooperating in this way, you can not only reduce the amount of waste, but also significantly reduce the costs of obtaining raw materials.

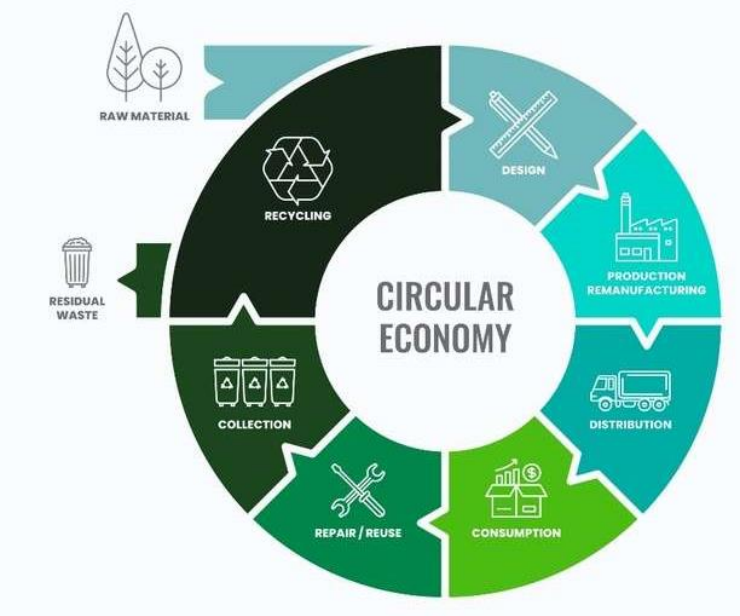

Figure 3. https://pl.freepik.com/

- Modification

This management method applies to the production stage and consists in extending the life of the product by modifying it through repairing, refreshing or improving the aesthetics. It makes the product the same as new or better than the new and obtains extended warranty.

- Repair

This is another example of a model at the production stage of the circular economy cycle. It consists in extending the life of the product by repairing, refreshing or improving its aesthetics, without extending its warranty, but without modifying the product.

- Product as a service

In the new closed-loop model, the manufacturer provides the consumer with constant access to the functionality he needs, not to a one-off product. The product becomes a service, and producers of goods take on the role of service providers. Products as services can be sold in a subscription, leasing or pay-for-use model. Efficiency is more important than quantity, durability is more than disposable. This leads to innovations in product life extension and recovery.

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- Access

The so-called "Access" is a business model that can be implemented at the use stage of the circular economy cycle. It consists in providing the end user with access to the product/resource instead of owning it. A classic example of the application of this model are rental companies - from libraries to car renting. In the virtual version, they correspond to online platforms that offer virtual products - such as e-book rentals or streaming services for movies and series or music (like Spotify and Tidal). The user may use the products and resources available there free of charge or for a fee, but may not own them. Another application of this model is sharing platforms. Consumers can rent, share, trade or loan their goods. This is how they earn or save money. Well-known sharing platforms include BlaBlaCar or AirBnB.

- Recycling of raw materials

Recycling of raw materials is a business model, thanks to which it is possible to maximise the economic value of each produced item, and at the same time the life cycle of the raw material is extended. This model can be implemented at the end-of-life stage of the circular economy cycle. It involves the recovery of used materials or products for use in new products, processes or value chains.

CASE STUDY 2: Maskup

Maskup is a company that reduces environmental impact by manufacturing special 'face shields' that protect clothing from traces of makeup during changing. Clothing store owners do not have to throw away tons of dirty clothes. On the other hand, private customers extend the service life of their garments. Plus, one washes stubborn stains less often, saving water, electricity and chemicals.

- Circular raw materials: the company uses polypropylene as the material for its Maskups. It is a type of renewable plastic that is 100% recyclable and can gain a second life;
- Recovery of by-products: there are no by-products, everything is calculated in such a way that there are no scraps or waste, simply meaning that the production line is tidy;
- Modification: when a woman wears out a Maskup or it gets shredded, it can be used as a bathroom trash bag and the Maskup packaging can be used as a jewellery box;
- Recovery of raw materials: Maskups themselves are raw materials, and recycling companies want them in large quantities.

The company orders such nonwoven rolls to ensure that there are no scraps during production. A well as the use of polypropylene as a renewable material for the production of Maskup. The company intends to introduce environmentally friendly

packaging made of plant-based foil that dissolves in nature. Moreover, during the startup competition, mentors suggested that they use Maskup as home insulation if

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they were sufficiently converted. The EU would strongly support such initiatives, especially given that raw materials for home insulation are becoming increasingly expensive. Maskup is also planned to be introduced in clothing stores, as each cover costs less than taking one dirty blouse to the washhouse by the companies.

Figure 4. https://maskup-makeup.pl/en

3. THE CIRCULAR ECONOMY TOOLS

In order to effectively implement a system in line with the circular economy strategy in your company, you need the right tools:

- circular economy standards,
- circular business model templates,
- analytical tools,
- environmental management systems.

Here are six examples of tools that can help you implement a new business model.

Figure 5. https://pl.freepik.com/

- Circular Economy Guidelines

This tool shows in six steps how to plan the process of implementing the chosen CEBM. Each step is described in detail, ready-made work materials are prepared, which were developed by the European R2π project commissioned by the European Commission as part of the EU Horizon 2020 programme.

You can read more about this tool here: http://www.r2piproject.eu/

- BS 8001 Norm

It is a practical guide to implementing the circular economy in an organisation. It describes the six principles of circular economy: systems thinking, innovation, management throughout the cycle, wide cooperation, value optimisation and transparency. It splits up their implementation into eight stages, from the analysis of the starting point, through building and testing business cases, to reporting and monitoring. This approach allows for a comprehensive look at the organisation in all aspects of its functioning. It also allows to diagnose the current state of the organization regarding circular economy and indicates strategic development directions for the future.

You can read more about this tool here:
https://www.bsigroup.com/en-IE/standards/benefits-of-using-standards/becoming-more-sustainable-with-standards/BS8001-Circular-Economy/

- Diagnosis GOZ

This circular economy matrix is prepared individually for each company. It contains circular economy issues important from the point of view of the specificity of the company and its industry, which are then analysed in detail. A review of the approach to the analysed issues on the market is also prepared. The circular economy diagnosis helps to determine the level of circular economy implementation in the company, to learn about the strengths and weaknesses and the best good practices in the industry. It also provides proposals for further actions. It is recommended as the first step to prepare a strategy for achieving circular economy in the company and/or implement the BS 800 standard.

You can read more about this tool here: https://www.csrconsulting.fr/

- Circulytics

This tool contains a set of indicators that measure various aspects of circular economy. It examines enabling factors and outcomes. It allows to assess the circularity of both production flows and the entire value chain of a company. Companies using the tool receive their results in various areas along with expert commentary.

You can read more about this tool here:
https://ellenmacarthurfoundation.org/resources/circulytics/overview

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- CTI Tool

This tool examines the circularity of material and energy flows in a company, the consumption of critical raw materials and the circular material efficiency. However, it does not measure the circularity of the entire enterprise.
You can read more about this tool here: https://ctitool.com/

CASE STUDY 3: Rambutan

BASF's Rambutan programme aims to create renewable raw materials from sustainable sources. High-quality active substances to produce cosmetics are obtained from previously unused parts of a plant called rambutan.

One of the pillars of the circular economy are renewable raw materials obtained from sustainable sources. There is a constant search for new renewable raw materials, for example plant-based ones, that could replace non-renewable raw materials. In addition, it is important to obtain them sustainably, *i.e.*, by building new, sustainable supply chains.

BASF researchers are always looking for useful active ingredients in nature - for example, in plant bark, leaves, roots, seeds and fruits. They analyse thousands of samples every year. That is how they discovered the substances contained in rambutan (*Nephelium lappaceum*) - a tree whose fruit closely resemble lychee. BASF scientists have determined that the liquid extract of the leaves of this tree has an activating effect on various genes of human skin and supports the production of collagen. In addition, active ingredients from the peel and grains of the rambutan fruit have a beneficial effect consisting in better skin hydration and stimulating hair roots.

BASF has found a way to use not only the juicy fruit, but also the skin, leaves and seeds, so that no part of the plant is wasted.

In pursuit of sustainable sources of cosmetic ingredients, BASF scientists built a socially and environmentally responsible supply chain in cooperation with local partners from Vietnam and launched cultivation in the first two organic rambutan gardens in Vietnam. This programme allows workers to earn above-average incomes, offers them health insurance and provides safer working conditions. As a result, the rambutan superfruit benefits not only consumers, but also workers and local wildlife.

Figure 6. https://pl.freepik.com/

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4. ADVICE FROM EXPERTS

"Profitability only appears when the entrepreneur really sits down and thinks about it; it doesn't come suddenly, it doesn't appear as a Christmas present. It really needs to be thought through, there are a lot of options to consider."

Maria Pawińska, Co-founder and CEO

Maskup sp. z o.o.

Advices from the expert:

1. Design Thinking in circular economy allows to plan activities to be designed without gaps.

2. There is no need to change the machinery to make the economy more economical; simply avoid purchasing aged materials. It is sufficient to begin producing from durable materials, such as clothes in thrift stores that are decades old and still look like they were just made.

3. The manufacturer can start a garment repair shop and can additionally benefit from having these garments professionally repaired. The customer will not have to look for a seamstress and simply send it back, which means that an additional service can be launched.

mask·up

"Entrepreneurs and businesses have a tendency to want to take the shortest route, i.e., to gain the most with the least expenditure. If we don't introduce some kind of restriction to narrow this path, then business has no limits and, let's face it, it will always take shortcuts. On the other hand, if regulations are introduced, business will always look for the cheapest way to produce a product."

Julita Pawińska, Vice President.

Maskup sp. z o.o.

