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Circular Economy - The Pedagogical Case Study of Corticeira Amorim's Business Model

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Master in management

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BUSINESS
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Department of Marketing, Operations and General Management

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Resumo

Num mundo que cada vez mais enfrenta os seus limites físicos, é necessário encontrar alternativas para um consumo de recursos mais sustentável. A Economia Circular (EC) apresenta-se como um novo modelo de uso de recursos, contrário ao modelo de Economia Linear. Cada vez mais as empresas começam a explorar novas formas de reutilizar os seus produtos, diminuir os seus recursos e assim reter o seu valor por mais tempo e mais eficientemente.

O presente caso de estudo pedagógico assenta sobre o modelo da Economia Circular aplicado na empresa Corticeira Amorim, uma das maiores empresas portuguesas que está presente no setor da cortiça há 150 anos. Este caso de estudo tem como objetivo analisar de que maneira a Corticeira Amorim aplica o modelo de EC ao longo do seu ciclo produção, e se a aplicação deste modelo apresenta benefícios para a empresa, ambiente e sociedade.

O caso de estudo foca-se primeiramente na descrição da empresa e, com o intuito de responder às questões, foi feita a revisão de literatura especializada no tema, onde é descrita a evolução histórica do modelo, as escolas de pensamento que sustentam a EC, os seus princípios e mudanças que a EC trouxe para os modelos de negócios.

Os resultados demonstrados através do desenvolvimento das questões propostas indicam que a Corticeira Amorim aplica os princípios da Economia Circular em todo o seu ciclo produtivo e que a utilização de uma política sustentável e o cumprimento dos princípios da EC são benéficos para o ambiente, sociedade e empresa.

Palavras-chave: Economia Circular, Corticeira Amorim, Sustentabilidade, Modelos de Negócio, Cortiça.

Sistema de classificação JEL:

- Q01 – Desenvolvimento Sustentável
- Q56 – Meio Ambiente e Desenvolvimento; Sustentabilidade

Abstract

In a world that is increasingly facing its physical limits, it is necessary to find alternatives for a more sustainable consumption of resources. Circular Economy (CE) is presented as a new model of resource use, contrary to the linear economy model that still prevails. Nowadays, businesses have started to explore new ways to rethink their business models by reusing their products, decreasing their resources and retaining their value for longer and more efficiently.

This Pedagogical Case Study is based on the Circular Economy model applied in Corticeira Amorim, one of the largest Portuguese companies that has been present in the cork sector for 150 years. This case study aims to analyse how Corticeira Amorim applies the CE model throughout its production cycle, and whether the application of this model presents benefits for the company, environment and society.

The case study focuses firstly on the description of the company and, in order to answer the questions and objectives, a specialized literature review on the subject was performed, where it was described the historical evolution of the model, the schools of thought that support CE, its principles and the changes that it brought to the business models.

The results demonstrated through the development of the proposed questions indicate that Corticeira Amorim applies the principles of Circular Economy throughout its production cycle, from the extraction of the cork until the waste generated and that the use of a sustainable policy and compliance with CE principles are beneficial for the environment, society, and company.

Key words: Circular Economy, Corticeira Amorim, Sustainability, Business Models, Cork.

JEL Classification System:

- Q01 - Sustainable Development
- Q56 - Environment and Development; Sustainability

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CHAPTER 1

Introduction

Throughout its evolution, our industrial economy has been based in one central characteristic established in the early days of industrialization: a linear model of resource consumption that follows an extract, transform and dispose pattern (Ellen MacArthur Foundation, 2015b). The natural resource base in which our society is built on is in severe danger of overexploitation and breakdown. “Humans today extract and use around 50% more natural resources than only 30 years ago, at about 60 billion tons of raw materials a year. This is equivalent to the weight of around 41,000 Empire State Buildings” (Friends of the Earth Europe, 2000). The intensification of this production system began in the early 18th century with the industrial revolution that, on one hand, brought unparalleled prosperity that resulted in a period of accelerated economic development, and on the other hand, led to the increasing consumption and misuse of resources that consequently created a negative impact in the environment (Wautelet, 2018a).

In this context, Circular Economy comes as an alternative to the linear economic model of resource consumption that currently predominates. The recognition of the limits to planetary resource and energy use, lay at the foundations of Circular Economy thinking (Bocken et al, 2016). Opposite to the linear economy, a Circular Economy model replaces the “end-of-life” concept with restoration and it aims to minimize the need for new inputs of materials and energy, while reducing environmental pressures associated to resource extraction, emissions and waste (Ellen MacArthur Foundation, 2013a). Circular Economy model seeks to decouple economic growth from finite resource consumption, by reducing the need for new materials and energy use, reducing environmental pressures, while generating business and economic opportunities, environmental and social benefits (Ellen MacArthur Foundation, 2015b). The Circular Economy concept has progressed over the years and has been developed by many schools of thought such as Regenerative Design, Industrial Ecology, Performance Economy, Biomimicry, Cradle to Cradle and Blue Economy. These schools of thought are complementary to each other and provide the foundation for the main principles of this new approach to economy (Moreno et al., 2016). A Circular Economy is described, according to the Ellen MacArthur foundation, as “an industrial system that is restorative or regenerative by intention and design” (Ellen MacArthur Foundation, 2013a, p. 7). The Ellen MacArthur foundation has conducted several studies which provided an overview of the three main principles of the

Circular Economy, considering the complementary school of thoughts previously mentioned. The first principle consists in "preserving and enhancing natural capital by controlling finite stocks and balancing renewable resource flows" (Ellen MacArthur Foundation, 2015b, p. 5), meaning that technology and processes are chosen according to their use of renewable or better-performing resources (Ellen MacArthur Foundation, 2015b). A Circular Economy also enhances natural capital by encouraging flows of nutrients within the system and creating the conditions for the regeneration of, for example, soil, energy and water (Moreno et al., 2016). The second principle consists in "optimize resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles" (Ellen MacArthur Foundation, 2015b, p. 7). This means designing for remanufacturing, restoring, and recycling to keep technical components and materials circulating and contributing to the economy, preserving embedded energy and other value. In the biological cycle, products are designed to be consumed or metabolized by the economy and regenerate new resource value (Bocken et al., 2016). Finally, the third principle consists in "foster system effectiveness by revealing and designing out negative externalities" (Ellen MacArthur Foundation, 2015b, p. 7). This includes reducing harm to "systems focusing on renewable sources of energy, to decrease resource dependence and increase systems resilience (Ellen MacArthur Foundation, 2015b). According to the Business Council for Sustainable Development (BCSD), the Circular Economy model defends that waste should be transformed, with the help of innovation, into potential by-products or other materials, in order to promote reuse, recovery and recycling. The same source points out that the Circular Economy will have a high impact on European Union by 2030, with figures such as 7% of GDP, 600 billion euros saved, 170,000 jobs in the waste management sector and a reduction in carbon emissions between 2% and 4% (BCSD Portugal, 2020).

The research problem present in this Pedagogical Case Study is focused on the Circular Economy, as previously stated, and tackles the prevalence of the linear economy and how it led to the emergence of the Circular Economy model in the current days. This research will also focus on how Circular Economy concept emerged, the schools of thought which have helped create its conceptual framework and in what ways it differentiates from the linear one. The case study is based on the application and benefits of the Circular Economy in the cork sector, more specifically the company under study, Corticeira Amorim. The Circular Economy model has been gaining traction throughout the past decades by many authors. These authors range from Stahel (2010), Bocken et al. (2016), Braungart et al. (2007) to the Ellen Macarthur Foundation, a non-profit foundation that works with companies, governments and researchers

in order to accelerate the transition to the Circular Economy. However, it is still important to strengthen the research and raise awareness on this topic, not only at an individual level but to governments, institutions and companies. For this motive the theme of this Pedagogical Case Study aims to understand in which way a Circular Economy-based model can be incorporated in a company, and how it will create advantages not only for the company itself but for the environment and society.

The theme of this Pedagogical Case Study is relevant as it is currently one of the main concerns of economic and political debates at national and international level (Wautelet, 2018a). This new approach for economic growth, that incorporates reduced consumption and dependence on raw materials and energy, is increasingly present in European and Portuguese policies. Circular Economy is beginning to be perceived as the solution that can bring improvements to the economy, the wellbeing of society, companies and the environment. The specific case study becomes relevant since it intends to evaluate how one of the largest Portuguese companies, Corticeira Amorim, makes use of the Circular Economy in its business model and the consequent benefits.

The aim of this case study is to in a first phase, be able to understand what a Circular Economy is, define its main principles and characteristics, and indicate the main differences from the linear business model. Then, be able to understand how the circular business model is implemented in the production process of Corticeira Amorim and to which extent the principles and characteristics of a Circular Economy are consistent with the business model of Corticeira Amorim. Finally, it is also intended to analyse the sustainable practices of Corticeira Amorim and reflect on the advantages of CE for the company, environment and society.

This thesis is structured in five main chapters: Introduction, Case Study, Methodology, Pedagogical Note and Conclusion. In the Case Study chapter are included the presentation of the case study problem followed by the data organized by themes, where the company under analysis is presented and the type of economic model the company practices is analysed. In the Methodology chapter it is presented the work methodology and the method used. In the Pedagogical Note chapter, are included the case study target audience and pedagogical objectives, literature review, where it is done a thoroughly analysis in the Circular Economy concept, the case study lecture plan and the resolution of the case study questions. In the last chapter, the Conclusion, it will include the final conclusions, as well as the research limitations and suggestions for future researches.

CHAPTER 2

Case

2.1 Problem Identification

Humanity's rapid growing consumption of natural resources like raw materials, water, energy and fertile land are causing serious damages to our planet. The natural resource base in which our society is built on is in extreme danger of overexploitation. Many of the problems that threaten our planet to prosper and that are leading to climate change result from the increased consumption of natural resources and the increased production of waste and emissions. "Humans today extract and use around 50% more natural resources than only 30 years ago, at about 60 billion tons of raw materials a year. This is equivalent to the weight of around 41,000 Empire State Buildings."[1] The Industrial Revolution in the 18th century launched the most important change in natural resource consumption to date. The use of these natural resources such as fossil fuels enabled the economic growth that has continued until today. The availability of energy in a cheaper and more concentrated way allowed a drastic increase in the production of goods and services.[2] However, progress has had an environmental price, as the consumption of resources has risen dramatically. At the same time, with a growing global population, economy and affluence, the consumption of nature grows accordingly. Consumerism has progressed over the years and is now reaching its exponent, as almost everything we do in our daily basis involves the consumption of materials that were extracted, processed and transformed.

Since the early days of industrialization, our industrial economy has been based on a linear model of resource consumption that follows a take-make-dispose pattern.[3] This system generates high amounts of waste not only at the end of the products' life, but throughout their entire life cycle. However, in the last few years, the perception that this system is not sustainable and needs to be improved has been increasing, due to the rising awareness that comes from not only the limited availability of natural resources of the planet earth, but also from the assimilation of the pollution and waste generated.

[1] Friends of the Earth Europe. (2000). Overconsumption? Our use of the world's natural resources.
[2] Ibid.
[3] Ellen MacArthur Foundation. (2012). Towards the Circular Economy: Economic and business rationale for accelerated transition. In *Journal of Industrial Ecology*. https://doi.org/10.1162/108819806775545321

The call for a new economic model is getting louder. In the search for a significant improvement in resource performance across the economy, businesses have started to explore ways to reuse products or their components, and restore more of their material, energy and labour inputs. A strategy of reducing resource use will not only diminish the pressures on the global environment. Running a resource efficient economy will also be a competitive advantage in a world with rising commodity prices and increased resource constraints. In a world increasingly facing physical limits, we need to find alternative approaches to human development and wellbeing. Finding new models of resource use is one keystone of such a new way of development. The challenge is to ensure a high quality of life for today's global population of nearly 7 billion people, and for the 9 to 10 billion people predicted for the middle of this century, without exceeding the environmental capacities of our planet.[4]

2.2 The Cork Market

2.2.1 Cork Origins and its Environmental impact

The cork oak tree is a long-life species living from 250 to 350 years with an outer bark, the cork, characterized by its elasticity, permeability and good thermal insulator.[5] Cork is a natural material that, depending on its quality, has a wide range of applications.[6] In the 19th century, the cork industry was developed in cork-producing countries like Portugal, Spain, France and Italy, and other net importers countries of unmanufactured cork such as USA, the United Kingdom and Germany. A growing market demand led to the growth of international trade in cork products. During the 20th century there was a concentration of production, industry and commerce in the Iberian Peninsula, mainly in the wine industry**,** taking advantage of the location of the major wine-growing regions of the world and possessing abundant raw cork and a cheap workforce.[7] This has resulted in a concentration of the global cork business in Portugal and Spain.

[4] Friends of the Earth Europe. (2000). Overconsumption? Our use of the world's natural resources.

[5]Jorge Sierra-Pérez, Jesús Boschmonart-Rives, X. G. (2015). Production and trade analysis in the Iberian cork sector: Economic characterization of a forest industry. Resources, Conservation and Recycling, 98(March), 55–66. https://doi.org/10.1016/j.resconrec.2015.02.011

[6]Dias, A. C., Boschmonart-Rives, J., González-García, S., Demertzi, M., Gabarrell, X., & Arroja, L. (2014). Analysis of raw cork production in Portugal and Catalonia using life cycle assessment. *International Journal of Life Cycle Assessment*, *19*(12), 1985–2000. https://doi.org/10.1007/s11367-014-0801-7

[7]Jorge Sierra-Pérez, Jesús Boschmonart-Rives, X. G. (2015). Production and trade analysis in the Iberian cork sector: Economic characterization of a forest industry. *Resources, Conservation and Recycling*, *98*(March), 55–66. https://doi.org/10.1016/j.resconrec.2015.02.011

Cork oak forests and woodlands may contribute to climate change mitigation when they are sustainably managed as they retain carbon dioxide (CO2) from the atmosphere. In addition, they play key role in ecological processes as they are important reservoirs of fauna and flora biodiversity, provide opportunities for development in economically and socially disadvantaged areas, and vital mechanisms of water retention and soil conservation. The extraction of cork is a sustainable process as it does not damage the tree. The cork stripping stage begins when the trees are 20 to 30 years old, and this process is repeated every 9 to 14 years, depending on the area.[8] The cork's first harvest - called virgin cork - has low industrial quality and is used in the manufacture of agglomerates. The cork from the second stripping - called second cork - has also low quality being only appropriate to produce agglomerates. The cork obtained from the third stripping onwards - called reproduction cork - has the best quality and is applied in the production of natural cork stoppers, the most profitable product, as well as in the production of other products from natural cork such as disks or decorative objects.[9]

2.2.2 The Cork Sector

Cork oak forests and woodlands cover an area of around 2.1 million hectares, mostly in countries of the Western Mediterranean Basin such as Portugal, Spain, Morocco, Algeria, Tunisia, France, and Italy.[10] Portugal has the most extensive cork oak area followed by Spain, representing about 34% and 27% of the global cork oak area, respectively, as shown in Table 2.1:

[8]Jorge Sierra-Pérez, Jesús Boschmonart-Rives, X. G. (2015). Production and trade analysis in the Iberian cork sector: Economic characterization of a forest industry. *Resources, Conservation and Recycling*, *98*(March), 55–66. https://doi.org/10.1016/j.resconrec.2015.02.011

[9] Dias, A. C., Boschmonart-Rives, J., González-García, S., Demertzi, M., Gabarrell, X., & Arroja, L. (2014). Analysis of raw cork production in Portugal and Catalonia using life cycle assessment. *International Journal of Life Cycle Assessment*, *19*(12), 1985–2000. https://doi.org/10.1007/s11367-014-0801-7

[10]APCOR. (2019). *Boletim Estatístico 19|20*. *BMC Public Health*, *5*(1), 1–8. Retrieved from https://ejournal.poltektegal.ac.id/index.php/siklus/article/view/298%0Ahttp://repositorio.unan.edu.ni/2986/1/5624.pdf%0Ahttp://dx.doi.org/10.1016/j.jana.2015.10.005%0Ahttp://www.biomedcentral.com/1471-2458/12/58%0Ahttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&P

Table 2.1 – Cork oak forest area.