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Advices from the expert:

1. Be open to new solutions and design the business differently.
2. The important thing is the goal that entrepreneurs impose on themselves. If the goal is to produce something that will have a low negative impact on the environment, the goal will be achieved just by analysing their product step by step during the design process,
3. Start with a diagnosis of the company's negative environmental impact, looking at the whole business and everything that happens with raw materials and carbon footprint - how much is transported, where the product goes, what happens to it - and then point out where the negative impact is. That is how the way is shown, which problems there are to solve.

"We must mitigate climate change. We therefore support the goals of the Green Deal. But to realise them, we also need an ambitious industrial strategy from policymakers."

Source: BASF SE

Dr. Martin Brudermüller,

Chairman of the Board of Executive Directors and Chief Technology Officer.
BASF SE

Advices from the expert:

1. There are three action areas to focus first: new feedstocks, new material cycles, and new business models.
2. Develop business models in which digitalisation helps to conserve resources.
3. Ask yourself: How can we keep raw materials circulating to be reused as long as possible? How can we avoid waste, conserve resources and protect our environment? And how can we ensure that this is all affordable and therefore sustainable?

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5. SELF-DIAGNOSIS

A few questions to ask yourself…

1. **How does my business impact the environment?**
2. **How does my businesses contribute positively to the environment?**
3. **Which materials do we waste the most?**
4. **How can we prevent the waste from causing any damage to the environment?**
5. **Which are the benefits to entrepreneurs of taking steps to reduce their negative impact on the environment?**

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RAW

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4

CHAPTER

REUSE AND REDISTRIBUTION

VET TRAINERS' WORKSHEET:
LEARNING OUTCOMES

Circular Economy Awareness App:

ANDROID

iOS

Chapter 4: Reuse, redistribute

This chapter focuses on the **reusing and redistribution of goods and materials in business and manufacturing.** The topic of waste management does not just focus on throwing out less, but also on producing less and using the things we own to their full potential.

SKILLS:

- Be able to identify basic concepts of redistributed manufacturing
- Be able to apply the basic concepts of sharing economy in your Business
- Be able to give examples of successful case studies on the topic

KNOWLEDGE:

- To have knowledge about sharing economy
- To understand how economy models relate to waste management
- To have basic knowledge of the redistributed manufacturing concept

ATTITUDES:

- Raise awareness on sharing economy in your business
- Influence and motivate colleagues on reusing possibilities in the company
- Further explore examples of companies following the concepts of reusing and redistributing materials

LENGTH OF THE COURSE:

Chapter 4 is 10 pages

Study duration is appr. 2h

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CHAPTER 4: REUSE, REDISTRIBUTE

INTRODUCTION

The aim

The aim of module 4 is to raise awareness of effective waste management techniques among employees of chambers of commerce, regional development agencies, local authorities, and centres for entrepreneurship development, with the focus on two activities: reusing and redistributing. Additionally, the RAW project will help foster symbiosis and cooperation between municipalities and entrepreneurs who are working to disrupt traditional waste-handling habits.

The objectives

This chapter focuses on the concepts of reusing and redistribution of goods and materials in business and manufacturing. The topic of waste management does not just focus on throwing out less but also on producing less and using the things we own to their full potential.

The rationale

The zero waste principle is a way of living that encourages the reuse and recycling of resources near the entire product life cycle. This can be applied to businesses. It aims to reduce costs and improve waste management practices in the production process. In terms of communities, the zero waste principle supports economic and social well-being as well as a cleaner environment.

The learning outcomes

In this chapter, you will learn the definition of reusing and redistribution in the topic of sustainable business and circular economy. You will learn what redistributed manufacturing, and the sharing economy is, and how these economy models relate to waste management.
You will also explore examples of companies following these definitions.

The duration of the course/study of this chapter:

Approximately 2h

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1. REUSE – GIVING ITEMS A SECOND LIFE

The idea of reusing items has been around for a very long time. In an earlier era, nothing went to waste. If possible, unfashionable dresses were altered to fit new styles, they were re-cut for children or teared up and used as rags until nothing was left from the original garment. All waste was recycled or reused depending on possibilities and items were first and foremost fixed rather than replaced.

With the industrialisation of the XIX century rose the second-hand market that we know now, whether in the form of retail chains, outlets, charity shops, "shared wardrobe" websites or second-hand online shops.

Reuse – to use for a second or further time, to make use of again – is the simplest way of reducing the waste brought into the environment in the current economy. Reusing items or packaging extends a product's life, minimizing environmental impact, limiting the use of virgin materials, reducing greenhouse emissions, saving money and most importantly allowing the product to be used to its fullest extent.

However, reusing doesn't just focus on clothes or everyday household items – while they are still very important to the environmental impact they have on our planet. In general, reuse can focus on every aspect of production, delivery or products. Multi-use packaging, while having a higher initial cost for both producers and consumers, is a great example of saving the environment and money in the long run.

Figure 1

A study from 2021 conducted by Circular Economy Portugal showed that replacing 50% of packaging in food and beverage containers in hotel, restaurant and catering industries, e-commerce fashion and household care in retail, for reusable ones would mean up to 13 times less impact on the environment depending on the product category.

Reaching that 50% in Europe would mean 2 660 full truckloads saved from landfills, more than 4 million Olympic pools in water consumed and economic saving worth up to €16.261billion. There is also a social impact associated with this change, because

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of changes at various levels there is an aspect of job creation in reverse logistic models.

An important point of reusing a component or product should be considered against the energy consumption throughout its lifetime. For example, older electrical and electronic equipment tends to consume more energy, which might offset product life extension achievements.

CASE STUDY 1: Emaus

Emaus – Rzeszów is an association that is an excellent example of giving everyday household items a second life while also helping those in need. They operate on a local level with two main spaces in Rzeszów and Czudec in Poland.

They source second-hand items by a donation from local people, the items can be brought to their premises during hours of operation or after contact with the association, they can organise pickup with their transport. This ensures that all items, no matter the size and weight, can be transported and have a chance at second life with a new owner. Donated items include furniture, home equipment, antiques, books, toys and others. Those items are then sold at fairs.

Emaus uses social media to share new items that can be brought, to increase visibility and the chance that these items will be sold. This allows more people to find these articles and find a new home.

- Having such a wide range of items, that can be donated and then sold, creates possible wider audience/more customers;

- Easy donation methods and help with transport make it so fewer items land in landfills, making a positive impact on the environment.

Additionally, Emaus is using profits from sales to help those excluded from society, employing them in their second-hand fairs, as well as organising workshops on the topics of social inclusion and professional activation.

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2. REDISTRIBUTION: ACCESS VERSUS OWNERSHIP

Within the circular economy, there is a shift in the distinction between consuming the thing – product or material – and using it. Biological materials are materials that can be safely returned to the natural world after they have been used, where they will break down over time and release essential nutrients back into the environment. Technical materials cannot re-enter the environment. These materials, such as metals, plastics, and synthetic chemicals, must continuously cycle through the system so that their value can be captured and recaptured.

In a circular economy, biological materials are the only ones that should be thought of as consumable, while technical materials are the ones that are used. It makes no sense to say that we consume our bicycles and ovens in the same way that we consume food. Our relationship to materials needs to be viewed differently in a circular economy, to create a more sustainable and environmentally friendly way of living.

That seemingly small distinction poses a new question - do we need to own everything to use it? Another question that follows this idea is, how many objects do we own for that "one thing" project that needed to be done?

The most environmentally friendly objects are those used frequently. Frequent use makes the overall cost lower, there is no need to produce more of the thing to satisfy the same need in the area. It's the access to a product that is important rather than the product itself. Owning requires something new to be manufactured, while access uses what's already made.

This leads to the sharing economy, a fairly new concept coined in the 1970s. The idea of sharing economy is based on giving access to a product or resource to an individual or company for some time, in most cases making it more affordable per use. In most cases, the lending of the resource is aided by IT solutions (a website and/or a mobile app). The main goal of sharing economy is to connect people who have underutilized assets with those who want to use them.

Figure 2

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There are two main types of digital spaces in sharing economy: companies that developed their platforms to give access to items and resources, and typical sharing platforms where the owner of the website is there to help connect owners with a person needing it. In both cases, the platform is there to connect the owner of the item with the customer.

This concept in a way shifts the responsibility for the item to the collective.

CASE STUDY 2: Girl Meets Dress

An example of sharing economy and battling the "one-time" use of clothes, especially those for evening wear and party wear, are clothes renting spaces that are being created. Most of them are operating on a regional or national level through online spaces, with some organising "pop-up shops". A limited area of operation ensures low delivery costs and an environmental impact.

One of these rental spaces is "Girl Meets Dress", operating in the UK. Their focus is formal wear for women in categories ranging from personal events like weddings or christenings to work events and formal parties. Girl Meets Dress has two renting systems, pay as you go – where you can rent dresses for 2 or 7 nights - or a membership system in which you get 3 dresses on rotation for a month, depending on personal needs.

Before the event you can choose up to 3 dresses that will be delivered to you, chose one to wear to a party, and after renting period is over send back all outfits using the same box you got them in.

Since you aren't buying the clothes themselves and after each "temporary owner" they are returned, cleaned and put back again "on stock" there are economic and environmental advantages of this model:

- diminishing the impact: by using clothes multiple times, individually they have a lesser impact on the environment, which is especially important with evening and party wear, where more fabric and trims are used, making it more "expensive" in CO_2 emissions
- reducing production: renting clothes reduces the further need of producing more clothes to satisfy "one-time outfits"; it's the quickest and easiest solution to bridge the gap between the need of having new outfits for every occasion and saving the planet.
- cutting costs: since you are renting the dress for a short time, the costs are much lower than buying it, making designer dresses affordable to more consumers.

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3. REDISTRIBUTED MANUFACTURING

Redistributed manufacturing (RDM) is an emerging concept which captures the anticipated change in production, moving away from large-scale manufacturing plants to smaller-scale, locally based, customisable production units, largely driven by new possibilities from digital production technologies.