Country	Area (HA)	Percentage
Portugal	**720**	34%
Spain	**574**	27%
Marocco	**383**	18%
Algeria	**230**	11%
Tunisia	**86**	4%
France	**65**	3%
Italy	**65**	3%
Total	**2 123**	**100%**

Source: Adapted from APCOR (2019)

In Portugal, cork oak is the second most important tree species in terms of area occupation, which covers an area of about 737,000 hectares, representing 23% of the total forest area.[11]

In terms of cork production, Portugal plays a very important role in the global cork sector as it is the largest producer of natural cork in the world. Portugal is the leading country, responsible for the production of about 100 thousand tonnes of cork products per year, which corresponds to almost 50% world share, as shown in Table 2.2. This means that the 80% of the worldwide cork extracted comes from the Iberian Peninsula.

Table 2.2 – Cork oak production by country.

Country	Anual average production (tonnes)	Percentage
Portugal	**100 000**	50%
Spain	**61 504**	31%
Marocco	**11 686**	6%
Algeria	**9 915**	5%
Tunisia	**6 962**	3%
France	**6 161**	3%
Italy	**5 200**	3%
Total	**201 428**	**100%**

Source: Adapted from APCOR (2019)

From the total cork bark harvested, 40% is immediately used for natural cork stoppers, 30% is destined for disks and blocks used in technical stoppers, while the rest are by-products (25%) and pieces (5%).

[11] Dias, A. C., Boschmonart-Rives, J., González-García, S., Demertzi, M., Gabarrell, X., & Arroja, L. (2014). Analysis of raw cork production in Portugal and Catalonia using life cycle assessment. *International Journal of Life Cycle Assessment*, *19*(12), 1985–2000. https://doi.org/10.1007/s11367-014-0801-7

In terms of exports, Portugal is the world leader in the cork sector. The total world cork exports reached 1,714 million euros in 2018, and Portugal represented 62.5% of the total. Portuguese cork exports account for around 2% of exports of Portuguese goods and 1.2% of total Portuguese exports, representing a trade balance of 852.2 million euros and a coverage rate of 496%.[12] Cork stoppers lead Portuguese cork exports, accounting for 70.5% of the total (corresponding to 752.8 million euros), followed by cork as a building material with 25.7% and 274 million euros. The main target sector of cork products is the wine industry, which accounts for 70.5% of all production, followed by the construction sector, with 25.7% - including floors, insulation and coverings.

In terms of imports, Portugal is the third highest importer of cork in the world, using it for processing and subsequent export in the form of consumer end products, with a share of 12.3%, valued at 216.2 million euros. The main import is natural cork, which reached 170.8 million euros in 2018, representing around 79% of total Portuguese cork imports.[13]

Currently the sector accounts for 642 companies operating in Portugal - 487 in the municipality of Santa Maria da Feira -, which produce around 40 million cork stoppers per day and employ 8305 workers (6544 in the municipality of Santa Maria da Feira).[14]

2.3 The Organization

2.3.1 Who are they?

Corticeira Amorim is one of the largest, most entrepreneurial and dynamic multinationals of Portuguese origin and has been in the cork business for 150 years. Its origin in the cork business dates to 1870 and today it is the world leader in the sector. Corticeira Amorim is a Portuguese company created in 1870 as a factory of manual production of cork stoppers in Vila Nova de Gaia. In 1922 the first company was born, Amorim & Irmãos, Lda., and the group developed a strategy for the verticalization of the business with the goal of reach the world leadership of cork products' production and exportation.[15] In 1963 Corticeira Amorim is formed, an industrial unit to produce cork granules and agglomerates. Its goal was to transform 70% of the waste produced by Amorim & Irmãos, Lda., generated from the manufacture of cork stoppers,

[12] APCOR. (2020). *Boletim Estatístico 19|20*. Retrieved from https://ejournal.poltektegal.ac.id/index.php/siklus/article/view/298%0Ahttp://repositorio.unan.edu.ni/2986/1/5624.pdf%0Ahttp://dx.doi.org/10.1016/j.jana.2015.10.005%0Ahttp://www.biomedcentral.com/1471-2458/12/58%0Ahttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&P

[13] Ibid.

[14] Ibid.

[15] Corticeira Amorim. (2020). Who are we. Retrieved September 20, 2020, from https://www.amorim.com/en/who-are-we/corporate-milestones/

into granules and these into valuable pure compound agglomerates, from which it is possible to produce a set of new cork applications.[16] It was in this year that Corticeira Amorim determined to increase its portfolio by transforming the cork waste in a variety of products. It began with the diversification of applications of cork starting from the granules and agglomerates, followed by floor and wall coverings years later, and an expansion in the cork stoppers by producing it for champagne and sparkling wines.

Operating under the motto "not just one market, not just one client, not just one currency, not just one product", the company has been growing and reinventing itself by introducing new products and entering new markets. Today, Corticeira Amorim has a presence on 27 different countries, through its operations in the fields of production, distribution, joint ventures or market agency, and counts with 4424 employees.[17]

2.3.2 Business Units

Corticeira Amorim Group has an extensive portfolio of cork products for different markets and applications, and its business is organized in five main business units (BU): Raw Materials (Amorim Florestal, S.A.), Cork Stoppers (Amorim Cork, S. G. P. S., S.A.), Composite Cork (Amorim Cork Composites, S.A), Floor and wall coverings (Amorim Cork Flooring, S.A.) and Insulation Cork (Amorim Cork Insulation, S.A.).[18]

- Raw Materials Business Unit

The global and integrated management of the value chain begins in the Raw Materials BU, created in 2002, which extends across the company. This BU is responsible for the overall and integrated management of the company's value chain and is essential to promote synergies between the various units, as well as to ensure the optimization of the flow of raw materials. As so, this BU is developing and promoting cork extraction in high-potential countries and regions, while guaranteeing an instant response to possible increases in consumption of the raw material.[19]

[16]Corticeira Amorim. (2020). Who are we. Retrieved September 20, 2020, from https://www.amorim.com/en/who-are-we/corporate-milestones/

[17]Corticeira Amorim, SGPS, S.A. (2020a). *Consolidated annual report 2019*. Retrieved from https://www.amorim.com/xms/files/Investidores/5_Relatorio_e_Contas/Amorim_RC_EN_21Mai_web.pdf

[18] Ibid.

[19] Ibid.

- Cork Stoppers Business Unit

This BU is the world leader in the production and supply selling to over 18,000 active customers, with annual production of 5,5 billion units. Its extensive portfolio of natural cork stoppers - for wine, sparkling wine and spirits - and its own distribution network place it in an unparalleled position to supply the ideal cork stopper for every wine segment and in any part of the world.[20]

- Floor and wall coverings Business Unit

This BU is the world leader in the production and distribution of cork flooring and wall coverings and operates in more than 80 countries. In line with sustainability and nature-inspired values, the Floor and Wall Coverings BU produces high quality and sustainable flooring, ensuring better quality of life, while preserving the environment. It produces 10,000,000m2 per year of installed capacity.[21]

- Composite Cork Business Unit

This BU is the most technological advanced area within Corticeira Amorim's companies and is focused on the production of granulated cork, agglomerates and cork composites. The natural properties of cork, enhanced by combination with other materials, result in the development a unique portfolio of high-performance materials for a wide range of business sectors such as aerospace, panels and composites, automobile, electricity industry, construction, flooring, consumer goods, furniture and footwear. It produces 200,000 blocks and 40,000 cylinders per year.[22]

- Insulation Cork

This BU is dedicated to the production of acoustic and thermal insulation agglomerates which are 100% natural with an excellent technical performance. The exclusive characteristics of expanded cork agglomerate ensure a high level of thermal, acoustic and anti-vibration insulation – as well as practically unlimited durability – making it a material of choice for sustainable construction projects. It requires low energy consumption as 93% of its energy

[20]Corticeira Amorim, SGPS, S.A. (2020a). *Consolidated annual report 2019*. Retrieved from https://www.amorim.com/xms/files/Investidores/5_Relatorio_e_Contas/Amorim_RC_EN_21Mai_web.pdf

[21]Corticeira Amorim, SGPS, S.A. (2020b). *Sustainability Report 2019*. Retrieved from https://www.amorim.com/xms/files/2019_Amorim_RC_EN_Sustentabilidade_Website_7Mai.pdf

[22]Corticeira Amorim, SGPS, S.A. (2020a). *Consolidated annual report 2019*. Retrieved from https://www.amorim.com/xms/files/Investidores/5_Relatorio_e_Contas/Amorim_RC_EN_21Mai_web.pdf

needs are met using biomass - cork dust -, which maximizes its positive impact on the environment.[23]

2.3.3 Business model

Corticeira Amorim is characterized for having a vertically integrated business model that makes use of the principles of Circular Economy, controlling all stages of production, from acquisition of the raw material to commercialization of a varied portfolio of cork products. The application of the principles of the Circular Economy, from the recovery of cork to the waste generated, is one of Corticeira Amorim's main strategies and challenges. Operating under the motto "nothing is wasted, everything is valued", the group strives continuously to end general and cork waste, therefore optimizing the added value of all its raw materials. This concept, that is the basis of the Circular Economy, has been applied in Corticeira Amorim since 1963, when the industrial unit for the production of cork grains and agglomerates was formed with the objective of transforming 70% of the waste generated from the manufacture of cork stoppers - until then only marginally used.[24] The main material of Corticeira Amorim's operations is cork – a 100% natural raw material -, extracted cyclically from cork oak trees without damaging them.[25] In addition to the 100% use of cork, this biological, nontoxic material with several unique properties, it allows synergies between other renewable materials or by-products from other industries, expanding the range of applications. Cork promotes the economic and social sustainability of areas at risk of desertification, while encouraging the preservation of the cork oak forest. The montados - cork oak forests - are a perfect example of the balance between preserving the environment and sustainable development. They protect against erosion and resulting desertification and provide an essential contribution for reducing greenhouse gas emissions. The cork industry helps to maintain thousands of jobs and keeps people on their land.[26]

The optimisation of the use and consumption of cork throughout the production cycle is one of the sustainability practices adopted by Corticeira Amorim. The Figure 2.3 illustrated below shows the cork transformation process adopted by Corticeira Amorim, and some of the

[23]Corticeira Amorim, SGPS, S.A. (2020a). *Consolidated annual report 2019*. Retrieved from https://www.amorim.com/xms/files/Investidores/5_Relatorio_e_Contas/Amorim_RC_EN_21Mai_web.pdf

[24]Corticeira Amorim. (2020). Who are we. Retrieved May 20, 2020, from https://www.amorim.com/en/who-are-we/corporate-milestones/

[25]Corticeira Amorim, SGPS, S.A. (2020b). *Sustainability Report 2019*. Retrieved from https://www.amorim.com/xms/files/2019_Amorim_RC_EN_Sustentabilidade_Website_7Mai.pdf

[26] Ibid.

applications resulting from its integral application, a paradigmatic case of the Circular Economy:

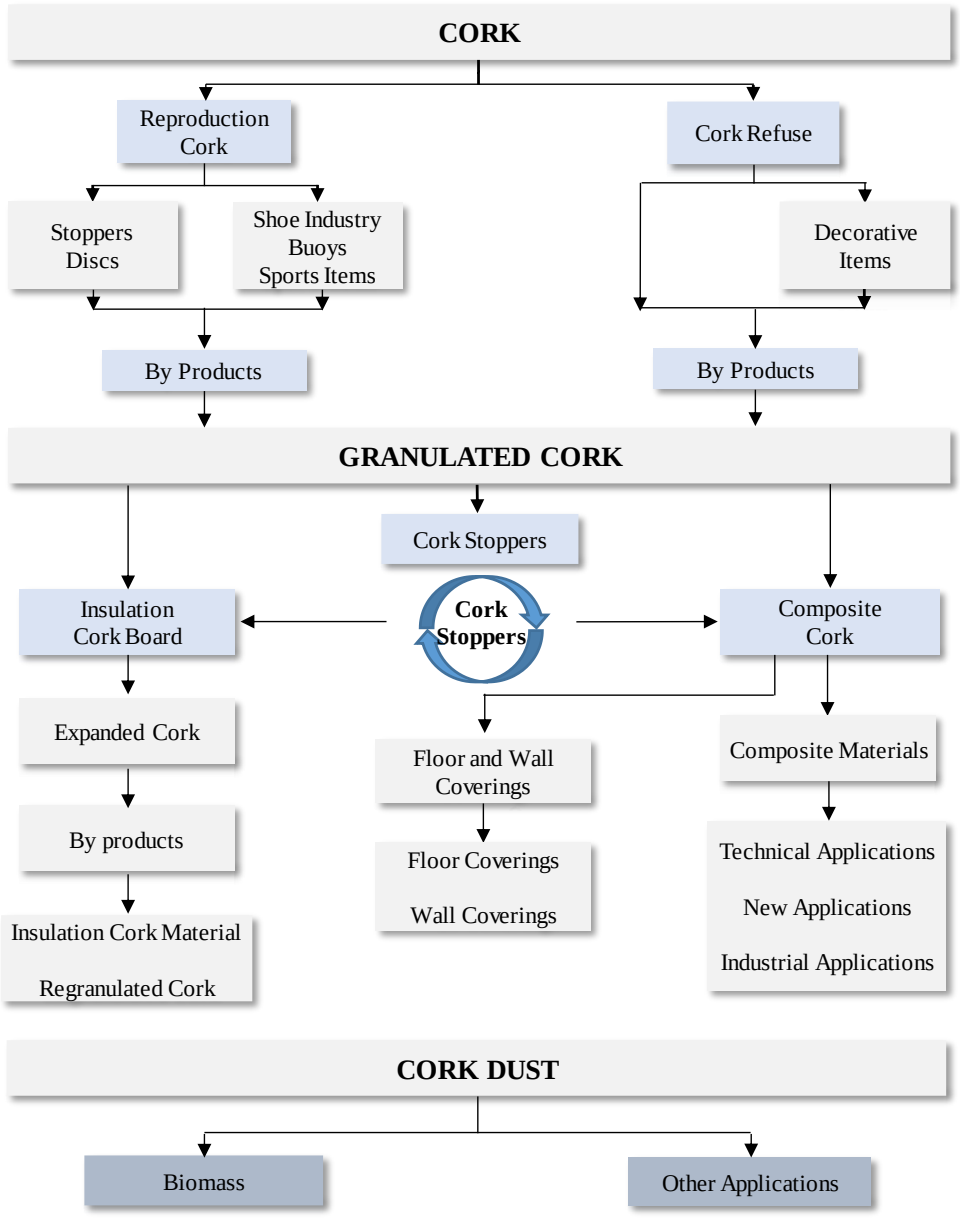


Fig 2.3: Corticeira Amorim's cork transformation process.

Source: Adapted from Corticeira Amorim Sustainability Report (2019)

Corticeira Amorim's business model ensures that all sub-products associated to cork processing are reused, so there are no forms of cork waste or residues. By-products generated during the cork stopper production process, cork that does not meet production standards or recycled cork at the end of life, are incorporated into other high added-value applications. Additionally, Corticeira Amorim has several recycling initiatives where recycled cork stoppers

and other cork products are collected, treated and ground at one of three Corticeira Amorim industrial units in Portugal, licensed for recycling cork. After being processed into granules, they can be reintegrated into the production process and used to produce composite and insulation cork agglomerates. Finally, the part that cannot be incorporated in products, cork dust, it is not considered waste, it is used as an energy source - biomass. In addition to the 100% use of cork, since cork is a material that promotes synergies with other materials and by-products, whenever feasible, the group uses recycled materials from other industries and thereby saving the planet's natural resources and reducing the problems associated with their depletion. For example, through the Composite Cork BU, they use by-products from other industries that previously ended up in landfills to produce a wide range of products and that meet the needs of diverse industries such as aerospace, footwear, automotive, sports or construction.[27] This approach centres on the social responsibility of re-using and saving natural resources in order to create added value for its business, in some cases by improving the performance of the material and providing more cork to meet the market needs of all business segments.[28]

In 2019, Corticeira Amorim's total energy consumption decreased by 3% compared to the previous reporting year. The primary source of energy consumed by Corticeira Amorim is biomass (63%), followed by electricity (32%). However, fossil fuels (gasoline, diesel, propane and natural gas) are also consumed, and represent the remaining 5% of the energy consumed by the Group.[29]

2.3.4 Projects and Initiatives

The recovery of waste to extend its use in the economy is an important business concept for Corticeira Amorim. To this end, the Group has implemented several initiatives, which aim to extend the useful life in the economy and the benefits of the products. According to Corticeira Amorim's 2019 Sustainability report, in 2019, 90% of the total waste generated by Corticeira Amorim was recovered. The company has implemented work processes and technologies to reduce, recycle or reuse waste. The recovery of the waste generated is an important issue to the company, that enables the company to prolong the products' life in the economy and obtain the

[27]Corticeira Amorim, SGPS, S.A. (2020b). *Sustainability Report 2019*. Retrieved from https://www.amorim.com/xms/files/2019_Amorim_RC_EN_Sustentabilidade_Website_7Mai.pdf
[28] Ibid.
[29] Ibid.

associated benefits. As a result of this system, no cork is lost, and everything is used to generate value. A few examples of Corticeira Amorim's initiatives are:

- Recupera

This initiative from the Floor & Wall Coverings BU aims to reincorporate the by-products of cork composite sanding, cutting and profiling processes, thus allowing controlled dosing in the subertech and hydro cork product composite process. As a result, more than 700 tonnes of cork composites have been used with since its launch in 2018.[30]

- Cork Recycling

The concept of recycling cork stoppers originated in Portugal in 2008, when the Green Cork project was launched, a partnership between Corticeira Amorim and Portugal's biggest environmental association, Quercus. Although it will never be reused in stoppers, recycled cork is converted into granules and is reintegrated into the production process, particularly for the Composite Cork BU and Insulation Cork BU products. In 2019, 485 tonnes of cork were recycled in Corticeira Amorim's facilities. Recycling, in addition to increasing reuse of the raw material, extends the cork life cycle and its environmental benefits.[31]

- Greencork - is the Quercus project that has been promoting the collection and recycling of cork stoppers since 2008. One of the main objectives of this programme is to finance the planting of indigenous trees through the Floresta Comum programme. To date, this initiative has allowed the collection of over 90 million cork stoppers and the planting of over 971,000 trees.[32]
- Cork2Cork - Amorim Cork Flooring has joined forces with the NH Hotel Group to promote a more sustainable world with the Cork2Cork project. The first phase began in 2011, with the supply of 68 bins for the collection of corks stoppers in hotels in Belgium, Spain, Italy, Germany, France and Holland. To date, more than two tonnes of corks have been recycled and 8,000 m2 of flooring has been produced (equivalent to approximately 300 hotel rooms).[33]

[30]Corticeira Amorim, SGPS, S.A. (2020b). *Sustainability Report 2019*. Retrieved from https://www.amorim.com/xms/files/2019_Amorim_RC_EN_Sustentabilidade_Website_7Mai.pdf
[31] Ibid.
[32] Ibid.
[33] Ibid.

- Etico - This is an Italian recycling programme which started in 2011 and involves associations and institutions that mobilise around a thousand volunteers and generate more than five thousand collection points throughout Italy.[34]

- Forestry Intervention Programme

Corticeira Amorim finds sustainable management of the cork oak forest as a strategic priority. In this context, it seeks to raise awareness amongst forest producers of the need to conserve the cork oak forest and adopt good practices that improve the fundamental ecosystems services, that provide sustenance to the entire population, encouraging good agricultural and forestry practices. The Forestry Intervention Project was developed in 2013 for the preservation and sustainable development of the cork oak forest. 2019 was the year of the first large-scale plantations, which benefit from the installation of an improved irrigation system with drip irrigation. This is a project of great importance for Corticeira Amorim, not only because of the impact in terms of change of land use, but also because it marks the beginning of the company's journey as a forest owner, through the purchase of a farm. The purchase of the company Cosabe in 2018, owner of the Herdade da Baliza estate, which spans a total area of 2866 hectares, will help promote and spread the implementation of new techniques for managing the national cork oak forest.[35]

2.3.5 Economic Performance

According to the latest Corticeira Amorim's Consolidated annual report, during 2019, it was calculated the net value added to society by Corticeira Amorim, revealing that it exceeded one billion euros. This value is mainly supported by the impact that it has on the cork oak forest ecosystem – as one of the 36 biodiversity hotspots in the world, this ecosystem provides, also, other environmental benefits: CO2 retention, protection against fires or controlling the hydrological cycle avoiding the risk of soil erosion and reducing the risk of desertification.[36]

Concerning results by business unit, the latest data is: Raw Materials BU increased by 9.8%, the Cork Stoppers BU increased its proportion of total sales to 70.3%, with a 4.7% increase in sales. The Composite Cork BU and Insulation Cork BU also recorded an increase in their respective sales. The Floor & Wall Coverings BU recorded a 3.2% decrease in sales.

[34]Corticeira Amorim, SGPS, S.A. (2020b). *Sustainability Report 2019*. Retrieved from https://www.amorim.com/xms/files/2019_Amorim_RC_EN_Sustentabilidade_Website_7Mai.pdf

[35] Ibid.

[36]Corticeira Amorim, SGPS, S.A. (2020a). *Consolidated annual report 2019*. Retrieved from https://www.amorim.com/xms/files/Investidores/5_Relatorio_e_Contas/Amorim_RC_EN_21Mai_web.pdf

The relative weight of each BU's sales in the group remains stable, as shown in Figure 2.4, with a slight variation reflecting the increase in the weight of the Cork Stoppers BU and a decrease in the weight of the Floor & Wall Coverings BU.[37]

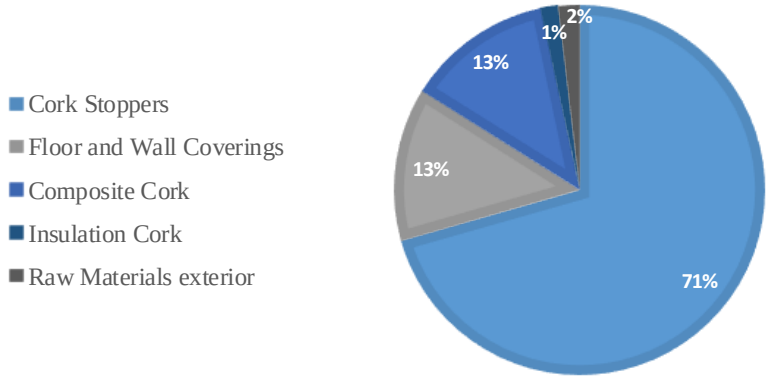
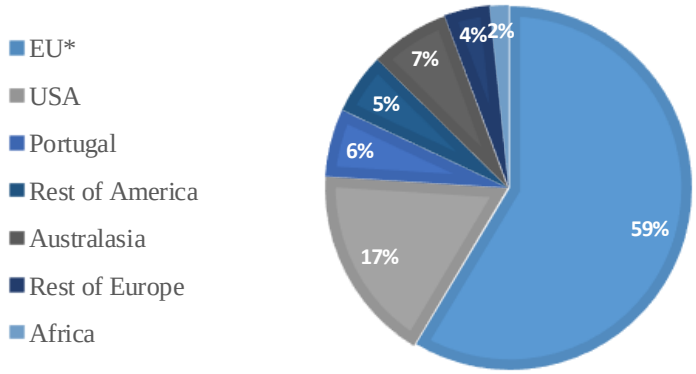


Figure 2.4 – Weight of Sales per Business Unit.

Source: Adapted from Corticeira Amorim Consolidated Annual Report (2019)

In geographic terms, as shown in Figure 2.5, the main market for the group's sales is France (19%), followed by the United States (17%). Italy remained the third main sales market and continues to increase its relative weight. Fourth, fifth and sixth positions are occupied by Germany, Spain and Portugal maintaining the relative position they held in 2018.[38]



*excludes Portugal; includes Switzerland and Norway.

Figure 2.5– Consolidated Sales by Geographic Area.

Source: Adapted from Corticeira Amorim Consolidated Annual Report (2019)

[37]Corticeira Amorim, SGPS, S.A. (2020a). *Consolidated annual report 2019*. Retrieved from https://www.amorim.com/xms/files/Investidores/5_Relatorio_e_Contas/Amorim_RC_EN_21Mai_web.pdf

[38] Ibid.

2.4 Problem Review:

The environment is being negatively impacted by the increase of the overall consumption of raw materials, energy, water and the increased production of waste and human use of land area.[39] This over-demand is creating environmental consequences that are leading to an acceleration of the climate change.[40] The economic growth the world has experienced over the last decades has been holding hands with the consumerism, that is currently developed to its exponent. Not only we, as consumers and industry itself, are increasingly consuming more, the current economy is based on a linear system that lays on the extraction, manufacture, use and rejection of materials. This system generates high amounts of waste not only at the end of the products' life, but throughout their entire life cycle.[41] It was in light of the unconcerned vision of our actions that made this current economic model grow and prosper, originating a consumerist society.

However, in recent decades, the environmental destabilization has increased the global concern for the economic growth and how it is affecting the environment and the future generations.[42] The call for a new economic model is getting louder, so in the search for a substantial improvement in resource performance across the economy, businesses have started to explore ways to rethink their business models.[43] A strategy of reducing resource use will not only diminish the pressures on the global environment. Running a resource efficient economy will also be a competitive advantage in a world with rising commodity prices and increased resource constraints.

[39] Friends of the Earth Europe. (2000). Overconsumption? Our use of the world's natural resources.
[40] Ibid.
[41] CIRAIG. (2015). Circular Economy: a Critical Literature review of Concepts. *Journal of Chemical Information and Modeling*. https://doi.org/10.1017/CBO9781107415324.004
[42] Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2016). The Circular Economy – A new sustainability paradigm? *Journal of Cleaner Production.* https://doi.org/10.1016/j.jclepro.2016.12.048
[43] Friends of the Earth Europe. (2000). Overconsumption? Our use of the world's natural resources.

CHAPTER 3

Methodology

Case studies can be used as a resource for teaching purposes and were popularized in the fields of law, administration, medicine or public politics, but are now predominant in all academic areas (Yin, 2001). According to Yin (2001), the aim of case studies for teaching purposes is to establish a framework for discussion and debate among students. Contrary to the research case study, the case studies for teaching purposes do not need to present a rigorous analysis on empirical data (Yin, 2001). According to Barney and Hesterly, "The core of many strategic management courses is the case method of instruction" (Barney & Hesterly, 2014, p. 365). They argue that in this case method, students will study and discuss real-world challenges and provide opportunities and challenges to face. This case method enables students to develop their skills for analysing and synthesize data by learning and applying the conceptual knowledge to real world situations (Barney & Hesterly, 2014).

The methodology used for this Pedagogical Case study will be qualitative, as the data under analysis is not numerical and does not use statistical methods. This case study is descriptive and follows an investigation strategy that is qualitative and interpretative. It is descriptive since it intends to describe the model of Circular Economy in the company to be studied, interpreting it and analysing the characteristics' qualitative results for the company, society and the environment, and describes situations that occur.

The elaboration of the description of the company under study, the study of several documents related to the operations of the company, definition of the issues for the case study and the literature review, form essential steps throughout this Pedagogical Case Study.

Corticeira Amorim was the company selected as it is one of the biggest Portuguese companies, that exists since 1870, and it leads an economic activity based on the circularity of its operations.