Without a clear definition, there is no clear consensus on what redistributed manufacturing entails, and this model's benefits have yet to be determined. The Engineering and Physical Sciences Research Council identifies it as "local manufacturing for local communities capable of creating customisable or multi-variant products; sustainable resource efficiency and flexibility/agility in production suited to short ramp-up times".

The characteristic aspects of RDM are:

- People–focused: production isn't only based on technology and machinery but also focuses on local networks and social interactions;
- Brings production to a more local level, whether it's regional, national or continent based;
- Open source, open design linked with sharing of practices, knowledge and skills. The idea of openness brings more innovation and ideas in production and repair spaces;
- Personalisation and customisation: production being locally based, customisation of products is easier, and communication and sharing the ideas aren't limited to just written communication.

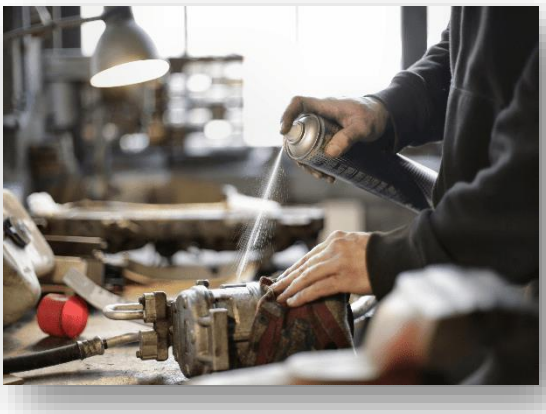

Figure 3

While small workshops and businesses start to emerge and operate in this system, many challenges and limits hold back the implementation of redistributed manufacturing and circular economy in wider form. It's worth noting that these limitations aren't unique to this particular system, but rather reflect a wider body of knowledge and barriers to sustainability in the industry.

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The main challenge to the implementation of RDM and circular economy is scalability, the uncertainty of how to evolve from prototyping and small production to larger quantities. Connected with this are supply chain management issues – the facilities to store materials and products – and knowledge of production management.

However, even with these challenges, opportunities and advantages of redistribution manufacturing are very beneficial to local communities and the environment. The underlying ideology of openness and collaboration leads to sharing of best practices and tools, making overall sustainability goals easier to reach.

CASE STUDY 3: Freitag

Freitag is an innovative company based in Switzerland that is producing everyday items from unique materials. The flagship product of Freitag is an everyday backpack made from truck tarps, but they are also making among other things phone & laptop accessories as well as everyday apparel. It's an example of many layers of sustainability and circular economy, with both reuse and redistribution, creating products with a low negative impact on the environment.

With the best of the environment in mind, Freitag uses truck tarps, recycled PET, b-stock airbags or natural fibre fabric engineered by Freitag. All materials are used with cycles in mind. Tuck tarps are made from durable and long-lasting material, making the product last for many years to come. In turn, their clothes are made fully from natural fibres, including threads and selvedge, making them 100% compostable. Additionally, the fabric is made locally in Europe, and with as few chemicals as possible making it more sustainable. With production based in Portugal, Poland, the Czech Republic, Bulgaria, Romania and Switzerland.

In addition, they have a couple of systems in place to ensure the long-lasting of the product:

- Bag repair: you can send your damaged bag to Care Points, where it will be repaired or you can repair the bag yourself at home by ordering a repair kit with spare parts that are needed.
- S.W.A.P: Shopping without payment. When you have fallen out of love with a Freitag bag you can swap your existing one for a new one. After registering your bag online, you can view other swappable bags.
- In the case of PET-based products there is a take-back system in place where you can give back worn-out phone cases, and then they are taken apart and shredded. The batch of PET granulate is then used to make new products.

Compared to other less sustainable options, Freitag products are more expensive highlining the complexity of environmentally friendly products on the market.

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4. ADVICE FROM EXPERTS

"We can eliminate waste and reduce our reliance on resources through reuse models. This idea of circular economy going to eliminate the need for primary resources."

Anne Johnson,

Principal & VP.

Global Corporate Sustainability for Resource Recycling Systems.

Advices from the expert:

1. Have an **Effective Business Model**: align your product to the expectations of consumers.
2. Understand **Desired Consumer Behaviour**, to get the benefit you are striving for.
3. Have **Efficient Reverse Logistic** to be able to bring back materials and resources.
4. Keep an eye on your **Loss Rates** to have them on as low levels as possible.

"Running a sustaiable buissness in a unsustaiable system is a journey that will take time."

Christopher Davis

Director of Sustainability, Activism and Corporate Communications.

Advices from the expert:

1. Accept the fact that having a sustainable company is a journey.

2. You need to know where you want your company to end up in the scope of sustainability.

3. To really achieve sustainability, you need to set clear targets for the future and then work backwards to what you can implement and change but the targets need to be measurable, based on science and do zero harm rule.

"In a complex system, all that we need to do is make a change in our sphere of influence. A litte change you make might cause someone else to make a little change as well."

Wayne Visser, Professor.

University of Cambridge Institute for Sustainability Leadership.

Advices from the expert:

1. Especially as SMBs, form a coalition of willing people, companies, and institutions. Make connections with businesses that share your values which in turn will help amplification of the voices and practices.

2. Look at your supply chain and customer use, most of the impact is in the things you're buying.

3. Make sure the products you are putting into the market are purpose-driven so they are aligned with a social or environmental mission.

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5. SELF-DIAGNOSIS

A few questions to ask yourself…

1. **What steps can we take to ensure reusing more items and equipment in my business?**
2. **Does your company have a sustainability goal for the future? If not, what goals can you set that will be possible to achieve in near future?**
3. **What items do you own but not use very often? How can you make sure they will be used more often?**
4. **Are there any "one-time" use items that you use? In what ways you can substitute them or ensure multiple use?**

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5

CHAPTER

USAGE OPTIMIZATION AND MAINTENANCE

VET TRAINERS WORKSHEET:
LEARNING OUTCOMES

Circular Economy Awareness App:

ANDROID

iOS

Chapter 5: Usage optimization/maintenance

This chapter focuses on the **concepts of usage optimization and maintenance in business life.** In the context of usage optimization, the effect of the product life cycle on the product lifetime is addressed. The relationship between maintenance services and usage optimization is another topic evaluated. In addition, green maintenance and lean maintenance are discussed.

SKILLS:

- Be able to carry out business and production processes according to usage optimization principles
- Be able to make maintenance plans to maximize lifespan
- Be able to understand the environmental impact of maintenance processes

KNOWLEDGE:

- To understand the usage optimization concept.
- To have basic concept ideas between maintenance and usage optimization.
- To learn green and lean maintenance principles.
- To understand the effects of usage optimization and maintenance on sustainability

ATTITUDES:

- Raise awareness on usage optimization and maintenance principles.
- Apply green and lean maintenance principles in maintenance processes.
- Develop new behaviors on waste management in business and in the environment.

LENGTH OF THE COURSE:

Chapter 5 has 14 pages.

Study duration is appr. 2h.

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CHAPTER 5: USAGE OPTIMIZATION/MAINTENANCE

INTRODUCTION

The aim

The aim of the chapter is to raise awareness among stakeholders about usage optimization and maintenance, which play a key role in waste management. We can specify these stakeholders as chambers of commerce, regional development agencies, local governments, employees and end users. Chapter 5 focuses on two key components: Usage optimization and maintenance. In these two issues, it is aimed to raise awareness among stakeholders about effective waste management approaches. Usage optimization, which is an important component of the circular economy, aims to extend the life of the product, while maintenance is an important factor that extends this life. In this chapter, usage optimization and maintenance are discussed together.

The objectives

Chapter 5 focuses on the concepts of usage optimization and maintenance in business life. In the context of usage optimization, the effect of the product life cycle on the product lifetime is addressed. The relationship between maintenance services and usage optimization is another topic evaluated within the scope of the chapter. In addition, green maintenance and lean maintenance are discussed in the context of maintenance and sustainability.

The rationale

Extending the life of a product contributes to reducing environmental waste and produces results that support the zero waste principle. Since there is a close relationship between service life and maintenance, usage optimization and maintenance must be considered together. While the right maintenance extends the life of the product, it is important for a sustainable environment to adhere to the principle of minimum waste during the maintenance stages. For this reason, lean maintenance and green maintenance principles should be followed in maintenance processes.

The learning outcome

In this chapter, the concepts of usage optimization and maintenance will be learned in the context of circular economy. The impact of Green and Lean maintenance on sustainability are the other learning outcomes of the chapter. You will find good practice examples supporting the theoretical information on usage optimization and maintenance in the chapter.

The duration of the course/study of this chapter: Approximately 2h

1. USAGE OPTIMIZATION

Product life cycle in terms of use of resources and environmental impacts; it covers the design of the product, the selection of the materials in the product, the extraction of the raw materials, the processing of the raw materials, the transportation of the raw materials, the production method, the energy sources used during the production, the packaging of the product, the storage of the product, the transportation of the product to the distribution centers, the transportation of the product to the user, the use of the product by the user, recycling processes and final disposal of the product [1]. Each mentioned step can be considering as the impact that a product has on the environment during its lifetime. The prolongation of the use of the product, which is one of these stages, contributes to the reduction of environmental waste. The phase of turning the product into waste contributes to the circular economy by turning the product into waste as intended. Usage optimization becomes an important pillar of the circular economy, given that the circular economy is an economic and industrial model [2] that aims to always keep products, components and materials at the highest utility and value across technical and biological cycles.