The case questions were developed with the intention for students to apply the knowledge concerning the concept of Circular Economy to a real-world situation, which is in this case to Corticeira Amorim's business model. The questions proposed aimed at systematically apply the conceptual frameworks and the theoretical knowledge concerning the theme under study, which is the Circular Economy, and then being able to, from this existing knowledge, support the ideas by applying them into the company.

The preparation of the case study, in which a detailed description of the company and its operations is made, was done through an analysis of the contents of the information present in official reports of the company, such as the consolidated annual accounts report and sustainability report referring to the year 2019, and data available from the official sources. The literature review was developed in an initial approach by the exhaustive search for articles in databases such as Science Direct, Google Scholar, Business Searching Interface using key words such as “Circular Economy concept”, “Circular Economy business models”, “Circular Economy and Sustainability review”, “Circular Economy opportunities”, “Circular Economy limitations”, and articles used in the bibliographic reviews of other articles, which were linked to the objective in question. The search for articles and respective reading ended when none of the available articles contained new and important information for the proposed case.

Concerning the development of the case questions, by allying the information present in the case study and the conceptual knowledge concerning the Circular Economy, it was possible to achieve the defined goal and answer to the proposed questions

CHAPTER 4

Pedagogical Note

4.1 Case Study Target Audience

This case study's audience are undergraduate and graduate students from Management and its related areas within Sustainably, targeting the courses with focus on Business Ethics, Responsibility and Sustainability and that cover these concepts of Circular Economy. Given its nature, this case study will also be viable for professionals that are willing to learn from a real case of circularity within a company business model and use it to address similar problems, particularly from the cork sector.

4.2 Pedagogical Objectives

As a practical tool to study the current problem and potential changes in the prominent economic business model, this study case conciliates three main objectives: consolidate the theoretical knowledge concerning the Circular Economy, be able to apply this knowledge to a real company's example through the most appropriate frameworks and concepts, identify if the concepts are being applied to the determined case study and how it can create a positive impact in the company, environment and society. Besides these goals, this Pedagogical Case Study gives insights on how to address Circular Economy issues for organizations within the cork sector. It helps all individuals that specifically deal with this sector to transfer this analysis to similar problems and apply these methods and strategies to their own cases.

4.3 Literature Review

4.3.1 Sustainability

In recent decades, the environmental destabilization has increased the global concern for the way that development of the economic growth is affecting the environment and the future generations. Sustainability concerns are increasingly incorporated into both the agendas of policymakers and the strategies of (Geissdoerfer et al., 2016).

The concept emerged firstly in "The Limits to Growth", published in 1972, in which it was debated the excessive industrialization and economic development and how it would soon cross the ecological boundaries (World Commission on Environment and Development, 1988). However, the concept gained notoriety after the 1987 Brundtland Report was issued. This

report links the issues of economic development and environmental stability stressing the need for sustainable development. It famously defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (World Commission on Environment and Development, 1988, p.41). Despite being initially driven by environmental concerns, its most recent understanding relies on the triple bottom line concept, which represents the three pillars of sustainability: people, profit, and planet (Elkington, 1997). The triple bottom line has been referred to as the balanced integration of economic, environmental and social performance (Elkington, 1997). The environmental performance aims at "maintaining the quality of the environment, which is necessary to conduct the economic activities and overall quality of life" (Klarin, 2018, p. 68). The social performance strives to preserve society's respect of cultural diversity, preservation of social values and the protection of human rights and equality. Finally, the economic performance aims to "maintain the natural, social and human capital required to achieve income and living standards" (Klarin, 2018, p. 68). The three pillars are systemically intertwined and affect one another through mutual causality and positive feedbacks (Geissdoerfer et al., 2016).

The concept of sustainability is considerably older than the Circular Economy, which has emerged more recently. Sustainability was institutionalized by environmental movements and supranational bodies, especially after the publication of the Brundtland report in 1987 (Geissdoerfer et al., 2016), whereas the Circular Economy concept is based on a fragmented collection of ideas derived from scientific fields (Korhonen, Honkasalo, & Seppälä, 2018), which will be addressed later in this chapter. While some of these approaches have made important sustainability science contributions, the connection to the current popular concept of Circular Economy is unclear, as the scientific research on this link is practically non-existent (Korhonen, Honkasalo, et al., 2018). However, according to Korhonen et al. (2018), Circular Economy can be used to achieve sustainable development. They argue that the Circular Economy concept has environmental, economic and societal objectives, which is in accordance with the triple bottom line concept of the sustainable development. In this way, the environmental objective of Circular Economy is to "reduce the production-consumption system and energy inputs, waste and emissions" (Korhonen, Honkasalo, et al., 2018, p. 41). Its economic objective is to "reduce the economic production-consumption system's raw material and energy costs, waste management and emissions control costs" (Korhonen, Honkasalo, et al., 2018, p. 41) and focus on innovation and market opportunities. Its social objective is the "sharing economy, increased employment and more efficient use of the existing physical

material capacity" (Korhonen, Honkasalo, et al., 2018, p. 41). According to Geissdoerfer et al. (2016), sustainability and Circular Economy concepts present a set of similarities and differences in the literature. On one hand, both notions emphasise commitments motivated by environmental threats and focus on the importance of increasing agency and public cooperation towards development. They also share an essentially global perspective, highlighting problems on a global scale that lead to shared responsibilities and to the importance of cooperation between various agents. Both concepts rely on business model innovation as the key strategy for reaching an industry transformation. They also describe not only potential costs and risks, but also the importance of diversification in order to take advantage of the value creation. Private businesses play a central role due to their capabilities and resources comparing to any other entities (Geissdoerfer et al., 2016). On the other hand, while Circular Economy aims at a closed loop system, eliminating all resource inputs and waste, "the goals of sustainability are open-ended and may change depending on the considered agents and their interests" (Geissdoerfer et al., 2016, p. 764). There is also a difference in agency, influencing the understanding of the agents that should influence system changes. "While agency is diffused in the case of sustainability as the priorities should be defined by all stakeholders" (Geissdoerfer et al., 2016, p. 764), Circular Economy's priorities should be emphasized by governments and companies. Finally, the responsibility for the transition to a circular system is allocated to private business, regulators and policymakers, contrary to sustainability's' responsibilities which are shred but not clearly defined.

4.3.2 Circular Economy

4.3.2.1 Circular Economy key concepts

The Circular Economy concept has progressed during the years and cannot be traced back to one single author or date, but to different schools of thought. Those schools of thought are complementary to each other and provide the foundation for the main principles of this new approach to economy (Moreno et al., 2016). Its practical applications to modern economic systems and industrial processes have gained momentum since the late 1970s as a result of the efforts of a small number of academics, thought leaders, and businesses, according to the Ellen MacArthur Foundation (2015b). The general concept underlying the Circular Economy has been developed by many schools of thought such as Regenerative Design, Industrial Ecology, Performance Economy, Biomimicry, Cradle to Cradle and Blue Economy.

- Regenerative Design

The concept of regenerative design arose in the 1970s by an American professor named John T. Lyle. The concept lays in the idea that all systems, from agriculture onwards, should be orchestrated in a regenerative manner. Which means that processes themselves renew or regenerate the sources of energy and materials that they consume (Ellen MacArthur Foundation, 2013b). Lyle's vision of regenerative design was founded on 12 principles: "Let natural processes do the work for us; use nature as the model for human enterprise; aggregate functions and processes to create resilience; strive for optimum levels, not maximum; match technology to needs; replace power with information; provide multiple pathways; solve many problems simultaneously; manage storage as a key to sustainability; shape form to guide flow; shape form to manifest process; prioritize for sustainability" (Lauria & Deonna, 2017, p. 163).

- Industrial Ecology

The Industrial Ecology concept has risen from the perception that human economic activity is causing unprecedent environmental changes, and emerged in 1970s, in opposition to the idea that the industrial system is considered separate from the environment (Wautelet, 2018b). Industrial Ecology relies on the study of industrial metabolism - material and energy flows through industrial systems and all activities performing a material energy balance. "Ecology" refers to scientific ecology, ecosystem studies and "Industrial" means the contemporary industrial society as a whole (Wautelet, 2018b). This approach aims to understand how the industrial system works, and the analysis of the industrial metabolism is then used as a basis to optimize the industrial materials' cycle - from virgin material to finished product to ultimate disposal of wastes – relying on the nature principles as the foundation (Iung & Levrat, 2014). This approach aims at creating closed-loop processes in which waste serves as an input, thus eliminating the notion of an undesirable by-product. The concept adopts a systemic point of view, designing production processes in accordance with local ecological constraints whilst looking at their global impact. With an emphasis on natural capital restoration, industrial Ecology also focuses on social wellbeing (Ellen Macarthur Foundation, 2013).

- Performance Economy

The concept of the performance Economy started in 1976 by Walter Stahel in a research report called "The potential for substituting manpower for energy", co-authored with Geneviève Reday (Ellen MacArthur Foundation, 2013b). According to the report, an economy with closed loops favouring reuse, repair and remanufacturing of goods over manufacturing of new products has positive impact in terms of job creation, economic competitiveness, resource savings and waste prevention (Wautelet, 2018b). Business models in a Performance Economy involve retaining ownership of the product and taking responsibility of the product throughout

its lifetime. Accordingly, selling performance implies to internalize the costs of risk and of waste. As a consequence, it provides an economic incentive to prevent any future liability after the point of sale (Stahel, 2010). Furthermore, by retaining ownership of products and their embedded resources, companies benefit from a high future resource security and resource price guarantee, which provides a competitive cost advantage in times of rising resource prices.

- Biomimicry

The concept of biomimicry was popularized by Janine Benyus in her book "Biomimicry: Innovation inspired by Nature" published in 1997. Biomimicry is defined as "a revolutionary new science that analyses nature's best ideas and adapts them for human use" (Marshall & Lozeva, 2009, p. 1). The core idea of this concept is that nature has already solved many problems that we are currently handling. Through the development of nature inspired technologies, processes and industrial systems, the main goal of biomimicry is to strive for sustainability. Finally, biomimicry aims at fostering innovation inspired by nature, in an environment where waste does not exist, as an organism's "waste" feeds other organism in such way that materials circulate within the cycle without polluting the ecosystem (Wautelet, 2018b).

- Cradle to cradle

The concept of Cradle-to-cradle was firstly developed by William McDonough and Michael Braungart in their book "Cradle to Cradle: Remaking the way we make things" (2002) (Bakker, Wever, Teoh, & de Clercq, 2010). Cradle-to-cradle design provides a practical design framework for creating products and industrial systems in a positive relationship with ecological health and abundance, and long-term economic growth (Braungart et al., 2007). The concept thinking is recognized to be at the core of Circular Economy's closed loop system, and it aims to create products not only minimizing the negative influences but also create a positive environmental impact. The Cradle to Cradle framework attempts to turn materials into nutrients by enabling their continuous flow within either biological or technical metabolisms. Biological materials are absorbed back into and have a positive impact on the environment (Braungart et al., 2007). Technical nutrients remain safely in a closed loop system of manufacture, recovery and reuse to maintain their material value through many cycles, and are owned by manufacturers, but are used by consumers as products or services (Braungart et al., 2007). The Cradle to Cradle framework focuses on design for effectiveness in terms of product flows with positive impact, which basically differentiates it from the traditional design focus on reducing negative impacts (Reay, McCool, & Withell, 2011).

- Blue Economy

Blue economy is a movement originated by Guenter Pauli's Zero Emission Research Initiative in 1994 and strives to find sustainable solutions to society's problems (Wautelet, 2018b). Blue economy is a concept based on a new way of creating businesses which uses principles of waterfall – cascade - in a way that waste from one industry becomes raw material for another (Ellen MacArthur Foundation, 2015b). This cascade system aims to remove an additional value from the products, which means that after the material is disintegrated, the components are usefully extracted (Ellen MacArthur Foundation, 2015b). Through this approach, the waste of one product becomes the input to create a new cash flow, favouring the local economy (Wautelet, 2018b).

4.3.2.2 From Linear to Circular

Throughout its evolution, our industrial economy has been based in one central characteristic established in the early days of industrialization: a linear model of resource consumption that follows a "take-make-dispose" pattern (Ellen MacArthur Foundation, 2015b). The intensification of this production system began in the earlies 18th century with the industrial revolution. During this period, the global economic model of growth was based exclusively on a linear model, which rested on an "extract, transform, dispose" principle, as illustrated by the Figure 4.1.:

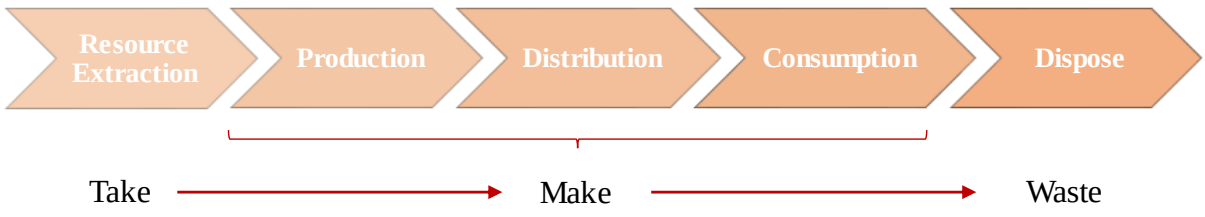


Fig 4.1 - The linear economy.

Source: Adapted from Wautelet (2018).

The Industrial Revolution brought unparalleled prosperity that resulted in a period of accelerated economic development. During the industrial revolution, the European economy developed in an accelerated rate. The European GDP per capita grew by an average of 1,6% a year, since 1820 as a result of the bet on productivity, which generated an increase in income and, consequently, an increase in consumption (Ellen MacArthur Foundation, 2015a). Although the linear model accelerated the economic growth, it also led to the increasing consumption and misuse of resources, based on the premise that both natural resources and the

space needed to dispose of waste were considered inexhaustible, which led to a negative impact in the environment (Wautelet, 2018a). Furthermore, in the present era, the costs and supply risks surrounding non-renewable natural resources are high, and the negative externalities associated with their use, such as climate change and biodiversity loss, are clearly felt (Corticeira Amorim, SGPS, 2020).

Circular Economy comes as an alternative to the linear economic model of resource consumption that currently predominates. The recognition of the limits to planetary resource and energy use, lay at the foundations of Circular Economy thinking (Bocken et al, 2016). The Circular Economy model and the linear economy model differ from each other in the way in which value is created or maintained. Opposite to the linear economy, a Circular Economy model, replaces the "end-of-life" concept with repair and it aims to minimize the need for new inputs of materials and energy, while reducing environmental pressures associated to resource extraction, emissions and waste, as illustrated in Figure 4.2:

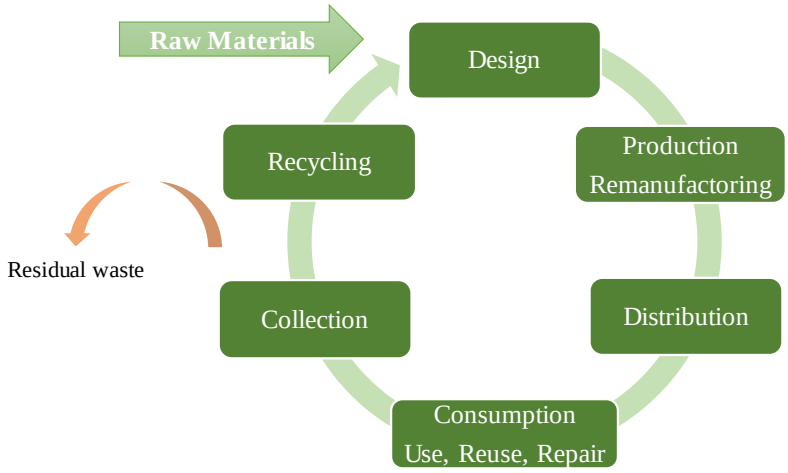


Fig 4.2 - The Circular Economy.

Source: Adapted from European Commission (2014).

A linear economy model that pursues sustainability, is focused on eco-efficiency. In this system, eco-efficiency seeks only to minimize the volume, velocity, and toxicity of the material flow system, but are unable of shifting its linear progression and value is created by producing and selling as many products as possible (Braungart et al., 2007). Within a Circular Economy, sustainability is pursued in increasing the eco-effectiveness of the system. This means that not only the ecological impact is minimized, but that the ecological, economic and social impact are even positive (Braungart et al., 2007).

The most prominent definition of a Circular Economy was described in the Ellen Macarthur foundation 2013 report "Towards the Circular Economy" (Ellen MacArthur Foundation, 2013a). This definition has been adopted extensively by professionals and frequently used as a reference in academic and non-academic debates on Circular Economy in Europe (Wautelet, 2018a). A Circular Economy is described, according to the Ellen MacArthur foundation, as "an industrial system that is restorative or regenerative by intention and design" (Ellen MacArthur Foundation, 2013a, p. 7). It replaces the "end-of-life" concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models (Ellen Macarthur Foundation, 2014). Circular Economy model seeks to ultimately decouple economic growth from finite resource consumption, by reducing the need for new materials and energy use, reducing environmental pressures, while generating business and economic opportunities, environmental and social benefits (Ellen MacArthur Foundation, 2015b).

4.3.2.3 Principles

The Ellen MacArthur foundation has conducted several studies which provided an overview of the three main principles of the Circular Economy, considering the complementary school of thoughts previously discussed in this literature review, as illustrated in Figure 4.3.

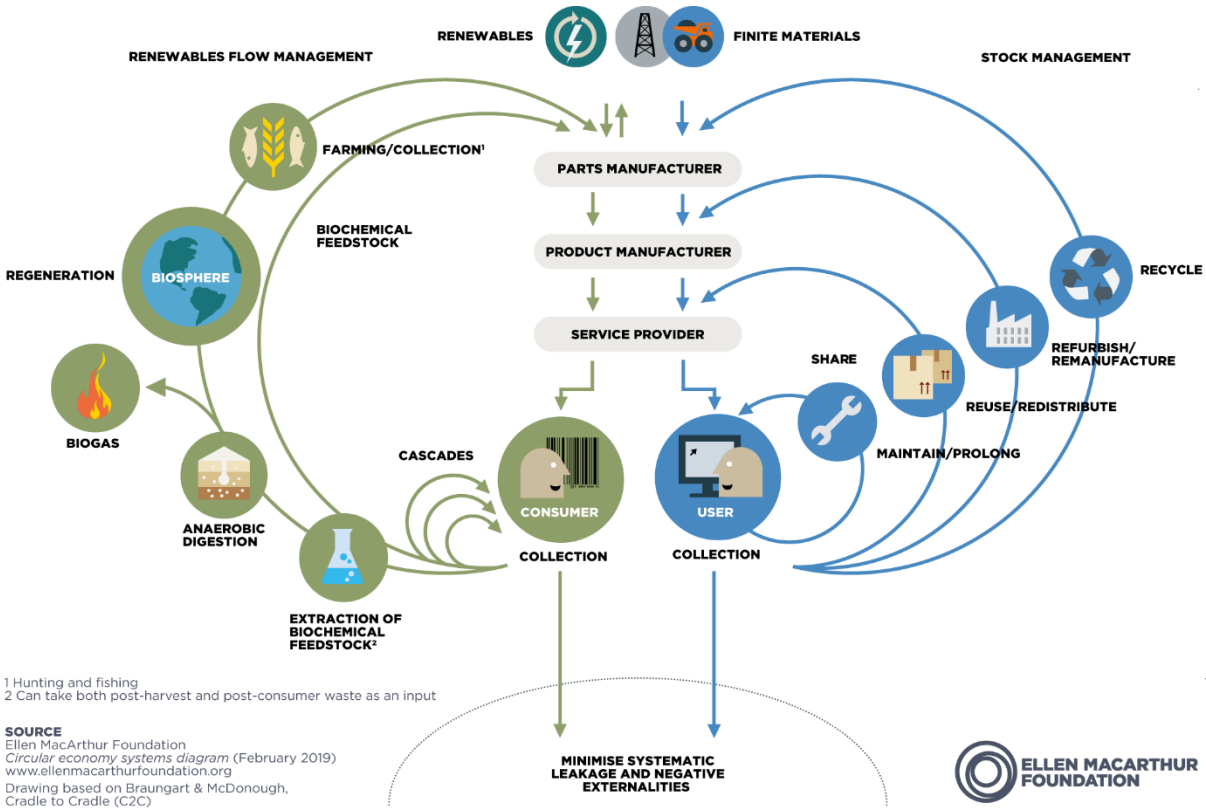


Figure 4.3 – Outline of a Circular Economy.

Source: Ellen Macarthur Foundation (2015)

The first principle consists in "preserving and enhancing natural capital by controlling finite stocks and balancing renewable resource flows" (Ellen MacArthur Foundation, 2015b, p. 5), meaning that technology and processes are chosen wisely according to their use of renewable or better-performing resources (Ellen MacArthur Foundation, 2015b). A Circular Economy also enhances natural capital by encouraging flows of nutrients within the system and creating the conditions for the regeneration of, for example, soil, energy and water (Moreno et al., 2016).

The second principle consists in "optimize resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles" (Ellen MacArthur Foundation, 2015b, p. 7). This means designing for remanufacturing, restoring, and recycling to keep technical components and materials circulating in and contributing to the economy, preserving embedded energy and other value. It also refers to encouraging biological nutrients to re-enter the biosphere to become valuable feedstock for a new cycle. In the biological cycle, products are designed by intention to be consumed or metabolized by the economy and regenerate new resource value (Bocken et al., 2016). For biological materials, the essence of value creation lies in the opportunity to extract additional

value from products and materials by cascading them through other applications. Durables such as engines or computers, on the other hand, are made of technical nutrients unsuitable for the biosphere, such as metals and most plastics. These are designed for reuse, and products subject to rapid technological advance are designed for upgrade (Ellen MacArthur Foundation, 2015b).

Finally, the third principle consists in "foster system effectiveness by revealing and designing out negative externalities" (Ellen MacArthur Foundation, 2015b, p. 7). This includes reducing harm to "systems and areas such as food, mobility, shelter, education, health, and entertainment, and managing externalities, such as land use, air, water and noise pollution, and the release of toxic substances" (Ellen MacArthur Foundation, 2015b, p. 7). Additionally, the energy required to fuel this cycle should be renewable by nature, again to decrease resource dependence and increase systems resilience (Ellen MacArthur Foundation, 2015b).

The principles above act as principles for action. In this way, a Circular Economy is defined by the following characteristics, according to the Ellen Macarthur Foundation (Ellen MacArthur Foundation, 2015b):

- Design out waste: In a Circular Economy, waste does not exist and the products are designed in a way to fit the material cycle of the product, focusing on creating no disposal or even recycling. Biological materials are non-toxic and can easily be returned to the soil by composting or anaerobic digestion (Iung & Levrat, 2014). Technical materials are designed to be recovered, refreshed and upgraded, minimizing the energy input required and maximizing the retention of value (Iung & Levrat, 2014). This is the opposite idea of the linear economic model, where the products are not designed with the intention of being regenerated and often results in a fast degradation of value.
- Build resilience through diversity: Across many types of systems, diversity is a key driver of versatility and resilience. Economies need a balance of various scales of businesses to thrive in the long term (Wautelet, 2018b). The larger enterprises bring volume and efficiency, while the smaller ones offer alternative models when crises occur. "Modularity, versatility, and adaptivity" (Ellen MacArthur Foundation, 2013b, p. 27), are key features a business must comply for their business and consequently product/service to thrive in a fast-passed evolving world. Diverse systems with many connections and scales are more resilient in the face of external shocks than systems built simply for efficiency.
- Rely on energy from renewable sources: Systems should ultimately aim to run on renewable sources. The energy required in a Circular Economy should be renewable by nature, in order to decrease resource dependence and increase systems resilience (Korhonen, Nuur,

Feldmann, & Birkie, 2018). This will be further enabled by the reduced threshold energy levels required in a Circular Economy.

- Think in systems: In a Circular Economy, many real-world elements, such as businesses, people or plants, are part of complex systems where different parts are strongly linked to each other. The relationship of the elements to their environmental and social contexts must be considered. Systems thinking emphasizes flow and connection over time and has the potential to encompass regenerative conditions rather than needing to limit its focus to one or more parts and the short term (Ellen MacArthur Foundation, 2013b).
- Waste is food: On the biological nutrient side, the ability to reintroduce products and materials back into the biosphere through non-toxic, restorative loops is central idea. On the technical nutrient side, improvements in quality are also possible (Ellen MacArthur Foundation, 2015b). The change from technical material towards biological materials, the use of cascades through different applications before extracting new raw materials and finally reintroducing their nutrients into the biosphere, are fundamental principles of a restorative Circular Economy (Moreno et al., 2016).

4.3.2.4 ReSOLVE Framework

There are six business actions to implement the principles of the Circular Economy and which represent major circular business opportunities described by the ReSOLVE framework (Ellen MacArthur Foundation, 2015a). This set of six business actions will help business and governments to transition to a Circular Economy (Ellen MacArthur Foundation, 2015a):

- Regenerate – represents the shift to renewable energy and materials. It is related to returning recovered biological resources to the biosphere in order to reclaim, retain, and regenerate the health of ecosystems (Ellen MacArthur Foundation, 2015a);
- Share – focuses on the utilization of products by sharing them among users. It may be done through peer-to-peer sharing of private products or public sharing of a pool of products. Sharing means also reusing products for as long as they are technically acceptable to use, and prolonging their life through maintenance, repair, and design-enhancing durability (Ellen MacArthur Foundation, 2015a);
- Optimise – focuses on increasing the performance/efficiency of a product and removing waste in the production process and supply chain. They may also be related to leveraging big data, automation, remote sensing, and steering. None of these actions requires changing the product or technology (Ellen MacArthur Foundation, 2015a);

- Loop – actions aim at keeping components and materials in closed loops and prioritize inner loops. For finite materials, this means remanufacturing products or components and as a last resort recycling material. For renewable materials, this means anaerobic digestion and extracting bio-chemicals from organic waste (Ellen MacArthur Foundation, 2015a);
- Virtualize – aim to deliver particular utility virtually instead of materially (Ellen MacArthur Foundation, 2015a);
- Exchange – aim to replace old materials with advanced non-renewable materials and/or with applying new technologies (Ellen MacArthur Foundation, 2015a).

Each action reinforces and accelerates the performance of the other actions and represents a crucial circular business opportunity enabled by the technology revolution that is available. "In different ways, these actions all increase the utilisation of physical assets, prolong their life, and shift resource use from finite to renewable sources". (Ellen MacArthur Foundation, 2015a, p. 26)

4.3.2.5 New Business Models and Value Creation

The literature presents various perspectives and comprehensive reviews on the business model definitions. Geissdoerfer et al. (2018) define a business model as "simplified representation of the elements of a complex organizational system and the interrelation between these elements. It determines the organization's value proposition, value creation and delivery, and value capturing and aims at analysis, planning, and communication in face of increasing complexity." (Geissdoerfer et al., 2018, p. 3), and Bocken et al. (2014) argue that the business model concept provides a framework for understanding how companies propose, create, and capture value while applying the principles and practices of the Circular Economy (Bocken et al., 2014).

Circular business models present different practices from the linear business models. They differ in two main characteristics: the flow of products and the business model (Kooloos et al., 2018). The first concerns the flow of products from materials to consumer and vice versa. The second concerns the business model and the way the activities of the business are organized (Kooloos et al., 2018). A circular business model can be described as a business model that incorporates elements that slow, narrow, and close resource loops, so that the resource input into the organisation and its value network is decreased and waste and emission leakage out of the system is minimised (Bocken et al., 2016). Circular business models can also be presented as an integrated approach of value creation and resource efficiency strategies (Nußholz, 2017). The transition towards a Circular Economy will require that new innovative business models are created or replaced by the existing ones, adapting the linear model by following the

principles of a circular model. According to several authors such as Geissdoerfer et al. (2018), Moreno et al. (2016) and Bocken et al. (2016), there are several key business strategies based on fundamental strategies toward the cycling of resources to take into consideration in order to move to a Circular Economy business model: Slowing resource loops and Closing resource loops.

Business models to slow resource loops encourage long product life and reuse of products through business model innovation. There are three main models described by Bocken et al. (2016):

1. Access and performance model: focused on providing the capability or services to satisfy users' needs without needing to own physical products. Similar terms include "Product Service Systems", a combination of products and services that seek to provide this capability or functionality for consumers while reducing environmental impact and "deliver capability rather than ownership" (Bocken et al., 2016).

2. Extending product value: focused on exploiting the residual value of products from manufacture, to consumers, and then back to manufacturing – or collection of products between distinct business entities (Moreno et al., 2016). In this type of business model, remanufacturing typically becomes the activity of the original manufacturer (Bocken et al., 2016).

3. Classic long-life model and encourage sufficiency: The "classic long-life model" is focused on delivering long product life, supported by design for durability and repair for instance. Similarly, "encourage sufficiency" is focused on long lasting products, and in solutions that actively seek to reduce end-user consumption through principles such as such as repair or remanufacturing, and recycling materials (Nußholz, 2017).