There are many different methods to increase the service life of products. Features such as the design of the product, the quality of the materials used, the suitability of the product for the future, keeping up with the times aesthetically, and the preservation of the functionality of the product extend the life of the product [3]. In order to reduce the effects of the ecological crisis we are facing and to leave a more livable world to future generations, the existing social, industrial and public environments expand sustainability policies in all areas with a holistic approach. Within the framework of these objectives, optimization of use of product is one important factor, since it directly extends life of product and turns products into waste in accordance with their purpose [4]. The usage optimization of the product can be defined as maintaining the current quality and functionality of the product with easy and planned maintenance and completing the life cycle of the product by using it in accordance with its purpose. As a result the usage optimization aims to reduce waste generation by extending product life or to achieve zero waste principle.

There is still confusion about maintenance and repair concepts across the society. To repair is to make a product that has lost its functionality functional again. On the other hand, maintenance ensures that a product can be used for a longer period of time without losing its functionality [5]. At this point, usage optimization is important to reduce the need for maintenance of the product and to eliminate the need for repairs.

In the context of usage optimization, when buying equipment for the working environment, it is important to consider some principles:

- take care that it is easy to maintain.
- Accesibility to the service
- there is a user and maintenance manual.

Although we are sure how much we know, it is very useful to look at the user manual when using the products. For example, plugging a newly purchased refrigerator into the outlet immediately may cause the product to fail as soon as it arrives. In addition,

some of these electronic products are damaged due to power outages due to power grid problems. Therefore, current protected sockets should be preferred within the framework of the usage optimization of the product [6]. As an example of the relationship between maintenance and sustainability, the maintenance of air conditioners, which is one of the devices frequently used in work environments, is often neglected. Eventually the air conditioner suddenly breaks down and needs to be replaced or repaired to get it working again. Both situations are Although we are sure how much we know economically, sustainability and psychologically undesirable.

However, the term usage optimization is not just about maintenance. It is also an important topic for disposable products that do not need maintenance. In this context, usage optimization can be associated with the product's lifetime. One of the important goals of usage optimization is maximizing the Product life cycle (PLC) time of the product. Undoubtedly, this will be possible with the correct use and maintenance of the product. In this context, the product life cycle, which refers to the time from the product's first encounter with the consumer to its disposal, maximizing the useful life is the main goal of usage optimization. This target is also vital in terms of waste management and sustainability.

The misuse of a product contradicts the idea of usage optimization. Surveys conducted within the scope of the RAW project show that wastes such as ready-made food packaging, PET bottles, PET cups and paper are frequently generated in the business environment. A good example of this in the context of usage optimization are the PET bottles or PET cups we use every day to drink water in the business environment. The purpose of PET bottles is only for drinking water, not for throwing sunflower seeds or other waste into it. Waste thrown into PET bottles often makes it impossible to recycle them. Similarly, applying ketchup and mayonnaise to the cardboard packaging of the food you order in the business environment makes it difficult to recycle the cardboard. Because the purpose of use of these cartons is to deliver the food to the customer in a healthy way.

In summary, for a more sustainable future, it is a must to use the products properly and do not neglect their maintenance. Maximization of the product's useful life is undoubtedly possible with correct use and maintenance. Correct planning of these processes is important in terms of waste management.

Figure 2: Repairman, Source:(freepik.com/author/pressfoto)

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CASE STUDY 1: Change that Starts with a Conference

How much can a conference change a company? You can come across one of the striking examples of this in the OSFA Group company. Fatih Görgülü, one of the employees of the company, is very impressed by what he hears at a conference on ecological awareness. At the conference, he not only explores what he listens to, but also explores how they can adopt a more environmentally friendly approach in their own companies.

He realizes that optimizing the use of products is not only more environmentally friendly, but also profitable for the company in terms of economy and time. That's enough to activate him.

Fatih Görgülü turns this idea into a project by meeting with the CEO of the company, Osman Uludağ. Within the scope of the project, he brings the record of all the materials in the company into a table and states for what purpose they should be used. In addition, this table specifically states how each product should not be used. At the same time, he writes the relevant information on a piece of paper and pastes it in the locations of the products. As this stabilizes the position of the materials in the company, it also provides a usage advantage and time savings. In addition, the maintenance times of the products in need of maintenance are also indicated in this table. By conducting this activity, the life of the products is extended, by enabling employees to use the products in accordance with the instructions given in the user manuals.

You can see an example in the photo below;

- **How to use?** – Use paper only for writing and printing.
- **How should you not use it?** - Do not apply glue on it. Do not smear other foods such as ketchup or mayonnaise on it. Avoid contact with a liquid. Don't use the papers to store another waste inside.
- **What should you do after using it?** – If reusable, set aside as scrap paper. If this paper is waste, please put it in the " paper waste recycling bin".

Figure 3: Photo showing how paper should be used in OSFA Group office (2022, October 3)

As a result, this approach is successful throughout the company, and employees jokingly warn each other. The CEO of the company, Osman Uludağ, is very pleased with the time, less waste and cost savings.

2. MAINTENANCE SERVICES AND SUSTAINABILITY RELATIONSHIP

Ecology and industry, which have been against each other for a long time, have started to come together in the concept of sustainability to overcome the economic, environmental and social problems facing the world. Although not at the desired level, this situation is positive for the future. This cooperation has resulted in industrial enterprises and manufacturing companies incorporating the environment into their strategies with an innovative approach in production in the context of industrial ecology and circular economy. This led to the transition from product to product-service systems approach. However, this approach includes maintenance, which is a natural service of the product, not an after-sales service needed to maintain the functionality of the product. Generally, maintenance is defined as a combination of all technical, administrative and managerial actions throughout the life cycle of a product that are intended to maintain or restore it in a condition where it can perform its required function.A common mistake is to think of maintenance as "fixing something when it breaks". Nevertheless, if something breaks, it means that the maintenance has failed. Since standard maintenance of products without deterioration requires an extra cost, it has a negative impact on customers, making the transition to a product-service systems approach difficult [8]. Although many manufacturers go to optimization in production by using lean production principles, maintenance costs, it is a big burden and constitute approximately 40% of the total production cost [9]. At the same time, classical care itself does not include a sustainable approach. Various challenges such as these have led to the emergence of new strategies in the field of care, such as "lean maintenance" and "green maintenance" [8].

If you are a manufacturer or a conscious user who thinks that maintenance is important, it would be useful to have information about the concepts of lean maintenance and green maintenance;

Lean maintenance is the process of identifying, reducing and eliminating waste from maintenance activities. It is a maintenance strategy that aims to increase efficiency while reducing waste in the management of products and systems. A product's maintenance strategy should be determined at the design stage. There is a common misconception that lean maintenance is only a subset or by-product of adopting lean manufacturing practices. However, in order to be successful in lean manufacturing, you must first implement lean maintenance. Lean maintenance is based on the application of lean methodology in the field of product/machine/system maintenance and repair [9].

Waste in maintenance is a perennial problem due to a plethora of inefficient practices, such as: excessive maintenance, unnecessary transportation of spares, walking back to a central location after every task to pick up new work orders, wasting time searching for tools and replacement parts , work order pile-ups due to poor inventory management, premature replacement of costly spares, delays and downtime due to slow processing or overprocessing, extra expenses to correct servicing errors and repair defects, etc. [9]. Therefore, using a lean approach to maintenance can bring major improvements to vital aspects of the manufacturing

process. Without proper maintenance, machines break down, the production process stops, your plans are messed up due to breakdown, and your equipment life is shortened.

Lean maintenance helps you maintain more effectively with fewer resources.

For lean maintenance, the following 5 main topics should be followed [9];

- *Proactive maintenance strategy:* Do not rely on a passive maintenance strategy to reduce start-up costs. Waiting for critical assets to fail before repair/replacement is inefficient.
- *Computer-assisted maintenance management system (CMMS):* A computer-assisted software is a good strategy for increasing efficiency in work order management, general planning, maintenance scheduling, backup management, budgeting, worker management, and more.
- *Updating asset inventory:* Having a fully updated inventory of all your core assets is essential for lean maintenance. You can use it to plan your repair schedules, spare parts request processes, and allocation of maintenance teams.
- *Operator training and autonomy:* Oversight by maintenance managers often leads to slowdowns and inefficiencies in the maintenance system. Firms and managers should embrace the concept of increased autonomy in the workspace in lean maintenance. This requires a team of highly trained, preferably highly skilled repair technicians.
- *Leadership change and lean culture:* Lean maintenance often requires a significant change in how systems are managed – focusing on increased autonomy at lower levels rather than overt centralization of power. This cannot happen without a fundamental change in attitudes about the role of leadership.

Figure 4: Two mechanics repairing the car, Source: (freepik.com/author/serhiibobyk)

Green maintenance is an attempt to make care more environmentally friendly by eliminating all waste streams associated with care [10]. Green maintenance focuses on integrating product design with the maintenance process to minimize negative environmental impact. This situation serves not only a cleaner environment, but also the health and safety of the personnel involved in production [10].
On the other hand, the green maintenance strategy focuses on energy efficiency. Improving energy efficiency practices and using renewable energy sources improves air quality and reduces greenhouse gas emissions that cause climate change. It also reduces ongoing operating costs by reducing electricity bills. Green maintenance is

basically an investment for a sustainable world with changes made during maintenance. For example, replacing a blown lamp with a new product with high energy efficiency and long life. In addition, green maintenance emphasizes that parts which are replaced during maintenance are designed for recycling/reuse. This mentality of green care helps reduce environmental waste and conserve natural resources [11].

CASE STUDY 2: First Step to Green Maintenance

Turkey-based Raptor Teknoloji, which was established in 2017 to carry out and develop R&D projects based on high technology and science, carried out its first general maintenance in 2022 with the "green maintenance" approach, while acting with the understanding of sustainable production and circular economy.

The CEO of the company, Enes Kale, states that they went through such a transformation when employees with high environmental awareness started working in the company. Enes Kale said, "Since the day our company was founded, we have encountered various malfunctions in our equipment due to maintenance negligence, and this has resulted in loss of time, money and customers." Enes Kale states that when they look back, the maintenance costs are very low compared to the problems that arose, and that after implementing the green maintenance strategy in his company, he also felt psychologically relieved.