Business models for closing loops focuses on capturing the value from what is considered in a linear business approach, as by-products or "waste." There are two main models described:

4. Extending resource value: focused on exploitation of the residual value of resources, based on the collection or sourcing of otherwise "wasted" materials and resources to turn these into new forms of value (Bocken et al., 2016).

5. Industrial symbiosis: focused on a process-orientated solution, concerned with using residual outputs from one process as feedstock for another process or product line (Moreno et al., 2016).

4.3.2.6 Opportunities and Limitations

There are several potential benefits to be generated when transitioning to a Circular Economy, including material cost savings, reduced price volatility, improved security of supply, employment creation, as well as reduced environmental pressures and impacts (Wautelet, 2018a). According to the European Environment Agency, and their report on "Circular Economy in Europe Developing: the knowledge base", the benefits of a transitions to a Circular Economy are divided in four main areas: "resource use, the environment, the economy and social aspects" (European Environment Agency, 2016, p. 12):

- Resource opportunity, by improving resource security and decreasing import dependency. A Circular Economy could increase the efficiency of primary resource consumption by reducing the demand for primary raw materials' extraction and resource exhaustion, thus reducing waste and emissions (Bocken et al., 2014) and extracting more value from less natural resource consumption (Geissdoerfer et al., 2018). "This would help to reduce Europe's dependence on imports, making the procurement chains less subject to the price volatility of international commodity markets and supply uncertainty due to scarcity and/or geopolitical factors" (European Environment Agency, 2016, p. 12).

- Environmental opportunities, by generating less environmental impact. Circular Economy will reduce Carbon dioxide emissions and primary material consumption for example by using biomass for energy purposes, which does not contribute to the carbon dioxide emissions to the atmosphere (Garrido Azevedo, Susana, Matias, 2016). It will also preserve and improve land productivity and soil health, by reducing waste in the food value chain, and the return of nutrients to the soil. Finally, it will reduce negative externalities such as land use, air, water and noise pollution, release of toxic substances, and climate change. (Ellen MacArthur Foundation, 2015a)

- Economic opportunities, by creating opportunities for economic growth and innovation. A Circular Economy could enable product innovation, such as technologies and business models to create more economic value from fewer natural resource and provide significant cost savings (European Environment Agency, 2016). According to the Ellen MacArthur Foundation (2015), "economic growth, as defined by GDP, would be achieved mainly through a combination of increased revenues from emerging circular activities, and lower cost of production through the more productive utilization of inputs" (Ellen MacArthur Foundation, 2015b, p. 11). The benefits of a more innovative economy include higher rates of technological development, improved materials, labour, and energy efficiency, and more profit opportunities for companies.

- Social benefits, by fostering sustainable consumer behaviour and job opportunities. Social innovation associated the Circular Economy can be expected to result in more sustainable consumer behaviour (Bocken et al., 2014), while contributing to human health and safety (European Environment Agency, 2016). A Circular Economy is also expected to create job opportunities (Ellen MacArthur Foundation, 2015b). For example, by replacing products with services.

Concerning Circular Economy limitations, the concept presents a set of several challenges to be faced:

- Reuse is seen as an effective strategy to prolong the product lifetime and enhance resource efficiency. However, reuse of products does not guarantee resource efficiency gains. For example, if energy savings from reuse outweigh the energy savings from avoiding primary production, replacement with more efficient product rather than reusing may be desirable. As so, the optimal lifetime of products needs to be identified (Nußholz, 2017);
- A cyclic flow may not secure a sustainable outcome. For example, in the utilization of forest residues from cuttings as a source for renewable energy, "nutrient rich parts of the trees, may be removed from the forest ecosystem where they would support ecosystem health, biodiversity and forest growth" (Korhonen, Honkasalo, et al., 2018, p. 42). Circular Economy promoted product reuse, remanufacturing and refurbishment should be prioritized (Korhonen, Honkasalo, et al., 2018) and the recycling of raw-material value only should be avoided as there can be inefficiencies at each stage of the recycling process that will keep recycling efficiencies lower than 100% (Nußholz, 2017);
- Although closing product and material loops have a solid potential for material and energy efficiency gains, the fact that it can generate rebound effects is a major issue (Bocken et al., 2014). "If the resulting secondary production does not reduce primary production, implementing circular strategies risks increasing overall production, partially or fully offsetting their resource efficiency gains." (Nußholz, 2017, p. 11)
- Circular Economy focuses on durable products because it keeps the economic value provided longer within the economic and product cycle. When the value and service is utilized many times, the need for resource extraction for new products should be reduced (Korhonen, Honkasalo, et al., 2018). However, if those products turn out to create negative effects, extending product life might create unsustainability in the long-term. In that situation, short life-time and continuous innovation have an environmental advantage (Korhonen, Honkasalo, et al., 2018).

4.4 Case Study Lecture Plan

Session	Description of Activity	Time
Preparation	Individual case reading and clarification of the problem being addressed - should be done before class; Explore and collect further information about the organization and the theme of the case.	Around 45 mins
Session 1	Divide class into 5 groups of around 4 to 6 students.	10 mins
	Introduction to the case study and presentation of Corticeira Amorim (play video[44]).	
	Discussion about the organization and the problem identified.	10 mins
	Develop question 1 - Based on its principles and characteristics, describe the Circular Economy model and the main differences from the linear economy model.	40 mins
	Presentation and discussion of the main conclusions of question 1 by the students.	20 mins
Session 2	Develop question 2 – Analyse in which way are the schools of thought conceptually related to the Circular Economy and how are they reflected in Corticeira Amorim's business model.	50 mins
	Presentation and discussion of the main conclusions of question 2 by the students.	30 mins
Session 3	Develop question 3 – Explore the overall principles and characteristics of the CE and how are they applied in Corticeira Amorim's business model.	50 mins
	Presentation and discussion of the main conclusions of question 3 by the students.	30 mins
Session 4	Develop question 4 – Explore the ReSOLVE Framework and conclude if Corticeira Amorim is compliant with the framework.	50 mins
	Presentation and discussion of the main conclusions of question 4 by the students.	30 mins
Session 5	Develop question 5 – Based on Corticeira Amorim's case, explore the overall benefits of engaging a Circular Economy business model.	50 mins
	Presentation and discussion of the main conclusions of question 5 by the students.	30 mins
Session 6	The students should consolidate and wrap up the questions developed and deliver a written case resolution.	50 mins
	The professor presents the resolution slides, highlighting the analysis made and all the relevant conclusions/learnings.	30 mins

[44] https://www.youtube.com/watch?v=XNhDyUPozbA

4.5 Case Study Lecture from the faculty to the students

This case aims to study how is the Circular Economy characterized, in which concepts it is based on, the available strategies for new business models, its opportunities and limitations. Taking Corticeira Amorim's case as an example, in order to address this study, the following questions will be analysed:

Question 1. Based on its principles and characteristics, describe the Circular Economy model and the main differences from the linear economy model.

Question 2. The concept of Circular Economy has evolved during the years and has been developed by different schools of thought. Based on the different concepts related to Circular Economy, demonstrate which are more reflected in Corticeira Amorim's business model.

Question 3. Considering the principles and characteristics of a Circular Economy developed in the first question, in what way does Corticeira Amorim applies them and what are the company's strategies for a successful circular business model?

Question 4. The Ellen MacArthur Foundation has identified a set of six actions to be taken when transitioning to a Circular Economy: The ResOLVE framework. Elaborate on this framework and conclude the extent to which Corticeira Amorim is in line with these actions.

Question 5. Based on the Corticeira Amorim's case, explain why companies are increasingly moving towards a Circular Economy based model and explore the overall benefits of engaging a Circular Economy business model.

4.6 Resolution – analysis of the data

Question 1. Based on its principles and characteristics, describe the Circular Economy model and the main differences from the linear economy model.

The Circular Economy model and the linear economy model differ from each other mainly in the way in which value is created or maintained. A linear economy traditionally follows a "take-make-dispose" plan and its value is created by producing and selling as many products as possible, relying on finite resource consumption. The linear model is associated with having a negative impact on the environment as it implies an enormous misuse of resources that results in waste that is discarded in the end. A Circular Economy model, on the other hand, replaces the "end-of-life" concept with restoration. The materials are preserved, restored or even reintroduced into the system in a cyclical manner, prioritizing renewable sources of energy. It

aims to minimize the need for new inputs of materials and energy, while reducing environmental pressures linked to resource extraction, emissions and waste.

The foundation of the Circular Economy concept is based on three main principles:

1. Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows;
2. Optimize resource yields by circulating products, components, and materials at the highest utility always in both technical and biological cycles;
3. Create effective systems by revealing and designing out negative externalities.

The first principle consists in the idea that in a Circular Economy resources are selected minutely, and renewable sources of energy are prioritized. It also relies in the preservation of materials, creating conditions for their regeneration. The second principle consists in the idea that this model is designed to remanufacture, restore and recycle, in order to keep the materials and components circulating. In this way they will contribute to the economy by extending product life and optimizing reuse. The third principle consists in the idea that the circular model acts in a way to reduce the damage to systems and society and manage externalities. Additionally, the energy required to fuel this cycle should be renewable in order to decrease resource dependence and increase systems resilience.

Considering the previous principles, a Circular Economy is defined by the following characteristics:

- Design out waste: contrary to the linear economy, in a Circular Economy waste does not exist and is design out on purpose. This means that the products are designed and customized in a way that their materials can fit within the material cycle of the product, making it possible to create no disposal or recycling. In terms of biological materials, they are described as non-toxic and can be reintegrated into the soil. In case of the technical materials, they are designed to be recovered, thus maximizing the preservation of value.
- Build resilience through diversity: Diverse systems are more versatile and resilient in the face of external shocks than systems which are built solely for efficiency. As so, these are key features a business must acquire for its product or service to thrive in a fast-passed developing world.
- Rely on energy from renewable sources: in a Circular Economy, systems should rely on renewable sources of energy, in order to decrease resource dependence and increase systems resilience.
- Think in systems: in a Circular Economy, systems-thinking is applied broadly. Elements are considered in their relationship with their infrastructure, environment, and social

contexts. Systems thinking emphasizes flow and connection over time and has the potential to encompass regenerative conditions rather than needing to limit its focus to one or more parts and the short term.

Question 2. The concept of Circular Economy has evolved during the years and has been developed by different schools of thought. Based on the different concepts related to Circular Economy, demonstrate which are more reflected in Corticeira Amorim's business model.

The Circular Economy concept cannot be traced back to one unique author, but rather to different schools of thought. It has evolved during the years and has attracted increased attention in the recent ones. The general concept underlying the Circular Economy has been developed by many schools of thought, such as Regenerative Design, Industrial Ecology, Performance Economy, Biomimicry, Cradle to Cradle and Blue Economy. All schools of thought advocate, to a certain extent, the importance of system thinking when addressing the issues of our current linear economic model and so, the concept of Circular Economy relates to every mentioned school of thought and thus can be considered as a holistic framework.

First, Regenerative Design lays in the idea that all systems should be orchestrated in a regenerative manner, which means that processes themselves renew or regenerate the sources of energy and materials that they consume. Regenerative design is about ensuring the built environment has a net positive impact on natural systems. To progress towards regenerative design and systems for our planet, it is important to understand how to design respecting planetary boundaries and utilising science-based targets.

Second, Industrial Ecology aims to understand how the industrial system works, how flows of material and energy are regulated and how it interacts with the biosphere. It aims at creating closed-loop processes in which waste serves as an input, thus eliminating the notion of an undesirable by-product. The concept adopts a systemic point of view, designing production processes in accordance with local ecological constraints whilst looking at their global impact from the outset.

Third, Performance Economy supports the idea of an economy with closed loops favouring reuse, repair and remanufacturing of goods over manufacturing of new goods. It creates a positive impact in terms of job creation, economic competitiveness, resource savings and waste prevention. Business models in a Performance Economy involve retaining ownership and taking responsibility of the product throughout its lifetime.

Fourth, Biomimicry studies nature's best ideas and then imitates the most relevant inventions of nature for adapting them to provide innovative and sustainable solutions for the society. In natural ecosystems, waste does not exist as an organism's "waste" feeds other organism in such way that materials circulate within cycle without polluting the ecosystem. The concept rests on the idea that many of the challenges that businesses face have already been solved in nature.

Fifth, Cradle to Cradle aims to create products minimizing the negative effects and create a positive environmental impact, by attempting to eliminate waste altogether. In this scenario, biological materials are absorbed back into, and have a positive impact on the environment. Technical nutrients remain safely in a closed loop system of manufacture, recovery and reuse to maintain their material value through many cycles, and are owned by manufacturers, but are used by consumers as products of service. Its framework focuses on design for effectiveness in terms of product flows with positive impact, which fundamentally differentiates it from the traditional design focus on reducing negative impacts.

Finally, Blue Economy is based on creating businesses which use principles of waterfall – cascade - in a way that waste from one industry becomes raw material for another. This cascade system aims to remove an additional value from the products, which means that after the material is disintegrated, the components are usefully extracted. Through this approach, the waste of one product becomes the input to create a new cash flow, favouring the local economy.

Corticeira Amorim reflects mostly the concepts of the Industrial Ecology and Biomimicry in their business model in a way that, operating under the motto "nothing is wasted, everything is valued", they strive to end cork waste throughout the production system by ensuring that sub-products associated to cork processing are reused. By-products generated during the cork stopper production process, cork that does not meet production standards or recycled cork at the end of life, are incorporated into other high added-value applications within the several business units they own. Concerning the recycled products, the company treats and grounds them at one of three Corticeira Amorim industrial units in Portugal, and after being processed into granules, they can be reintegrated into the production process and used to produce composite and insulation cork agglomerates. Finally, the part that cannot be incorporated in products, cork dust, it is not considered waste and is used as an energy source - biomass. The company also applies the principles of the Blue Economy in a way that in addition to the 100% use of cork, whenever feasible, the group uses recycled materials from other industries to create new products, thereby saving the planet's natural resources and reducing the problems associated with their depletion. For example, the Composite Cork BU in particular, has a wide

range of products that uses by-products from other industries that previously ended up in landfills and that meet the needs of diverse industries such as aerospace, footwear, automotive, sports or construction. Finally, Corticeira Amorim also presents the characteristics of the Regenerative design and Cradle to cradle in their business model by not only minimizing the negative impacts through their policies and systems, aiming to eliminate waste altogether, but also creating positive impacts in the environment. Cork oak forests – the montados - play a key role in ecological processes by creating positive externalities for the environment and for societies. They may contribute to climate change mitigation if they are sustainably managed as they retain carbon dioxide, contribute to the water retention, prevent soil degradation and combat desertification. The extraction of the raw material, helps to maintain the vitality of the montados and at the same time promotes economic, environmental and social development, benefiting the high number of people who live and work in areas covered by these forests.

Question 3. Considering the principles and characteristics of a Circular Economy developed in the first question, in what way does Corticeira Amorim applies them and what are the company's strategies for a successful circular business model?

Corticeira Amorim applies the principles of a Circular Economy from the recovery of the main raw material – cork – to the waste generated by the business. The company does this through policies of reduction of waste, extending the life of materials, regenerating natural systems and adopting renewable sources of energy. This strategy is mirrored in their motto: "nothing is wasted, everything is valued", since 1963. One of the key strategies of the company relies on optimizing the use and consumption of cork throughout the production cycle. By applying a principle of 100% use of cork, the by-products generated during the cork stoppers production process are reintegrated in the production process and used to create other products. The part that cannot be incorporated in products is used as an energy source – biomass -, which is the main energy source the company uses. Additionally, Corticeira Amorim supports several initiatives that collect and recycle cork that is later reintegrated in the production process, and programmes for sustainable management of the cork oak forests.

Following the principles described above, Corticeira Amorim's Circular Economy business model is characterized as following:

- Design out waste: Corticeira Amorim's business verifies the Circular Economy characteristic of designing out waste, by applying the concept of 100% use of cork. They design the production process to ensure that all sub-products associated to cork processing are reused, so there are no forms of cork waste or residues, and in this way they are able to recover what

was previously considered waste, in order to extend its use in the economy. In addition to the integral use of cork, they also promote Circular Economy using by-products from other industries that previously ended up in landfills to create a wide range of products for diverse industries such as aerospace, footwear, automotive, sports or construction, which is the case of the Floor & Wall Coverings Business Unit.

- Diversity builds strength: Corticeira Amorim complies with the build resilience through diversity characteristic in a way that they have been balancing the various scales of businesses to thrive in the long term, by creating and adapting their diverse systems within their business units. They also have been adapting its process system throughout the time, making it possible to adapt the business to the changing world and circumstances.
- Rely on energy from renewable sources: Corticeira Amorim relies on renewable sources of energy within its Circular Economy business model. The company aims to reduce the environmental impact of operations by adopting renewable, affordable and efficient solutions. The company's primary source of energy consumed comes from renewable sources. They use cork dust – biomass – as their main source of energy, representing 63% of the total energy consumption and in this way, they are able to reduce carbon dioxide emissions and exploit the waste product created throughout the production process, reducing the waste generated.
- Think in systems: Corticeira Amorim has been adapting its process system throughout the time, making it possible to adapt the business to the changing world and circumstances. The raw materials BU is the starting point for global and integrated management of Corticeira Amorim's value chain. The Raw Materials BU is responsible for preparing, discussing and deciding on the multi-annual procurement policy of the company, ensuring optimization of the flow of all types of cork raw materials to be used in other BUs in the Group and respective market applications. This BU is essential to enhance synergies between the various units, as well as to ensure the optimisation of the flow of raw materials. By means of this strategy, the business unit is developing and fostering cork extraction in high potential, while guaranteeing an immediate response to possible increases in consumption of the raw material.

The application of the principles of the Circular Economy, through the valorisation of its main raw material and waste generated, is one of the Corticeira Amorim main strategies, achieving the notable landmark of 100% use of cork. Cork promotes the economic and social sustainability of the areas in risk of desertification, promoting the preservation of the cork oak forest. A circular business model focuses on slowing, narrowing, and even closing resource loops, so that waste and emission leakage out of the system are minimized. In this way,

Corticeira Amorim follows a strategy of extending product and resource value, as a way of creating value and achieve the economic performance. The extending product value strategy relies on exploiting the residual value of products from manufacture, to consumers, and then back to manufacturing – or collection of products between distinct business entities. Corticeira Amorim has a strong policy of reusing products, for example with their recycling strategy where they collect recycled cork stoppers and use them to create new products. In this way, they are extending the product's life by incorporating it into other business units and products. The extending resource value strategy relies on the exploitation of the residual value of resources, based on the utilization of otherwise wasted materials and resources to turn these into new forms of value. Within Corticeira Amorim, by-products generated during the production process, cork that does not meet production standards or recycled cork at the end of life, are incorporated into other high added-value applications and the part that cannot be incorporated in products, cork dust, it is not considered waste and it is used as an energy source. Additionally, for the Composite Cork BU in particular, they use by-products from other industries that previously ended up in landfills, to create a wide range of products that meet the needs of diverse industries.

Question 4. The Ellen MacArthur Foundation has identified a set of six actions to be taken when transitioning to a Circular Economy: The ResOLVE framework. Elaborate on this framework and conclude the extent to which Corticeira Amorim is in line with these actions.

The core principles of the Circular Economy can be translated into a set of six business actions: Regenerate, Share, Optimise, Loop, Virtualise, and Exchange – the ReSOLVE framework. Each of the six actions represents a major circular business opportunity that will increase the utilisation of physical assets, prolong their life, and shift resource use from finite to renewable sources. Each action reinforces and accelerates the performance of the other actions. The ReSOLVE framework is described and relates with the case as follows:

Regenerate – represents the shift to renewable energy and materials. It is related to returning recovered biological resources to the biosphere in order to reclaim, retain, and regenerate the health of ecosystems. Corticeira Amorim verifies the "Regenerate" action by adopting a business based on the 100% use of cork. Throughout its production system, the company ensures that all sub-products associated to cork processing are reused, so there are no forms of cork waste or residues. However, cork-dust that is created throughout the production system, cannot be incorporated in products. In this way, the company does not consider it

waste, so they use it as an energy source - biomass. Corticeira Amorim also stands for the shift to the use of renewable energy. The primary source of energy consumed by Corticeira Amorim is biomass (63%), followed by electricity (32%).

Share – focuses on the utilization of products by sharing them among users. Sharing means reusing products for as long as they are technically acceptable to use, and prolonging their life through maintenance, repair, and design-enhancing durability. Corticeira Amorim verifies the "Share" action by reusing products and prolonging their life through repair. By-products generated during the cork stopper production process, cork that does not meet production standards or recycled cork at the end of life, are incorporated into other products. In this way, recycled cork stoppers and other cork products are collected, and after being processed into granules, they can be reintegrated into the production process and used to produce composite and insulation cork agglomerates. The company has an initiative called "Recupera" where it reuses by-products of cork composite sanding, cutting and profiling processes to be exploited and reused in production processes. They also have several cork stopper recycling initiatives such as Greencork, Cork2Cork and Etico, in which recycled cork is converted into granules and is reintegrated into the production process, particularly for the Composite Cork BU and Insulation Cork BU products.

Optimise – focuses on increasing the performance/efficiency of a product and removing waste in the production process and supply chain. They may also be related to leveraging big data, automation, remote sensing, and steering. None of these actions requires changing the product or technology. The company verifies the "Optimise" action, by increasing the performance/efficiency of the products and removing waste in the production process and supply chain. Corticeira Amorim focuses on the optimization of the use and consumption of cork throughout the production cycle, as one of its sustainable practices. By using 100% of the cork extracted, the company ensures that all sub-products associated to cork processing are reused, so there are no forms of cork waste or residues. From the Raw materials BU to the Insulation cork BU, the company made it possible to optimize the production process in a way that all by-products of each business unit are used. An example would be the creation of the industrial unit to produce cork grains and agglomerates in 1963, formed with the objective of transforming 70% of the waste generated from the manufacture of cork stoppers - until then only marginally used.

Loop – aims at keeping components and materials in closed loops and prioritize inner loops. For finite materials, this means remanufacturing products or components and as a last resort recycling material. For renewable materials, this means anaerobic digestion and

extracting bio-chemicals from organic waste. Corticeira Amorim contributes to the "Loop" action by keeping components and materials in closed loops, for example by recycling materials and by the practicing anaerobic digestion. Corticeira Amorim's business model ensures that all sub-products associated to cork processing are reused. By-products generated during the cork stopper production process, cork that does not meet production standards or recycled cork at the end of life, are incorporated into other high added-value applications. Finally, the part that cannot be incorporated in products is used as an energy source. In this way, the company ensures that the cork value is kept in the loop being by recycling products, using by products to create other products or even using what would be consider waste, a source of energy for the company.

Virtualize – aim to deliver utility virtually instead of materially. Corticeira Amorim contributes to the "Virtualize" action, by deliver utility virtually instead of materially in some extent. For example, the company finds video conferencing as an effective method of communication and collaboration that actively reduces distances travelled for meetings. Corticeira Amorim has set up videoconferencing rooms in each of its business units, configured for both individual events and for meetings with various stakeholders. This initiative helps to minimise transport-related emissions through air, train and car travel, which would otherwise be necessary for collaboration between the BU and other business partners.

Exchange – aims to replace old materials with advanced non-renewable materials and/or with applying new technologies. Sustainability and innovation are intrinsic pillars of the Corticeira Amorim culture and strategy. The company strives to combine technology with nature and promote a sustainable balance between the two. New innovative equipment and technology are key strategies for the company in order to reduce consumption. For example, due to an increase in the production of cork stoppers in 2019, the company acquired a new thermal fluid circuit. The implementation of this new technology enabled increased the reliability of the energy use compared to the previous equipment and improve the energy ratio of the activity.

Question 5. Based on the Corticeira Amorim's case, explain why companies are increasingly moving towards a Circular Economy -based model and explore the overall benefits of engaging a Circular Economy business model.

The economic model currently predominating in our society, is a linear model of resource of resource consumption that follows a "take-make-dispose" pattern and that generates high amounts of waste not only at the end of the products' life, but throughout their entire life cycle.

In recent decades, the global concern for the way environment and future generations are being negatively impacted by this model has increased. The call for a new economic model is getting louder and businesses have started to explore ways to reuse products or their components and restore more of their material, energy and labour inputs. Finding new models of resource use is one keystone of such a new way of development.

Corticeira Amorim has been implementing the Circular Economy business model for decades, so it is a great example of how this economic model can generate benefits not only for the environment, but for the company and society. The potential benefits of shifting to a Circular Economy extend beyond the economy and into the natural environment, as we can observe by Corticeira Amorim's example.

On the environmental side, by designing out waste and pollution, keeping products and materials in use, and regenerating rather than degrading natural systems, the Circular Economy represents a powerful contribution to achieving global climate targets. In terms of contribution to the climate change mitigation, Corticeira Amorim plays an important role by fostering the carbon dioxide emissions' retention, enabled by the potential of the cork oak forests. Not only they are responsible for the reduction of CO2 emissions, but they create a positive contribution concerning carbon dioxide retention. Carbon retention also extends to cork products and is further enhanced through their recycling. By keeping products and materials in use, Corticeira Amorim reduces the consumption of primary materials. In this way, they are not only reducing consumption of materials but also being able to reduce in the raw material costs. Not only cork oak forests foster carbon retention, they play an important role in soil conservation, water cycle regulation, supporting a unique and fragile ecology which is a habitat for rare or endangered species. They also encourage the conservation of nature reserves, through projects and initiatives like for example the Forestry Intervention Project, which is an example of the efforts made by Corticeira Amorim to promote the cork oak forest, biodiversity and related ecosystem services. Through this project, the company is committed to maximize the positive externalities the cork oak forest has to offer. This project aims to raise awareness amongst forest producers of the need to conserve the cork oak forest and adopt good practices that improve the fundamental ecosystems services that provide sustenance to the entire population, encouraging good agricultural and forestry practices.

On the social impact side, Corticeira Amorim is committed to maximize its value by creating jobs and opportunities, through innovation and diversification of products and its support in promoting responsible management of the cork oak forests and use of natural resources. The activities associated with the various production systems existing in the cork

oak montado, foster the economic and social development of the areas involved, promoting sustainable development, generating employment and protecting the ecosystem. For example, stripping is a manual job that requires a deep understanding of the technique and forest. As it is a regular, cyclical process, it creates continuous activity and contributes to the settlement of people in areas at risk of desertification. Additionally, Corticeira Amorim is responsible for 51% of the jobs created in the forestry sector in Ponte de Sor and Coruche, the municipalities from which the Company acquires much of the cork raw material.

Businesses can benefit significantly by shifting businesses in line with the principles of the Circular Economy. These benefits include not only the creation of new profit opportunities and reduced costs due to lower virgin-material requirements, but also new innovative solutions based on a new way of thinking which means thinking about circular rather than linear value chains and striving for optimizations for the entire system. Additionally, it can reduce the need for new raw materials and more recycled materials, where the value of these raw materials is maximized over their entire life cycle. This could result in a more stable influence of the costs and availability of materials. Corticeira Amorim was able to create innovative solutions throughout the years with the circular business model. They can create new products and business units due to the optimization created in their value chain and production process. They take advantage of the by products produced from the cork stoppers business unit and incorporate them in new innovative products and business units. Also, they are able to reduce the raw materials production and needs by on one hand, use these by products to create new ones, and on the other hand adopting a cork stoppers recycling project where they use these products to incorporate in other business units, and in this way maximize the value of cork throughout its lifecycle. In Corticeira Amorim's case, in 2019 consolidated sales increased by 2.4% comparing with 2018, reaching €781.1 million and consolidated net result was €74.9 million. Due to its very positive financial position, Corticeira Amorim was able to maintain the distribution of dividends at around €35.9 million.

4.7 Spreadsheet or slides with answers

The slides for the resolution of this case study's questions are exhibited on Appendix A.

CHAPTER 5

Conclusions

This thesis intended to contribute to the awareness and spread of knowledge concerning this new business model that is now gaining traction – a Circular Economy business model. The CE model is increasingly being implemented by businesses who want to adopt solutions in the context of finite natural resources and primary materials, by reducing consumption and dependence on raw materials and energy, aiming at the same time for its economic growth. The present study aimed at reviewing in depth the concept of the Circular Economy, analyse how Corticeira Amorim applies the principles of a circular business model in its production system and explore the potential benefits that can be created by adopting this business model, in the specific case of Corticeira Amorim.

The choice of Corticeira Amorim to be the company under study in this Pedagogical Case Study relies firstly on the fact that it is a Portuguese company and secondly that it incorporates the principles of a CE since 1963, before the existing knowledge concerning this topic and before it became a priority for governments, businesses and also individuals.