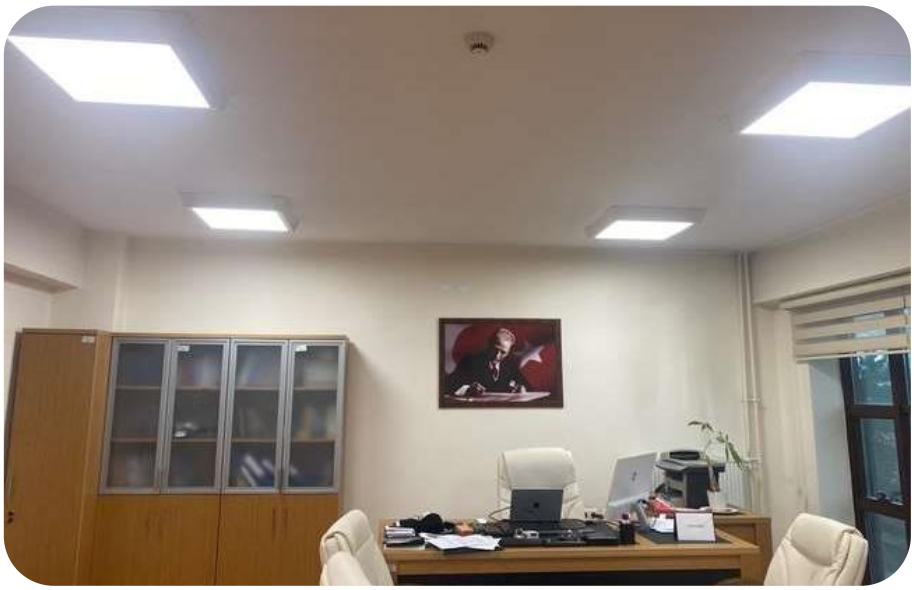

Figure 5: Raptor Technology energy efficiency study result

So how did Raptor Technology perform its first maintenance with its green maintenance approach?

- Energy efficiency and waste reduction were the main targets.

- They installed a water purifier in the offices and reduced the use of plastic bottles for water to zero. In addition, by not ordering drinking water from outside, they have reduced the carbon emissions that occur during transportation. Spare parts are available for the maintenance of the water purifier every 6 months and there are trained employees in this regard.
- They replaced all lighting devices in the working environment with the most energy efficient lighting devices. In addition, the intensity of all lighting devices changes sensitively to the light intensity in the environment.
- They now prefer using recycled paper.
- They made an agreement with a private company for the maintenance of air conditioners. They also created a special area at the entrance door of their company for thermal insulation.
- For each newly purchased equipment, employees receive maintenance strategy training or receive regular maintenance service guarantee.

As a result, Raptor Teknoloji saves time, energy and costs, as they encounter fewer breakdowns, and rises to the role of an exemplary company for the environment.

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3. ADVICE FROM EXPERTS

"Be familiar with how to perform maintenance services when purchasing products."

Assoc. Prof. Dr. Harun Gökçe, Lecturer

Industrial Design Engineering of Gazi University

Advices from the expert:

1. Address sustainability in a coordinated, integrated and formal way, not in an ad hoc and informal way. Have sustainability in production and maintenance processes as your official policy.
2. Train special workers for maintenance operations.
3. Create a multiplier effect for ecology and your company by focusing on the Green Care strategy.

"Do not wait for products to break to maintain them."

Prof. Dr. Hüdayim Başak, Lecturer

Industrial Design Engineering of Gazi University

Advices from the expert:

1. Do not misuse products in the business environment and find a way to prevent misuse in accordance with the company culture.

2. Replace products that deteriorate during repair with products with higher energy efficiency. Make sure that new parts are recyclable.

3. Do not wait for products to deteriorate to maintain them. This will cost you dearly. Instead, adopt a proactive understanding of care.

"Learn lean maintenance strategies. This may be more beneficial for your company and the ecology than you think."

Prof. Dr. Adnan Akkurt, Lecturer

Industrial Design Engineering of Gazi University

Advices from the expert:

If you are part of the manufacturing industry:

1. Adopt the lean maintenance principle when designing products.
2. Use standard components.
3. Aim for simplicity and few parts.
4. Make sure that the components are easy to replace.
5. Make designs that allow easy access for maintenance
6. Integrate sustainability into business functions.

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4. SELF-DIAGNOSIS

A few questions to ask yourself…

1. **Do you have a sample application of usage optimization approach in your business?**

2. **What do you pay attention to when applying the green maintenance processes on your products?**

3. **How do you handle sustainability in production and maintenance processes in your business?**

4. **How do you choose between energy efficiency and profitability while maintaining your products, why?**

5. **How do you relate the maintenance of products and the usage optimization?**

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RAW

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6

CHAPTER

SUSTAINABLE DESIGN

VET TRAINERS WORKSHEET:
LEARNING OUTCOMES

Circular Economy Awareness App:

ANDROID

iOS

Chapter 6: Sustainable Design

This chapter focuses on the sustainable design concept. It is presented as a way of how we can **design products and services while promoting sustainability** from the environmental, social, and economic dimensions. In addition, it contains a set of tools together with a co-creation approach explanation, for a successful sustainable design implementation.

SKILLS:

- Be able to identify the concept of sustainable design.
- Be able to explain and use existing tools and methods for a sustainable design implementation.
- Be able to give the examples of real successful cases about the concept.

KNOWLEDGE:

- To understand the main concepts of sustainable design and its various dimensions.
- To understand why a more efficient use of resources is necessary for a sustainable development.
- Have basic knowledge of tools that support sustainable design implementation.

ATTITUDES:

- Raise awareness on the need for sustainable design.
- Develop the motivation to engage relevant actors for a successful implementation of the approach.
- Encourage companies to use sustainable design tools and adopt good practices.

LENGTH OF THE COURSE:

Chapter 6 has 11 pages.

Study duration is appr. 2h.

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CHAPTER 6: SUSTAINABLE DESIGN

INTRODUCTION

The aim

The aim of the module is to focus on presenting basic concepts of sustainable design, as well as elaborating on practical case studies in order to understand the design of products and services while promoting sustainability from the environmental, social, and economic dimensions.

The objectives

In this chapter you will learn the how to identify sustainable design practices, to know existing tools and methods for its implementation and to be aware of companies and projects that already engage in sustainable design.

The rationale

Chapter 6 will take you through 3 examples of practical approaches to sustainable design. The first case study illustrates on "Fairphone", an example of how sustainable design is conducted in a holistic perspective, while the second shows a project already being implemented with tools to of sustainable design. The third example displays how participatory and co-creation practices can be useful for the innovation approach in sustainable design initiatives.

The learning outcomes

Learning outcomes achieved after this course of chapter 6 are mainly focused on shaping the learner's behaviour opinion towards sustainable design. The learners will be able to identify the concept of sustainable design, to explain and use existing tools and methods for a sustainable design implementation and to give the examples of real successful cases about the concept. A shift in patters of consume and productions are expected.

The duration of the course/study of this chapter:

Approximately 2 h

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1. SUSTAINABLE DESIGN: CONCEPT AND DEFINITIONS

The sustainable design concept has suffered an evolution regarding its concept and scope in the last years. During the 90's, it was mainly focused on product level, and terms like green Green Design and Eco-design came up. In the late 90's, it came the boost to the development approaches and terms as Design for Social Innovation were put in place.

The evolution of the scope shows the variation from a technical and product-centric focus (e.g., eco-design), towards a large-scale system level in which sustainability is considered as a socio-technical challenge, and from one product creation to complex systems with lots of interactions: as the role of users, resilience of communities, emotional aspects, etc.

In this sense, the sustainability focus has also been changed from addressing just the environmental aspects, to socioeconomic aspects such as labour conditions, poverty alleviation, integration of weak and marginalised people, social cohesion, etc. We can observe that this has been accompanied by an increased need for human-centred design knowledge.

Therefore, when talking about sustainable design, we are not just talking about the manufacturing process of products, nor the environmental impact, but in how we can design products considering social, economic, and environmental impacts the lifecycle of products. This must be thought considering the stages of raw material extraction, manufacturing, distribution, usage, recycling, and the final disposal in the landfill.

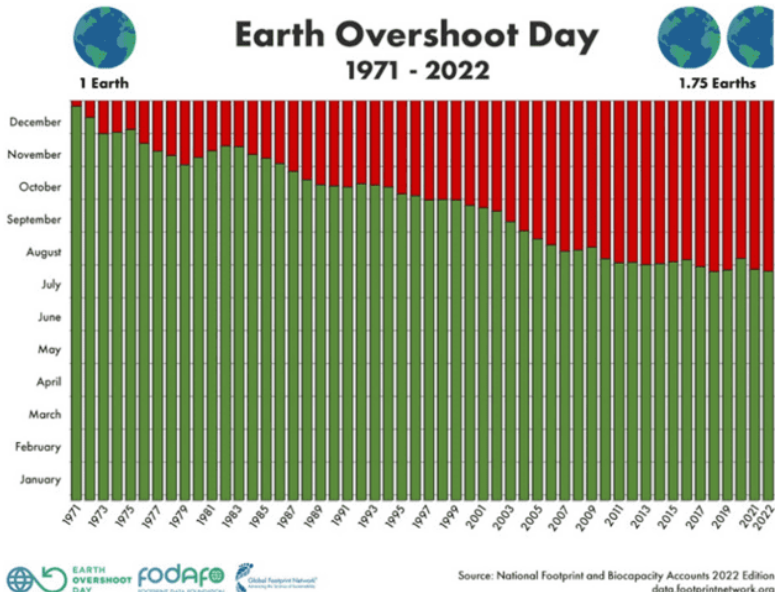

Figure 6

The sustainable design concept is closely linked to the Overshoot Day, which marks the date when humanity has used all the biological resources that Earth regenerates during the entire year.

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Each year, this date is getting earlier and earlier, which means that we are using more resources we can afford. According to latest data of the Overshoot Day, in 2022, the global population consumed the equivalent to 1.75 planets. One of the most important aspects to reduce the vast amount of resources consumption is to design sustainable products, by creating products which minimize this resources consumption along its whole lifecycle.

Furthermore, the social aspects are also considered in this study. If the **overshoot day per country** is analysed, it is possible to check that the richest countries are the ones which consumes the biggest quantities of resources. This raises the question of who has to put the bigger efforts in the ecological transition we are facing worldwide.

Other critical aspect is the competitiveness of sustainable production and the constrains of all different types which an actor may see for the process, as creating sustainable products requires big efforts, which should be shared among different stakeholders and not just to the manufacturer.

CASE STUDY 1: FAIRPHONE

"Fairphone is an excellent example of how sustainable design is conducted in a holistic perspective. This company which aims to change the electronic industry "from the inside" creates a more sustainable smartphone by implementing four main principles:

- **Creating products that last:** design for longevity, easy repair and modular upgrades, with the idea that "the longer you can keep your phone, the smaller its environmental footprint".
- **Reducing e-waste:** they promote circular economy by encouraging the reuse and repair of their phones, researching recycling options and reducing e-waste.
- **Choosing fairer materials:** by the incorporation of fairer, recycled and responsibly mined materials in their phones.
- **Putting people first:** creating better working conditions with employee representation, income and growth opportunities for all.

Because of their commitment with the change of the sector, they share their results and standard with the industry, from responsible material sourcing to advocating for workers' welfare, so the good practices applied can be replicated.

Fairphone is also a great example of the complexity of including sustainable products in the market, as its price is not affordable for everyone, and products with much more environmental and social impact are more competitive in terms of prices.

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2. TOOLS FOR THE SUSTAINABLE DESIGN

Sustainable design is seen as a great challenge for companies from different activity sectors. In this sense, there are a set of tools which can be used for this purpose so a consistent methodology is developed and sustainability is achieved:

- **The Product Design Specifications (PDS)**

Production Design Specifications (PDS) are standard practices in the development and production of manufactured products. They clearly state the properties of a product, including:

Size, specifications and materials	Environmental performance	Cost	Lifespan	Workers' conditions
Performance	Maintenance	Packaging and shipping	Safety	…

The most important thing about it is to include all the necessary conditions that a product should have, so considering these limits, improvements in terms of sustainable design can be included. The PDS has no a fixed structure and can be modified depending on the type of product assessed.

- **The Life Cycle Assessment (LCA)**

Life Cycle Assessment (LCA) methodology used in this study is based on the ISO 14040:2009 standard published by the International Organization for Standardization. Its main objective is to take into consideration all the aspects, direct and indirect, that could potentially affect the sustainability and are associated with a product or services. It results shows a rating of the impact of different stages, raw materials or processes, so improvements in the design can be implemented based on that.

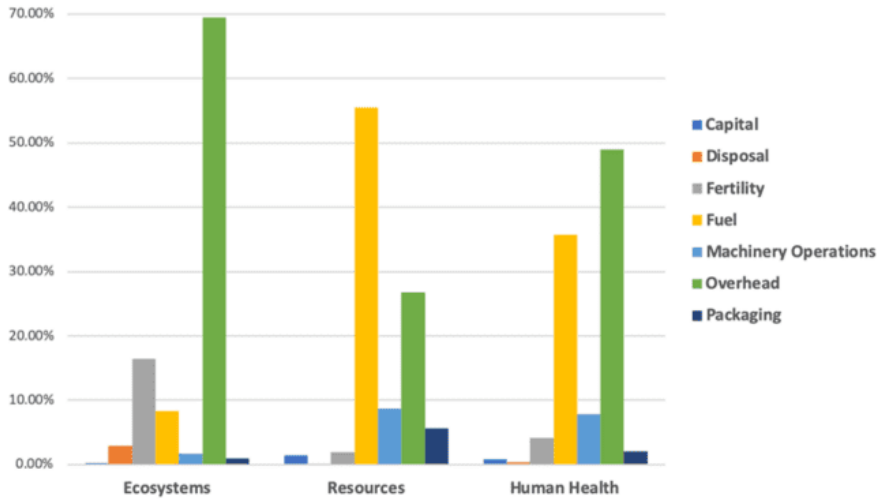

Figure 7 - LCA results example. H2020 CIRC4Life project. Deliverable 1.2 https://bit.ly/3Tl4ekW

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The LCA methodology can be used in different activity sector to apply the sustainable design and it is one of the keys for its good implementation. It is also important to remark that the LCA also cover the social and economic impacts of a product, being different methodologies but based on the same principles.

In this sense the LCA method will guide a company in the sustainable design. It will provide us information about where should we improve our practices and which are the most important point to be addressed.

- **Data mining for online consumer review**

Data mining for online consumer review is other important aspect for getting the impacts from consumers, so the sustainable design is in line with consumers preferences, one important aspect to a sustainable use of the products.

- **Participatory approaches**

Together with these tools, participatory approaches are highly recommended for the sustainable design, not only with potential consumers, but also with other relevant actors, which may influence in the design of the product and may have inputs and recommendations regarding this issue. Section 3 goes deep into the co-creation approach.

CASE STUDY 2: Sustainable design of meat products

In the framework of H2020 CIRC4Life project, Life Cycle Assessment, in the environmental and social ways, was one of the main tools used for the development of sustainable products. One interesting example is the environmental LCA influenced in the design of sustainable meat products.

The LCA was carried out for subsystems: feed production, pig housing, slaughtering, meat processing. Two scenarios: basic and improved were compared. In the basic scenario, the highest impacts are attributed to agricultural land occupation 29%, climate change 34%, natural land transformation 11% and fossil depletion 11%. Animal feed production is the most critical phase. Comparative analysis of the scenarios showed that there is a potential for beneficial trade-offs between different impact categories by changing the processes and materials for feed production. Some key factors for the sustainable design of the products which the LCA showed were:

- The most impactful are processes of production of agricultural raw materials use in the fodder production phase.
- It is crucial to pay attention to the origin of agricultural raw materials used for the production of feed. It is preferred to use locally produced materials whenever possible
- It is recommended o use by-products from agricultural production for animal feed production while ensuring the high quality of the feed.
- Pig farming causes emissions of gases to the environment related to stable and manure management and for this reason, it is recommended to use air protection solutions and manages them efficiently.

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Finally, with all these recommendations, were translated in a more sustainable meat products, and are applicable to the entire meat

3. THE CO-CREATION APPROACH

Open innovation is a concept introduced by Henry Chesbrough, who defines it as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. It assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market".

In this framework, the involvement of relevant stakeholders of different areas for the sustainable design is a key priority in every activity sector. Their engagement leads to improvements for sustainable design in line with their preferences, attitudes, and feelings.

The co-creation approach supposes a multi-stakeholder engagement to carry out innovation projects that follow the principles of open innovation and focus on real-life experimentation to co-ideate, test, and validate novel solutions. Open innovation involves external stakeholders, mainly users or consumers, making them co-participate in the innovation process.

To this aim, several participatory techniques can be used. Some examples of this techniques are:

- **Surveys**
- **Semi-structured interviews**
- **Focus Group**
- **Co-creative workshops.**
- **Prototype Testing Plan.**
- **Empathy map**

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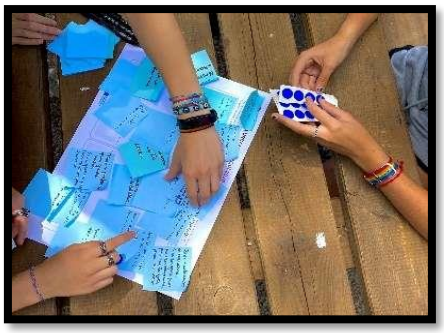

Figure 3, 4 and 5. Workshops developed in co-creation processes. ***Source:*** *EuroVértice workshops*

The goal of the method is to bring together partners, stakeholders, and end-users to co-create solutions in a couple of hours. It is composed of four co-creative phases: Co-analysis, Co-design, Co-evaluation, and Co-implementation.

This is clearly connected with the Sustainable design as in line to be successful in the future consumption, the stakeholders should be engaged from the very beginning.

In addition, it is important to remark that we live in the time with citizen are more aware about environmental aspects than any other time in history. Consumers start acquiring products and services while also considering sustainability as an important aspect. This phenomenon is expected to growth. Therefore, to understand consumers desires and to adapt practices for them is a must for companies. Consumers have the key of the industries evolution and to move them to a more sustainable behaviour.

CASE STUDY 3: SUSTAVIANFEED project.

SUSTAvianFEED "*Alternative animal feeds in Mediterranean poultry breeds to obtain sustainable products. A tangible approach for a more sustainable livestock sector based on circular economy principles*" is an EU project funded by the EC through the PRIMA Foundation.

The project SUSTAvianFEED aims to demonstrate innovative poultry farming systems by the inclusion of sustainable animal feeding: the project will develop a sustainable nutritional formula for poultry farming in which insects will play a key role and which will lead to an innovative poultry farming approach. This falls under the basis that new food chains must be environmentally friendly, foster local economies and consider social aspects. Feed production will be the mainstream of this change.

In this framework, partners are implementing a **Living Lab (LL) methodology**. A Living Lab is a multi-stakeholder approach set-up to carry our innovation projects that follow the principles of open innovation and focus on real-life experimentation to co-create, test and validate novel solutions. Open innovation involves external stakeholders, mainly users or consumers, making them co-participate in the innovation process.

This methodology has the general aim of involving relevant stakeholders and end-users along the agri-food value chain for the co-creation of SUSTAvianFEED activities and solutions.