The first question of this Pedagogical Case Study concerned a deep understanding of the concept of a Circular Economy and the main differences from a linear economy. It was determined that the concept of a Circular Economy relies on key principles that consist in the idea that resources must be preserved and renewable sources of energy prioritized, it is a model that designs to remanufacture, restore and recycle, and that it acts in a way to reduce the damage to systems and society and manage externalities. It was also concluded that the Circular Economy model and the linear economy model differ from each other mainly in the way in which value is created or maintained. A linear economy traditionally follows a “take-make-dispose” plan and a Circular Economy model replaces the ‘end-of-life’ concept with restoration.

The second question concerned the relationship between Corticeira Amorim’s circular business model and the way it relates to Circular Economy conceptual schools of thought. It was concluded that the company reflects the concepts of Industrial Ecology and Biomimicry by striving to end cork waste throughout the production system by ensuring that sub-products associated to cork processing are reused. The company also applies the principles of the Blue Economy by whenever feasible, using recycled materials from other industries, thereby saving the planet’s natural resources and reducing the problems associated with their depletion.

Finally, Corticeira Amorim also presents the characteristics of the Regenerative design and Cradle to cradle by not only minimizing the negative impacts through their policies and systems, aiming to eliminate waste altogether, but also creating positive impacts in the environment.

The third question aimed to confirm the extent to which Corticeira Amorim applies the principles of a Circular Economy in its business model. After the analysis it was possible to confirm that the company applies the principles of a CE from the recovery of the main raw material – cork – to the waste generated by the business, since 1963. The company does this through policies of reduction of waste, extending the life of materials, regenerating natural systems and adopting renewable sources of energy.

The fourth question's objective was to understand the extent to which Corticeira Amorim was in line with the ReSOLVE Framework actions. It was concluded that the company is in line with the framework by adopting a business based on the 100% use of cork, reusing products and prolonging their life through repair, increasing the performance and efficiency of the products and removing waste in the production process and supply chain, keeping components and materials in closed loops, deliver utility virtually instead of materially and finally combine technology with nature and promote a sustainable balance between the two.

The final question aimed at analysing the sustainable practices of Corticeira Amorim and reflect on the advantages of CE for the company, environment and society. It was concluded that on the environmental side, by designing out waste and pollution, keeping products and materials in use, and regenerating rather than degrading natural systems, the Circular Economy represents a powerful contribution to achieve global climate targets. On the social impact side, the company is committed to maximize its value by creating jobs and opportunities, through innovation and diversification of products and its support in promoting responsible management of the cork oak forests. On the company side, Corticeira Amorim reveals a positive financial position throughout the years, specifically in 2019 consolidated sales increased by 2.4% comparing with 2018, reaching €781.1 million and consolidated net result was €74.9 million. In this way it is concluded that the use of a sustainable policy and compliance with the principles of Circular Economy are beneficial to the economic results of Corticeira Amorim.

Throughout the work performed, a couple limitations were encountered. First, the fact that this study lacked on primary data and interviews and focused on the public information available in the official sources of the company, made it not possible to obtain additional and more detailed information. For this reason, and as a reference for future investigations, it would

be interesting to carry out a similar study with interviews in order to obtain further information. Finally, another limitation of this case study is the fact that most of the research done was performed in a qualitative and interpretative methods, so it lacks quantitative research. In this regard, it would be interesting for future researches to carry out surveys on the circular economic model to different employees, customers, suppliers, shareholders and partners of Corticeira Amorim, in order to obtain greater perspectives in the results obtained.

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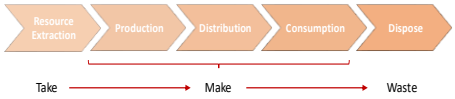
Appendixes

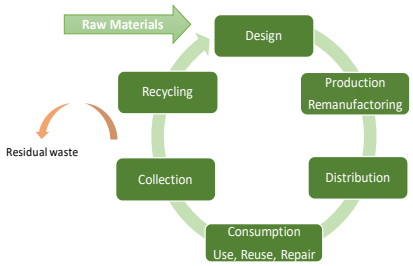
Appendix A. – Slides for case resolution

Question 1. Based on its principles and characteristics, describe the circular economy model and the main differences from the linear economy model.



Linear Economy:

- **"Take-make-dispose" plan;**
- **Value created by producing and selling as many products as possible;**
- **Rely on finite resource consumption;**
- **Negative impact on the environment due to the misuse of resources.**



Circular Economy:

- **Replaces "end-of-life" concept with restoration;**
- **Materials are preserved, restored or even reintroduced into the system;**
- **Prioritizes renewable sources of energy;**
- **Aims to minimize the need for new inputs of materials and energy.**

1

Continuation of Question 1.

Circular Economy Principles

Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows	Optimize resource yields by circulating products, components, and materials at the highest utility always in both technical and biological cycles	Create effective systems by revealing and designing out negative externalities
– Resources are selected minutely, and renewable sources of energy are prioritized; – Relies in the preservation of materials, creating conditions for their regeneration.	– Designed to remanufacture, restore and recycle; – Keep the materials and components circulating; – Extend product life and optimizing reuse.	– Reduce the damage to systems and society and manage externalities; – Rely on renewable sources of energy; – Decrease resource dependence and increase systems resilience.

2

Continuation of Question 1.

Circular Economy Characteristics

Design Out Waste

- **Products are designed and customized to fit within the material cycle of the product;**
- **Biological materials are non-toxic and can be reintegrated to the soil;**
- **Technical materials are designed to be recovered, preserving its value.**

Build resilience through diversity:

- **Diverse systems are more versatile and resilient in the face of external shocks than systems which are built solely for efficiency.**

Rely on energy from renewable sources:

- **Systems should rely on renewable sources of energy, in order to decrease resource dependence and increase systems resilience.**

Think in systems:

- **Elements are considered in their relationship with their infrastructure, environment, and social contexts;**
- **Systems thinking emphasizes flow and connection over time and has the potential to encompass regenerative conditions.**

3

Question 2. The concept of circular economy has evolved during the years and has been developed by different schools of thought. Based on the different concepts related to Circular economy, demonstrate which are more reflected in Corticeira Amorim's business model.

Schools of Thought:

Regenerative Design	• All systems should be orchestrated in a regenerative manner – processes renew or regenerate the sources of energy and materials that they consume; • Ensuring environmental net positive impact on natural systems.
Industrial ecology	• Understand how the industrial system works, how flows of material and energy are regulated and how it interacts with the biosphere; • Relies on closed-loop processes - waste serves as an input; • Systemic point of view, designing production processes in accordance with local ecological constraints whilst looking at their global impact.
Performance economy	• Economy with closed loops favouring reuse, repair and remanufacturing of goods over manufacturing of new products; • Retaining ownership and responsibility of the product throughout its lifetime; • Positive impact in job creation, economic competitiveness, resource savings and waste prevention.

4

Continuation of Question 2.

Biomimicry	• Imitates the most relevant inventions of nature for adapting them to provide innovative and sustainable solutions for the society; • Waste does not exist - materials circulate within cycle without polluting the ecosystem; • Rests on the idea that many of the challenges that business faces have already been solved in nature.
Cradle to Cradle	• Attempts to eliminate waste altogether; • Biological materials are absorbed back into the environment; Technical nutrients remain in a closed loop system of manufacture, recovery and reuse; • Design for effectiveness with positive impact, instead of focusing only on reducing negative impacts.
Blue Economy	• Create businesses which use principles of waterfall - waste from one industry becomes raw material for another; • Through this approach, the waste of one product becomes the input to create a new cash flow, favouring the local economy.

5

Continuation of Question 2.

Schools of Thought applied in Corticeira Amorim's business model:

Industrial Ecology and Biomimicry

- The company strives to end cork waste throughout the production system by ensuring that sub-products associated to cork processing are reused;
- By-products generated during the cork stopper production process, cork that does not meet production standards or recycled cork, are incorporated into other high added-value;
- Cork dust is used as an energy source - biomass.

Industrial Ecology and Biomimicry

- In addition to the 100% use of cork, the group uses recycled materials from other industries to produce other products, thus saving the planet's natural resources;
- Composite Cork BU has a wide range of products that use by-products from other industries that previously ended up in landfills that meet the needs of diverse industries.

Regenerative design and Cradle to cradle

- Cork oak forests play a key role in ecological processes by creating positive externalities for the environment and for societies. They contribute to climate change mitigation;
- The extraction of the raw material helps to maintain the vitality of the montados and promotes economic, environmental and social development, benefiting the high number of people who live and work in areas covered by these forests.

6

Question 3. Considering the principles and characteristics of a circular economy developed in the first question, in what way does Corticeira Amorim applies them and what are the company's strategies for a successful circular business model?

CE Principles applied in Corticeira Amorim

– **Corticeira Amorim applies the principles of a circular economy from the recovery of the cork to the waste generated by applying policies of:**

- waste reduction;
- extending the life of materials;
- regenerating natural systems and adopting renewable sources of energy;

– **Optimization of the production cycle:**

By applying a principle of 100% use of cork, the by-products generated during the cork stoppers production process are reintegrated in the production process and used to create other products. The part that cannot be incorporated in products is used as an energy source – biomass -, which is the main energy source the company uses.

– **Corticeira Amorim supports several sustainable initiatives:**

- Recuperation of waste - "Recupera" initiative.
- Collection of recycled cork to be reintegrated in the production process – "Greencork", "Cork2Cork" and "Etico" initiatives.
- Programmes for sustainable management of the cork oak forests – "Forestry Intervention Project".

7

Continuation of Question 3.

CE characteristics applied in Corticeira Amorim

Design Out Waste

– **Corticeira Amorim applies the concept of 100% use of cork;**
– **Production process designed to ensure that all sub-products associated to cork processing are reused;**
– **By-products from other industries that previously ended up in landfills used to create new products.**

Build resilience through diversity:

– **Focus on creating and adapting their diverse systems within their business units;**
– **Adapt process systems throughout the time, making it possible to adapt the business to the changing world.**

Rely on energy from renewable sources:

– **Reduce the environmental impact of operations by adopting renewable, affordable and efficient solutions;**
– **Primary source of energy consumed comes from renewable sources;**
– **Cork dust is their main source of energy, representing 63% of the total of the total energy consumption.**

Think in systems:

– **Focus on adapting processes making it possible to adjust the business to the changing world and circumstances;**
– **Raw materials BU is the starting point for integrated management of the value chain - responsible for preparing, discussing and deciding on the multi-annual procurement policy of the company;**
– **Optimization of flows of all types of cork raw materials to be used in other BUs.**

8

Continuation of Question 3.

Corticeira Amorim business model strategy

Extending Product Value

Exploiting the residual value of products from manufacture, to consumers, and then back to manufacturing – or collection of products between distinct business entities.

Corticeira Amorim has a strong policy of reusing products, for example with their recycling strategy where they collect recycled cork stoppers and use them to create new products. In this way, they are extending the product's life by incorporating it into other business units and products.

Extending Resource Value

Relies on the exploitation of the residual value of resources, based on the collection or sourcing of otherwise wasted materials and resources to turn these into new forms of value.

Within Corticeira Amorim, by-products generated during the production process, cork that does not meet production standards or recycled cork at the end of life, are incorporated into other high added-value applications;

By-products that cannot be incorporated in products, cork dust, is used as an energy source;

They use by-products from other industries that previously ended up in landfills, to create a wide range of products that meet the needs of diverse industries.

9

Question 4. The Ellen MacArthur Foundation has identified a set of six actions to be taken when transitioning to a circular economy: The ResOLVE framework. Elaborate on this framework and conclude the extent to which Corticeira Amorim is in line with these actions.

Re generate	Corticeira Amorim
Shift to renewable energy and materials; Returning recovered biological resources to the biosphere in order to reclaim, retain, and regenerate the health of ecosystems.	- Cork-dust cannot be incorporated in products so the company uses it as an energy source - biomass; - The primary source of energy consumed is biomass (63%), followed by electricity (32%).
S hare	
Sharing products among users; Reusing products and prolongate their life through maintenance, repair, and design-enhancing durability.	- By-products generated, cork that does not meet production standards or recycled cork are incorporated into other products; Cork stoppers are recycled and reintegrated into the production. - Recycling initiatives: Greencork, Cork2Cork and Etico.
O ptimize	
Increasing the performance/efficiency of products; Removing waste in the production process; Leveraging big data, automation, remote sensing, and steering.	- Optimization of the use and consumption of cork throughout the production cycle (100% use of cork) - ensures that all by-products of each business unit are used from the Raw materials BU to the Insulation cork BU; - No forms of cork waste generated.

10

Continuation of Question 4.

	Corticeira Amorim
Loop	
Keep components/materials in closed loops and prioritize inner loops; Finite materials: remanufacturing products or components and as a last resort recycling material; Renewable materials: anaerobic digestion.	- Keeps components and materials in closed loops - recycling materials and by the practicing anaerobic digestion; - Ensures that all sub-products associated to cork processing are reused and in this way the cork value is kept in the loop.
Virtualize	
Aims to deliver particular utility virtually instead of materially.	- Minimise transport-related emissions; - Video conferencing is an effective method of communication and collaboration that actively reduces distances travelled for meetings.
Exchange	
Replace old materials with advanced non-renewable materials and/or with applying new technologies.	New innovative equipment and technology are key strategies for the company in order to reduce consumption.; Acquisition a new thermal fluid circuit in 2019: a new technology that increased the reliability of the energy use compared to the previous equipment.

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Question 5. Based on the Corticeira Amorim's case, explain why companies are increasingly moving towards a circular economy-based model and explore the overall benefits of engaging a circular economy business model.

Environmental Benefits

- **Mitigation of climate change** by increasing the carbon dioxide emissions' retention;
- **Carbon retention** extends to cork products and is further enhanced through their recycling;
- **Reduce consumption of primary materials**;
- **Reduction of waste** generated;
- **Cork oak forests play an important role** in:
  - soil conservation;
  - water cycle regulation;
  - supporting a unique ecology which is a habitat for rare or endangered species.
  - Conservation of nature reserves, through initiatives like the Forestry Intervention Project.

Social Benefits

- **Create jobs and opportunities** through innovation and diversification of products;
- **Foster the economic and social development** of the areas involved;
- **Promote sustainable development**, generating employment and protecting the ecosystem;
- **Contribute to the settlement of people in areas at risk of desertification.**

Business Benefits

- **Create innovative business units and products**;
- **Create new products and business units** due to the optimization of value chain and production process;
- **Reduce raw materials' production and needs** and in this way maximize the value of cork throughout its lifecycle;
- **Very positive financial position** - in 2019, consolidated sales increased by 2.4% comparing with 2018, reaching €781.1 million and consolidated net result was €74.9 million.

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