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They will last during the whole project implementation. The ones associated to the co-creation of the sustainable diet have been already developed. These activities, among which there are participatory actions such as workshops, surveys, semi-structured interviews and others, had the main objective of improving the list of possible by-products, local ingredients, etc., to be included in the alternative nutritional diet to be developed in the project.

First interesting result have been already obtained and applied to project activities, about the quality of the diet, the reduction of soybean, the use of by-products and raw materials, the use of insects, the profitability and sustainability in a general view.

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4. ADVICE FROM EXPERTS

"Although there are tools and methods available for reducing the environmental impact of lighting products, it is a challenging task to integrate them throughout the product development process"."

Su, Daizhong.

Professor of Design Engineering and Head of the Advanced

Design and Manufacturing Engineering Centre in Nottingham Trent University

Advices from the expert:

1. **INTEGRATE** environmental and social life cycle assessment into the product development process.
2. **REQUIRED** for the PDS to include the eco-features of the product, i.e., eco-PDS, in order to ensure that the product reduces its impact on the environment.
3. **APPLY** eco-design methods, such as modular design, design for easy repair and upgrade, design for disassembly, design for reuse, etc.
4. **REDUCE** product's use to a small number of components, when possible, whilst maintaining the required functions.
5. **AVOID** the use of sticker-labels on the product materials, finishes in materials, and toxic materials.

""CLOSE THE CIRCLE. Design, produce and consume with circularity principles."

Sánchez Egea, Fabiola.

Architect expert in Sustainable Design

Advices from the expert:

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1. **DESIGN** products that are compostable, super-cyclable and demountable. Based on principles of biomimetics and green chemistry.
2. **PRODUCE** just-in-time, prefabricated, conditioned and additive manufacturing.
3. **CONSUMES and SUPPLIES** products with bio-based materials and sourced from local suppliers.
4. **RE-USE and ADD NEW VALUE** to products through consumption awareness policies. Elimination of planned obsolescence and promotion of reverse logistics and recycling.
5. **FINANCES, VISIVILISES and REGULATES** through crowdfunding, green bonds, and by supporting circular models. With multidisciplinary collaborative teams.

"It is time to take action towards meeting the Sustainable Development Goals (SDG)"

Segura Ruiz, Juan Carlos.

Head of R&D Department at SAT ALIA.

Advices from the expert:

1. **LOCAL, KM 0 AND SUSTAINABLE RAW MATERIALS**. When designing your product, consider the availability of local raw materials and/or the availability of by-products from nearby processes and/or products from other industries and that these raw materials do not come from deforested forests.
2. **EFFICIENCY OF NATURAL RESOURCE USE, ENERGY AND WATER CONSUMPTION.** Consider in the design of your product the optimisation of energy consumption, if possible, from clean and/or green energy and water consumption, a limited natural resource.
3. **CORPORATE SOCIAL RESPONSIBILITY**. Consider in the design of your product or service that in the production site of the product or service the health and safety of the workers is taken care of, that there is no discrimination in terms of skin colour, race, or gender and that they are paid a fair wage according to the work done.

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5. SELF-DIAGNOSIS

A few questions to ask yourself…

1. **Do I know how sustainable design addresses the social, economic and environmental impacts of the products in their lifecycle?**

2. **Do you consider it relevant for the environment protection to assess the sustainable design in the agri-food industry?**

3. **Taking into account the case study of Fairphone, what are the advantages and disadvantages of purchasing a product design sustainably rather than one that is not?**

4. **Why is it important to include participatory and co-creation methods in sustainable design processes?**

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7

CHAPTER

USE WASTE AS A RESOURCE

VET TRAINERS' WORKSHEET
LEARNING OUTCOMES

Circular Economy Awareness App

ANDROID

iOS

Chapter 7: Use waste as a resource

This chapter presents the most suitable approaches that can be adopted by business organizations **regarding strategies of waste management** and developing the main ideas and concepts on how these organizations can can **use waste as a resource**. Environmental, social and economic impacts are also addressed.

SKILLS

- Be able to compare circular economy principles with the principles of linear economy.
- Be able to explain how resource recovery can support the transition to a circular economy.
- Be able to evaluate the environmental, economic, and social impacts of different waste management options.

KNOWLEDGE

- To describe the environmental, economic, and social benefits of reducing, reusing, and recycling waste.
- To list different methods used to process and recover waste materials.
- To explain the challenges and limitations of using waste as a resource, and strategies for overcoming them.

ATTITUDES

- Analyse the role of regulations in promoting waste reduction and resources' recovery.
- Defend the importance of collaboration and partnerships in implementing sustainable waste management practices.
- Advocate for sustainable waste management practices.

LENGTH OF THE COURSE:

Chapter 7 has 13 pages.

Study duration is appr. 2h.

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CHAPTER 7: USE WASTE AS A RESOURCE

INTRODUCTION

The aim

The aim of this chapter is to provide an overview on how the amount of waste sent to landfills and incineration facilities can be reduced through the implementation of approaches that can be adopted by organisations.

The objectives

The objectives of Use waste as a resource chapter are to promote specific strategies for municipalities on the reusing of municipal waste and to provide general techniques that can be used by organisations to reduce the production of waste and to reuse different kinds of materials, such as paper, plastic, and glass, among other materials. Case studies of European organisations in different sectors that already use waste as a resource are presented as good practices and, finally, self-reflection of individuals and their organisations regarding the waste they produce is fostered.

The rationale

In 2020, the total waste generated in the European Union (EU) by all economic activities and households amounted to 2151 million tonnes or 4808 kg per capita, values that do not correspond to the aims of the EU. Considering these statistics, this module was developed to contribute to a wider awareness on the topic and on techniques that can impact in the improvement of these statistics.

The learning outcomes

The learning outcomes of Use waste as a resource chapter are to:

- Describe the environmental, economic, and social benefits of reducing, reusing, and recycling waste.
- List different methods used to process and recover waste materials.
- Explain the challenges and limitations of using waste as a resource, and strategies for overcoming them.
- Explain how resource recovery can support the transition to a circular economy.
- Evaluate the environmental, economic, and social impacts of different waste management options.
- Defend the importance of collaboration and partnerships in implementing sustainable waste management practices.

The duration of the course/study of this chapter:

Self-learning is expected to take 9 hours and self-diagnosis 1 hour.

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1. CONTEXT

For a long time, people believed that recycling was the best thing to do with waste to protect the environment. They were not completely wrong because there are benefits, as recycling creates jobs and reduces the waste that pollutes landfills, incinerators reduce the need to devote land and resources to traditional waste disposal methods, also reducing the energy used to manufacture goods and raising overall environmental consciousness.

However, there are also some cons to using recycling as an ecological method because recycling consumes energy, can lead to pollution, is costly and gives a sense to people that they are already doing everything they can do regarding waste, leading to excessive consumption.

People need to change their mindset by using other ways to be more eco-friendly, such as reducing consumption and reusing products giving waste a second life.

That is the aim of the Circular Economy (CE). CE is a strategic concept based on the reduction, reuse, recovery and recycling of materials and energy, replacing the end-of-life concept of the linear economy with new circular flows of reuse, restoration, and renovation, in an integrated process.

This way, waste – any substance discarded after primary use, which is worthless, defective, or considered of no use – can have a second life and be considered a resource. Waste as a resource is easily accessible, economically feasible and can help to satisfy human needs and wants more sustainably than by using raw materials

Figure 1. https://br.freepik.com/fotos-gratis/pessoa-fazendo-reciclagem-seletiva-de-lixo_18955505.htm

Statistics

In 2020, the total waste generated in the European Union (EU) by all economic activities and households amounted to 2151 million tonnes or 4808 kg per capita.

Construction contributed 37.1% of the total and was followed by mining and quarrying (23.4%), manufacturing (10.9%), waste and water services (10.7%) and households (9.5%); the remaining 8.4% was waste generated from other economic activities, mainly services (4.5%) and energy (2.3%).

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From this, some 2029 million tonnes of waste were treated in the EU. This does not include exported waste but includes the treatment of waste imported into the EU. The reported amounts are therefore not directly comparable with those on waste generation.

During the period 2004-2020 the quantity of waste recovered – in other words, recycled – used for backfilling (the use of waste in excavated areas for slope reclamation or safety or engineering purposes in landscaping) or incinerated with energy recovery grew by 40.3 %, from 870 million tonnes in 2004 to 1221 million tonnes in 2020. As a result, the share of such recovery in total waste treatment rose from 45.9% in 2004 to 60.2% in 2020. The quantity of waste subject to disposal decreased from 1027 million tonnes in 2004 to 808 million tonnes in 2020, which was a decrease of 21.3%. The share of disposal in total waste treatment decreased from 54.1% in 2004 to 39.8% in 2020.

As stated above, in the EU, in 2020, more than half (60.2 %) of the waste was treated in recovery operations: recycling (39.2 % of the total treated waste), backfilling (14.6 %) or energy recovery (6.4 %). The remaining 39.8% was either landfilled (31.3%), incinerated without energy recovery (0.5%) or disposed of otherwise (8.1%).

However, the EU still must find ways to manage in a better way the 39.8% that was landfilled. Everyone is responsible for this, but especially organisations, as they produce higher amounts of waste, having a higher impact on waste production.

CASE STUDY 1: ECO2BLOCKS (Portugal)

Pedro Humberto, a PhD student from the University of Beira Interior (UBI), invented the ECO2BLOCKS in 2018.

Pedro found that the manufacturing process of traditional cement blocks consumes a lot of energy and emits a lot of CO^2 while using natural raw materials such as drinking water, river sand and gravel. So, as part of his doctoral thesis and in collaboration with his mentor João Castro – professor at the Faculty of Civil Engineering and Architecture of the UBI–, he tried to find a more sustainable way of producing cement blocks. After several trials, they found a material that is very similar to concrete and is much more sustainable and less harmful to the environment.

The material they have developed uses industrial waste mixed with non-potable water or water from the sea and waste. The material becomes a building block in an environment specially created for hardening, where CO^2 prevails: it is a carbonisation process, unlike cement, which hardens through a hydration process.

The cost of this material is 50% inferior to traditional concrete, it is much more resistant and resembles a concrete block. The main difference is the colour and density, but this issue has also been resolved: this block can withstand up to 900 °C, while regular concrete can only withstand 400 °C.

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2. REUSING: STRATEGIES FOR MUNICIPALITIES

Municipal waste is defined as waste collected and disposed of by or for municipalities. It includes household waste – including bulky waste –, similar waste from commercial establishments, office buildings, institutions and small businesses, as well as garden and green waste, street sweepings, dustbin contents and market cleaning waste, which are considered similar to household waste. The definition excludes waste from municipal sewage systems and their treatment, as well as waste from construction and demolition. This indicator is measured in kilotons and kilogrammes per capita.

Municipal waste accounts for only about 10% of the total waste generated. However, it has a very high policy profile due to its complex composition, its distribution across many waste sources and its link to consumption patterns.

The total amount of municipal waste generated in 2020 varies widely in the EU, ranging from 282 kg per capita in Romania to 834 kg per capita in Austria. These variations reflect differences in consumer behaviour and economic conditions, but also depend on how municipal waste is collected and managed: the extent to which industrial, commercial, and administrative waste is collected and disposed of together with household waste varies from country to country.

Figure 2. www.freepik.com/free-photo/trash-bags_10095691.htm

Municipalities have a significant role in defining strategies for the reuse of waste, playing an important role in the circular economy. For example, they can set goals and create a chronogramme to plan each step of the process, involve the community in the process, increase community awareness of waste reduction and segregation, incentivise reduction and recycling, increase local trade and encourage the consumption of local products.

During this process, it is particularly important to evolve the community, to be truly clear about the results and recompensate the ones who are committed.

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CASE STUDY 2: Zero Waste Cities Certification (European Platform)

Zero Waste Cities is the European zero waste initiative that supports cities and municipalities into the transition to zero waste. It is based on a European knowledge platform for local actors to implement best practices and guidance and recognition programmes for municipalities. It is run by Zero Waste Europe (ZWE) and its member organisations.

ZWE connects and supports a network of 35 local and national non-governmental organisations from across Europe that share common values and goals and work together towards a waste-free future.

Member organisations promote waste reduction in the zero-waste hierarchy, manage a network of zero-waste communities and share ideas with policymakers and businesses.

The programme aims to accelerate the transition to zero waste, especially in small and medium-sized cities, by implementing the latest EU legislation and a zero-waste strategy based on a citizen-centered model, leading to a significant reduction in waste generation and increasing separate collection and recycling.

According to the ZWE Platform, the five steps to obtain the certificate are:

- Expression of interest: that must be submitted by the municipality to the local partner of ZWE.
- Commitment: the municipality needs to create and present its certification roadmap, under specific requirements.
- Implementation: the municipality has a maximum of two years to implement and complete the Certification scorecard and submit evidence to the formal auditor to be certified.
- Certification: After a successful third-party assessment focusing on performance levels and impacts, the applicant municipality becomes a Zero Waste Certified City.
- Yearly improvements: After certification, the municipality must carry out annual improvements to monitor and improve the results achieved. This is subject to a new audit every three years to confirm the status of the certification. There is the possibility of upgrading under a 5-star system.

3. HOW CAN ORGANISATIONS USE WASTE AS A RESOURCE?

What if we could increase the treatment of waste as a resource, and thus reduce the need to extract new resources from the environment? If we mine less material and use existing resources, we can avoid some impact along the production chain.

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For instance, entreprises can establish partnerships, as the waste of some can be the resource of others. A curious case is, for example, Danone, that, in Germany, turns whey – a by-product of cheese making – into lactose for pharmaceutical purposes. Other interesting case happens in Manchester, in the United Kingdom, where Kellogg's cereal factory has teamed up with the British brewery Seven Bro7hers, which uses the corn flakes that fail quality control to make beer. Do never forget that unused waste is always a potential loss.

Let's see some more detailed practical examples about how waste can be used as a resource.

Food waste

Retailers can reduce edible food waste by improving logistics, balancing supply and demand, redistributing surplus edible food and incorporating "ugly" products into recipes.

City and municipal governments can put in place the necessary procedures and regulations to collect organic waste separately and treat wastewater so that valuable products can be made from waste. They can also install infrastructures to supply fertilizers made from organic waste from cities to peri-urban agriculture (in conjunction with local sourcing of food).

Restaurants can redesign their menus to include components made from food scraps.

Farmers can change their practices and use fertilizers derived from organic waste streams to reduce losses on the farm.

Figure 3. www.freepik.com/free-photo/arrangement-compost-made-rotten-food-with-copy-space_17662397.htm

Paper

First, always think before printing – a lot of times things are printed without need and they end on the waste container soon, without having served any purpose. It is smart to transfer a business to an online level: this measure turns an office cleaner, saves space and supports saving paper and, consequently, decrease the amount of cut trees to produce paper.

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To reuse paper, you can partner with citizens or other SMEs and use it as an inlay for pet cages. This type of paper is great for lining bird cages or shredding hamster litter, for example. Paper can also be used as a cleaning agent for cleaning windows and as compost for agriculture. Newspapers can be an essential part of a balanced compost pile and are considered high in carbon.

Plastic

Plastic is used for many types of product packaging, including cups, bottles, wrappers and sleeves. Numerous factors have contributed to the widespread use of plastic, such as the low cost of production, its low weight and its cheap shipping as it is of lightweight. However, many plastics packaging and containers of consumer goods are of single use and end up in the rubbish quite soon.

SMEs, other organisations and citizens in general must refrain from using plastic as much as possible. Then, it is also possible to give to plastic a fresh design and purpose, for example using different packaging types as buckets, vases or containers.

It is also a good and strategic idea for companies to enter partnerships with other organisations and provide them plastics so they can give them a second life.

Glass

Glass can be 100% recycled and does not degrade through the recycling process so it can be recycled again and again. For example, glass can be melted and be used as a resource for the making of new bottles, decorative objects and jewellery.

But glass can also be reusable as must times as possible as it is long-lasting, nontoxic, durable and corrosion resistant, so it does not break down overtime like plastic. Consequently, reusable glass packaging has been experiencing a huge development and rethinking in the most recent years. Bottles, jars and containers can be used in different ways, such as for storage, crafts and DIY projects.

CASE STUDY 3: De Clique (Netherlands)

De Clique collects food waste from 50 businesses, including coffee grounds, orange peels and other culinary by-products, using bicycle couriers and electric vehicles.

These by-products are collected as pure waste streams, which De Clique then sells to external inventors and product manufacturers who use them to create new products such as food ingredients, cosmetics, and biomaterials.

The Hub also hosts several entrepreneurs who use organic waste, as well as horticulture and composting companies.

Creative businesses that work with De Clique are:

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- Peelpioneers, that produces hand soap and cleaning products from orange peel.
- Rotterzwam, that grows oyster mushrooms using used coffee grounds as substrate. These mushrooms are then processed into products such as vegetarian bitterballen, a traditional Dutch bar snack.
- De Leckere, that uses orange peels to make orange beer.

To measure the environmental impact of the products, De Clique and its partners produce impact reports:

- 0.6 kg of CO^2 emissions are avoided for every 1 kg of food waste that is composted, sold to customers, or used to grow tea and mint.
- 0.7 kg of CO^2 emissions are avoided for every 1 kg of orange peel processed into products such as flavourings, essential oils, fibre, and candied peel.
- 4.6 kg of CO^2 emissions are avoided for every 1 kg of leftover coffee grounds used to grow oyster mushrooms for bitterball snacks or as compost.

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4. ADVICE FROM EXPERTS

"Circos is an online shop with a rental subscription service for children's and maternity wear, with the mission to prolong the life of garments"

Erick Bouwer, CEO.

Circos, Denmark.

Advices from the expert:

2. Pay monthly per item for the right size and for the right occasion, at a fraction of the usual shop price, and swap for other size or style at any time.

3. Make it easy to update your wardrobe with home delivery and, even in a greener way, at accessible pick-up points.

4. Reduce your carbon footprint by up to 80% for the items you rent instead of buy.

"We buy empty printer cartridges and, in return, the customers receive a remuneration and the good feeling of conserving non-renewable resources"

Britta Wegner, Owner.

Geldfuermuell, Germany.

Advices from the expert:

1. Empty printer cartridges are not rubbish; they usually have some cash value. Do not throw away them but sell your empty original toner cartridges or inkjet cartridges to recovering organisations, such as Geldfuermuell.

2. The environment benefits from certified waste disposal specialists as they contribute to extend the lifetime of cartdriges.

3. Trained specialists ensure that cartridges are professionally emptied and refilled.

"CICECO is the Materials Institute of the University of Aveiro. There, a group of researchers investigate how to extend the lifecycle of materials."

Andreia Sousa, Researcher.

CICECO, Portugal.

Advices from the expert:

1. CICECO developed a simple, innovative and environmentally friendly process for recycling polyesters such as PEF or PET, which are often used in plastic bottles commonly used once and then thrown away.

2. This contributes to the recyclability of these polymers and to circular economy, while avoiding the pollution of the planet with plastic.

3. By using this single-step method, polyesters never lose their properties and, thus, can theoretically be recycled an infinite number of times.

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5. SELF-DIAGNOSIS

A few questions to ask yourself…

1. **Do you think that your organisation already does everything it can do to promote the reuse of materials? Why?**

2. **Which benefits do you think your organisation can gain by reusing specific materials?**

3. **Do you think it is difficult for organisations to move to a circular economy thinking? Why?**

4. **What do you think that needs to change in your organisation for a more effective implementation of the circular economy?**

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